SACO 77 13

Soils Report 77-13
Saco - York County
Interstate 195
Project 195-2(1)
March 1977

Maine Department of Transportation

Materials & Research Division

Soils Section

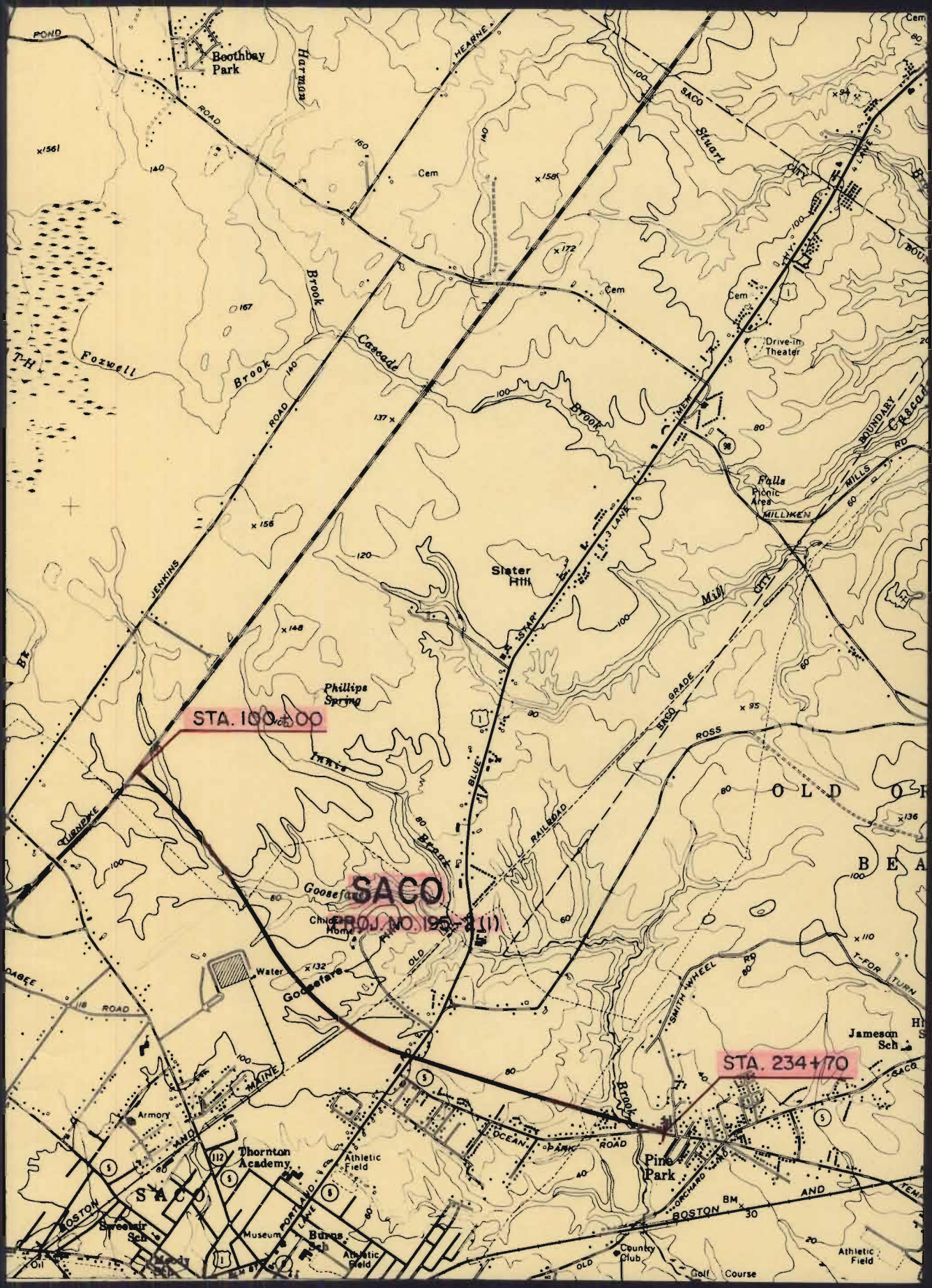
SUBSURFACE INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF INTERSTATE 195 IN SACO

YORK COUNTY

PROJECT 195-2 (1)

March 1977

Soils Report 77-13


Boothbay Park
Harmon
Brook
Cascade
Foxwell
Brook
Cem
Drive-in Theater
Falls Picnic Area
MILLIKEN
MILLS
BOUNDARY
Slater Hill
Mill
Phillips Spring
STA. 100+00
SACO
PROJ. NO. 195-2(1)
Goosefare
Chick Home
Water
Goosefare
Brook
BLUE
RAILROAD
ROSS
GRADE
SACO
OLD
BEA
SMITH WHEEL RD
Jameson Sch
STA. 234+70
Armory
Thornton Academy
Athletic Field
SACO
Museum
Burns Sch
Athletic Field
Pine Park
OCEAN PARK ROAD
ORCHARD
BOSTON AND MAINE
Country Club
Golf Course
Athletic Field
JENKINS
TURNPIKE
CAGEE ROAD
HEARNE
POND
ROAD
SACO
Stuart
Brook
Cascade
Brook
STAR
L. & J. LANE
MILLS RD
BOUNDARY
T-FOR TURN

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INTRODUCTION

Proposed Interstate 195 is to connect the Maine Turnpike with Route 5 in Saco. This piece of Interstate would connect with the Maine Turnpike approximately 2400 feet north of Route 112. From the Turnpike, Interstate 195 will carry traffic in a generally easterly direction 2.5+ miles to Route 5. Two major interchanges will be necessary between the Turnpike and Route 5; one will provide an interchange with an Industrial Spur approximately 1/2 mile east of the Maine Turnpike, and the other will be at Route 1, slightly more than 1.5 miles east of the Turnpike.

To provide preliminary soils information for Interstate 195, twenty-eight washborings have been completed along the proposed alignment during 1973 and 1975 under the supervision of Mr. Clark Taylor, Jr. The locations of these washborings are shown on the plan and profile Sheets 67 through 68 of the illustrations. Boring detail sheets for these washborings are included as Sheets 24 through 49. Several rod soundings, auger borings and test pits were made at selected locations by a geology crew under the supervision of Regional Geologist George Eaton. The details of these sheets are shown on Sheets 8 through 22 of the illustrations.

The samples obtained from the washborings and auger borings were submitted to the Soil Testing Laboratory in Bangor for identification and testing.

This report summarizes the soil stratification encountered by the washborings and geological explorations and indicates where stability problems can be anticipated as well as where major settlement is expected.

A preliminary materials inventory is included as Appendix A. Appendix B is comprised of a drainage study and Appendix C is an engineering soils types map.

GENERAL CONDITIONS

The proposed gradeline of I-195 requires a large amount of high fills as well as two rather substantial cut sections. Twenty-eight washborings have been completed along the proposed alignment to provide preliminary soils information.

Washborings made near the beginning of this project, i.e., near the Maine Turnpike, encountered more than 100 feet of gray silty clay. Very deep clay was also found near the end of the proposed I-195 alignment where it approaches Route 5. In addition, a 20± foot layer of clay was encountered by washborings near Station 124+00 and Station 134+50. At some locations the gray clay is overlain by sand. At other locations it is overlain by brown clay. Surficial peat was found at a few locations. At all locations where gray clay was encountered it was underlain by sand and/or gravel. Ledge is shallow from Station 145+75 to 157+00 and from Station 164+00 to 203+00. Ledge excavation is anticipated between Station 145+75 and 157+00. This cut section is discussed further in the 'Detailed Conditions' of this report.

There are three areas where severe stability problems are predicted if the proposed embankments are constructed. These problem areas are discussed in detail in the 'Detailed Conditions' and 'Stability Analyses' portions of this report.

The 'Detailed Conditions' portion of this report is summarized on Sheets 5 and 6 of the illustrations.

DETAILED CONDITIONS

Station 94+00 to 102+00:

This is a fill section with a maximum of 27 feet proposed. This section is to be composed of a bridge over the Maine Turnpike and the approach ramps to the bridge. Three washborings were made in this section at the following locations:

Washboring	Station	Offset
CT- 9-75	98+80	75 feet right
CT-60-73	100+00	2 feet left
CT- 6-75	101+20	75 feet left

The borings encountered 19 to 29 feet of brown silty sand with clay layers underlain by 124 to ~~127~~ 131 feet of medium to stiff gray laminated sandy silty clay. Beneath the thick clay layer is 12 to ~~23~~ 26 feet of medium to dense gray sand over ledge. The detailed sheets for the washborings made in this section are included as Sheets 24 through 26.

A stability analysis made at Station 101+50 indicate marginal stability with the proposed fill to finish grade. The results of the shear analysis is shown on Sheet 61 of the illustrations.

A settlement analysis was also made at Station 101+50 and calculations indicate that approximately ~~2.6~~ 4.0 feet of settlement may be anticipated at this location. 25% consolidation should be complete within 25 months and 90% within 36 yrs.

The preliminary soils information indicates that the bridge to carry I-195 over the Turnpike should be supported on piles. Further soils information will be required to determine the length of piles needed.

Station 102+00 to 113+00:

This is a fill section with a proposed embankment height between 25 and 33 feet. The gradeline generally decreases ahead. Five washborings were made in this section at the following locations:

Washboring	Station	Offset
CT-11-75	104+50	Centerline
CT-72-73	108+08	Centerline

Washborings	Station	Offset
CT-89-75	108+00	60 feet right
CT-90-75	108+00	60 feet left
CT-80-75	111+00	Centerline

The detailed sheets for these washborings are shown on Sheets 27 through 31. The borings encountered ~~11~~ 4 to ~~30~~ 24 feet of weathered soil varying from layers of sand and sandy clay to sandy silt. Beneath this weathered zone is ~~43 to 72~~ up to 26 feet of soft to medium gray sandy silty clay ~~with sand layers~~, underlain by ~~19 to 50 feet of~~ 37 medium to stiff gray silty clay w/sand lines 75' to at least 125' in depth. Beneath these clay layers the borings encountered gray sand and gravel. Ledge was not encountered in any of these borings.

A stability analysis was performed at Station 108+00. The analysis, using shear strengths indicated by the washborings data, indicate that the underlying soils will support only approximately 25 feet of fill. Thus, the full fill height proposed could not be built without counterbalancing toe berms unless it was constructed in stages allowing some time between stages for consolidation to occur, and for the shear strength of the underlying clay to increase. The waiting period between stages could be minimized by installing sand drains to hasten the rate of consolidation and thus the rate of shear strength increase. The use of sand drains would also minimize the post-pavement settlement. The stability analysis at Station 108+00 indicates that the embankment could be built to the proposed finish grade with the use of 14 by 90 foot toe berms as shown on Sheet 62 of the illustrations.

Calculations made utilizing data from washboring CT-72-73 indicate that the proposed fill at Station ~~198+00~~ 108+00 should settle approximately ~~5.25~~ 6.0 feet. 90% - 10-12 yrs.

Station 113+00 to 116+50: Sta. 104+50 7.5' settlement 90% - 30 yrs.

This is a fill section with a maximum proposed embankment height of 25 feet. The gradeline continues to decrease gently ahead. The toll plaza is proposed within this section at approximately Station 115+50.

Washboring CT-79-75 was made at Station 114+00 on Centerline. The boring encountered 25 feet of medium to stiff weathered sandy clay silt underlain by medium gray silty clay. The boring was continued to a depth of 83 feet. The boring details are shown on Sheet 32.

Based on the stability analysis conducted at Station 108+00 it appears that this section should have marginal stability with the proposed fill height.

Additional washborings will be required for the final design of the toll plaza.

Station 116+50 to 118+50:

A maximum of 30 feet of fill is proposed in this section. Ultimate plans call for I-195 to cross over a brook and a future railroad spur at approximately Station 117+50. Two options are being considered by the Interstate Design Section. The first option is to construct a culvert for the brook and build an embankment for the roadway. The building of the bridge for the crossing of the future railroad spur will be delayed until construction of the spur. The second option is to construct the bridge for the brook and the railroad spur during the initial construction of the Interstate roadway.

Washboring CT-43-75 was made at Station 117+40, 50 feet left of centerline. The soils at this location consist of 30 feet of stiff gray sandy silt over 85 feet of medium consistency gray silty clay. At a depth of 115 feet the gray silty clay becomes medium to stiff in consistency. The washboring continued to a depth of 140 feet without encountering granular soils. The boring details are shown on Sheet 33.

Settlements estimates indicate a 7.0' settlement at Sta 117+50 w/ a 30' high fill!

A stability analysis was conducted at Station 117+50. It was assumed that Option No. 1 was being implemented and the roadway embankment would be carried across this section. The analysis indicated that with the embankment constructed to finish grade the safety factor against shearing would be 1.15. This is believed unsatisfactory. The analysis also indicated that only approximately 26 feet of fill could be placed with adequate stability resulting. The embankment cannot be built to the proposed finish grade without counter-balancing toe berms unless

it was constructed in stages allowing some time between stages for consolidation to occur and for the shear strength of underlying clay to increase. The installation of sand drains in this area should minimize the waiting between the stages by hastening the rate of consolidation and the rate of shear strength increase. The stability analysis at Station 117+50 also indicated that it would require a 15 by 60 foot toe berms to obtain adequate stability if the embankment were to be constructed to finish grade. The results of the stability analyses are shown on Sheet 64 of the illustrations. The stability along the centerline of the roadway was investigated assuming the implementation of Option No. 2. The stability along centerline should be satisfactory, if the bridge is constructed. The transverse stability (perpendicular to the roadway centerline) should be marginal. The results of the longitudinal stability analysis are shown on Sheets 63 of the illustrations.

Station 118+50 to 125+00:

This is a fill section with a proposed embankment height reaching a maximum of 23 feet. A culvert is proposed at Station 124+00. Washboring CT-64-73 was made on centerline at Station 124+00. This boring encountered nine feet of medium consistency brown sandy silty clay over 22.5 feet of medium consistency gray silty clay. Beneath this clay the boring encountered two feet of gray sand and gravel. Ledge was core drilled below a depth of 33.5 feet at this location. The boring detail sheet for CT-64-73 is shown on Sheet 34. The stability analysis at Station 124+00 indicated that the 24 foot fill proposed at this station should have a safety factor of 1.3. The results of this analysis are shown on Sheet 65.

A preliminary settlement estimate based on the one washboring completed suggests that a settlement of 1.8 feet can be expected at Station 124+00.

Station 125+00 to 132+00:

A maximum of 16 feet of fill is proposed in this section. Interstate 195 will cross over the Industrial Spur at approximately Station 126+00.

Based on the soils conditions encountered at Station 124+00 it is believed that no stability problems will be encountered throughout this section. The proposed bridge to carry I-195 over the Industrial Spur will probably need piles to provide the support. Additional washborings may be required to determine the length of piles needed.

Station 132+00 to 137+80:

This is a fill section with a proposed fill height of ~~26~~ 29 feet maximum. Washboring CT-65-73 was made at Station 134+50, 25 feet left of centerline. A surficial layer of peat was encountered over 21 feet of gray silty clay which contained some sand layers. Below a depth of 22 feet this boring encountered gray sand and gravel. The boring detail sheet for wahsboring CT-65-73 is included at Sheet 35 of the illustrations.

No stability problems are anticipated within this section as samples of the clay layer obtained from the washboring exhibited good shear strength.

Station 137+80 to 140+40:

The proposed finish grade throughout this section is less than three feet above the existing ground line. No substantial explorations were made in this section. A small amount of excavation may probably be required but ledge is not anticipated in this section.

Station 140+40 to 145+75:

A maximum of 15 feet of fill is proposed in this section. Washboring CT-63-73 was made along centerline at Station 142+35. The boring encountered 16.5 feet of stiff brownish gray silty clay underlain by gray sand and gravel. and fine gray sand The boring encountered refusal at a depth of 23 feet. The boring detail sheet for this washboring is shown on Sheet 36.

The clay exhibits good shear strength characteristics and therefore no stability problems are anticipated throughout this section.

Station 145+75 to 157+00:

This is the largest proposed cut section on the project with a finish grade being 10 feet maximum below the existing ground line.

Washboring CT-73-73 was made at Station 151+00, four feet left of centerline. The boring encountered three feet of brown silty sand and gravel before reaching refusal. The washboring foreman then made test pits, 10 feet left and 40 feet left, of Station 151+20 and encountered ledge only a foot below the ground surface. The detail sheet for washboring CT-73-73 is shown on Sheet 37. Several rod soundings and auger borings were made in this section to better detail the ledge surface. The detail sheets on these explorations are shown on Sheets 8 through 22. Ledge excavation is anticipated between Station 145+75 and 148+50, 149+50 and 153+50, and 155+75 and 156+25.

Station 157+00 to 164+00:

The proposed finish grade varies from 2.0 to 7.5 feet above the existing ground.

Washboring CT-62-73 was made at Station 158+00, 10 feet left of centerline. The boring encountered three feet of peat immediately below the surface. This peat is underlain by medium density silty sand and gravel. The boring penetrated to a depth of 11.5 feet without encountering refusal. The detail sheet for boring CT-62-73 is included as Sheet 38. It is recommended that the surficial layer of peat be removed. With the peat removed, there should be no settlement problems.

Station 164+00 to 203+00:

This is a fill section with a maximum of 27 feet proposed. A bridge to carry I-195 over US Route 1 is proposed within this section.

Five washborings were made in this section and the following location:

Washboring	Station	Offset
CT-81-75	176+50	Centerline
CT-20-73	181+50	Centerline
CT-19-73	186+00	Centerline
CT-21-73	195+50	Centerline
CT-83+75	202+00	15 feet left of centerline

The soils generally consist of medium to dense brown sand and gravel. This

surficial layer of brown gray clay was noted in boring CT-21-73. All of the borings encountered refusal or ledge at shallow depths varying from 2.5 feet to 13.5 feet. Boring CT-20-73 encountered ledge at a depth of 7.0 feet and a 10 foot core was obtained. The detail sheets for the washborings made in this section are included as Sheets 39 through 41.

No stability or settlement problems are anticipated within this section.

Washboring CT-20-73 was made very close to the proposed location for the I-195 bridge over US Route 1. The soils information indicates that the bridge may be supported on footings in the medium to dense sand and gravel or directly on the ledge surface. Additional washborings will be required for the final bridge design.

Station 203+00 to 212+00:

The proposed finish grade varies from five feet above the existing ground to 0.5 feet below the existing ground. No subsurface explorations were made in this section. A small amount of excavation will be required within this section but ledge excavation is not anticipated.

Station 212+00 to 213+20:

This is a short fill section with a maximum of 12 feet proposed. No soils explorations were made within this section but based on washboring CT-86-75 which was made approximately 200 feet ahead, it is believed that the soils should adequately support the proposed fill.

Station 213+20 to 214+40:

This is a short cut section with the proposed finish grade approximately four feet below the existing ground. Subsurface explorations were not made in this section. It is anticipated that ledge will not be encountered during the required excavation.

Station 214+40 to 215+50:

This is a fill section with a maximum proposed fill height of 15 feet. A culvert is proposed at Station 214+75.

Three washborings were made in this section at the following locations:

Washboring	Station	Offset
CT-86-75	214+45	75 feet left
CT-23-73	214+90	Centerline
CT-85-75	214+80	75 feet right

The soils generally consist of the surficial organic layer to five feet thick. This layer varies from a peat to a peat sand. Underlying the organic layer boring CT-23-73 encountered seven feet of gray sand, boring CT-85-75 encountered seven feet of sandy silt with clay layers, and boring CT-86-75 encountered five feet of stiff gray sandy clay. The borings then encountered 65 to 68 feet of gray silty clay. Beneath the clay layer the borings encountered sand and gravel. Refusals were encountered at approximately 80 foot depths. The detail sheets for the washborings made in this section are included as Sheets 42 through 44.

No stability problem is anticipated in this section as the clay exhibits good shear strength characteristics.

Calculations based on soil information from boring CT-23-73 indicates that approximately 3.6 feet of settlement can be anticipated with the construction of a 15 foot fill. This settlement should occur over a very long period of time unless sand drains are used to hasten the consolidation rate.

Station 215+50 to 225+50:

This is a long cut section with a proposed finish grade approximately nine feet below the existing ground level.

Washboring CT-82-75 was made on centerline at Station 219+00. The boring encountered 31 feet of medium density fine brown sand underlain by a 94 foot layer of gray silty clay. The detail sheet for boring CT-82-75 is included on Sheet 45. Ledge should not be encountered in the excavation for the roadway through this section.

Station 225+50 to 227+00:

A maximum of 17 feet of fill is proposed in this section. No soils explorations were made within this section.

Based on the stability analysis conducted at Station 227+50 it is believed that the embankment can be constructed to the proposed finish grade with adequate

stability.

Station 227+00 to 229+00:

This is a fill section with a maximum of 22 feet proposed.

Four washborings were made in this section at the following locations:

Washboring	Station	Offset
CT-22-73	227+50	Centerline
CT-84-75	227+42	80 feet left
CT-87-75	227+50	172 feet left
CT-88-75	227+50	170 feet left

The detail sheets for these borings are shown on Sheet 46 through 49 of the illustrations. The borings encountered nine to 18 feet of brown organic sand. Beneath this surficial organic layer the borings encountered ~~53~~ 78 to ~~78~~ 89 feet of medium consistency gray silty clay. Underlying the clay the borings encountered gray sand and gravel. Refusals were noted in two washborings at a depth of approximately 100± 5 feet.

A preliminary settlement analysis was made at Station 227+50 and indicates that approximately ~~4.7~~ 5.7 feet of settlement may be anticipated. A stability analysis was also made at Station 227+50. The analysis indicates that if the embankment was built to proposed finish grade the factor safety agianst shear would be 1.16. The analysis also indicated that the embankment could only be built to a height of 18 feet while insuring adequate stability. The full proposed embankment height can be built only if counter-balancing toe berms are provided or if the embankment is constructed in stages with waiting periods between fill stages. If sand drains are installed the waiting periods could be minimized. The stability analysis also indicated that to insure a safety factor of approximately 1.25, 10 by 75 foot toe berms would have to be constructed. Relocation of Goosefare Brook to 10 feet beyond the outer limits of the berms would also be required. The results of the stability analyses are shwon on Sheet 66 of the illustrations.

The culvert is proposed at Station 228+50. Additional soils information will be required in this area before the final recommendations as to support

of the box culvert can be made.

Station 229+00 to 229+50:

This is a short fill section with a maximum of 16 feet proposed. With the construction of the proposed embankment to the finish grade, it is believed that the stability of the embankment will be satisfactory. This is based on the stability analyses made from the previous section.

Station 229+50 to 234+00:

The proposed finish grade of this section is less than three feet above the existing ground. A minor amount of excavation may be required but no ledge excavation is anticipated. The stability of this section should be adequate.

Industrial Spur:

An Industrial Spur is proposed to connect I-195 and Route 112 while providing access to an industrial park. The proposed Industrial Spur will connect with Route 112 at approximately Station 33+20 of Route 112 and run in a northerly direction approximately 4600 feet. The spur will connect with I-195 at approximately Station 126+00 of I-195.

No soils explorations were made along the proposed Industrial Spur alignment. Some soils information was obtained from washboring CT-64-73 which was made along the I-195 alignment at Station 124+00.

From Route 112 to Station 23+00 the proposed finish grade of the Industrial Spur is only a few feet above the existing roadway grade. From Station 23+00 to 25+00 the proposed grade is a maximum of a foot below the existing ground. The proposed alignment follows the existing roadway to approximately Station 28+00. A fill section is proposed to Station 42+00 with a maximum of 12 feet required at Station 33+00. A cut section is then proposed between Station 42+00 and 50+00. A maximum cut of ten feet is planned. The proposed finish grade for the remainder of the spur to Station 56+00 is near the existing ground. Some shallow cuts and fills will be required.

Settlement or stability problems are not anticipated along the Industrial Spur as the fills proposed are not excessive.

Based upon washboring CT-64-73, ledge excavation is not anticipated in cut sections.

SOIL PROPERTIES

Two major deposits of clay exist along the proposed alignment of I-195. One deposit is located at the beginning of the proposed project and extends to approximately Station 140+00. The other deposit extends from approximately Station 205+00 to the end of the project.

The many undisturbed samples taken from the clay deposits underlying this project were forwarded to the Soils Testing Laboratory in Bangor where they were tested to determine the index and consolidation properties of the clay.

The soil properties of these two clay deposits are discussed in detail within this section.

Station 94+00 to 140+00:

This marine clay deposit is very thick from the beginning of the project to approximately Station 124+00. The thickness of clay exceeds 100 feet adjacent to the Maine Turnpike. From Station 124+00 to 140+00, the thickness of clay is 20± feet.

Adjacent to the Maine Turnpike the upper 40+ feet of the clay layer has a water content of 34± 8 percent. In the middle of the clay layer (40 feet± to 85 feet±) the water content is 40± 5 percent. A water content of 37± 7 percent exists in the lower depths of the clay deposit. Between Station 124+00 and 140+00 the clay deposit has a water content of 40± 7 percent. The liquid limit of nearly all of the clay within this deposit is at or slightly below the natural water content. The plastic index is generally 16± 4 percent. The specific gravity of the clay is 2.78± .06.

The in-situ shear strength of the clay was measured using a field vane. Near the beginning of the project, the field vane shear strength is 0.32± .07

tons per square foot (TSF) in the upper 40± feet then gradually increases to 0.75± .08 TSF near the bottom of the clay deposit. At Station 124+00 the field vane shear strength is approximately 0.34 TSF to a depth of 20 feet and increases to about 0.45 TSF below 20 feet. Field vane tests indicate that the clay underlying the area behind the Maremont Corporation (Station 134+50) has a shear strength of 0.59± .05 TSF. The shear strength as determined using the laboratory vane is generally 2/3 the field vane strength, but does approach the field vane strength for the deeper clay at some locations. Undrained unconsolidated triaxial tests were run on a few samples and indicate close agreement with the lab vane shear strength. Several consolidated undrained triaxial tests were run of samples of clay from this deposit. The effective angle of shearing resistance is approximately 21 degrees. The results of these tests are shown on Sheets 56 through 60 of the illustrations.

Thirty samples were used for consolidation tests and the pressure-void ratio curves are summarized on Sheets 50 through 53. The compression index (C_c) as indicated by these tests ranges from 0.21 to 0.72 with the majority falling in the 0.43± .10 range. The recompression index (C_r) varies from 0.037± .004, in the upper portion of the clay deposit to 0.059± .011 in the lower depths. The coefficient of consolidation (C_v) varies considerably for those samples tested. The values range from 11 to 150 square feet per year (Ft.^{2}/yr.), but for many of the samples the C_v falls in the 45± 10 range. The preconsolidation pressures indicated by the consolidation tests when compared to the estimated existing stress indicate that much of the clay is normally consolidated. The clay encountered at Station 124+00 shows some preconsolidation.

Station 205+00 to 234+00±:

This marine clay deposit begins at approximately Station 205+00 and gradually becomes thicker ahead on the proposed roadway alignment. From Station 219+00 to the end of the project the clay layer exceeds 90 feet in thickness.

The clay deposit has a water content of 45± 5 percent in the upper 40± feet and a water content of 38± 6 percent below a depth of 40± feet. The clay is not as sensitive as near the beginning of the project as the liquid limit is approximately eight percent below the natural water content. The plastic limit is generally 12± 4 percent. The specific gravity of the clay is 2.77± .03.

The field vane shear strength is generally about 0.32± .08 TSF in the upper 40+ feet and gradually increases to about 0.70 TSF near the bottom of the clay layer. The laboratory vane tests and undrained unconsolidated triaxial tests indicate shear strengths equal to approximately 2/3 of the field vane strength.

Twelve samples were used for consolidation tests and the pressure-void ratio curves are summarized on Sheets 54 and 55. The compression index (C_c) ranges from 0.32 to 0.82 with the majority of values falling in the 0.47± .03 range. The recompression index (C_r) is generally 0.057± .01. The coefficient of consolidation (C_v) for those samples tested varies from 7 to 84 ft^2/yrs. for normal load increments. It is believed that 45 ft^2/yrs. would be a realistic design value of C_v. The upper portion of the clay encountered at Station 227+50 has apparently been slightly preconsolidated.

STABILITY ANALYSIS

Stability analyses were conducted at several locations where high fills are proposed. There are three areas where severe stability problems are predicted if the proposed embankments are constructed.

Inadequate stability is predicted between Station 102+00 and 113+00. The proposed fill height varies from 25 to 33 feet within this section. A stability analysis was performed at Station 108+00. Based upon soils information gathered from washborings made at this location, the analysis indicates that the underlying soils will support only 25 feet of fill. One method that will insure adequate stability is to construct the embankment in stages allowing a long time (years) between stages for consolidation to occur and shear strengths of the underlying clay to increase. The waiting period between stages can be

minimized by installing sand drains to hasten the rate of consolidation and, thus, the rate of increase in shear strength. The use of sand drains should also minimize post pavement settlement in this section. The second method which should provide adequate stability to the embankment is to provide counter-balancing toe berms. The stability analysis at Station 108+00 indicates that the embankment could be built to the proposed finish grade (FILL HT. 32') with the use of 14 by 90 foot toe berms. If this option is implemented the toe berm elevation would vary from approximately elevation 107 at Station 102+00 to elevation 100 at Station 113+00. The results of the stability analyses are shown on Sheet 62 of the illustrations.

Another area where stability problems will exist if the embankment is constructed to the proposed finish grade is between Station 116+50 and 118+50. It is proposed that I-195 cross over the brook and a future railroad spur at approximately Station 117+50. Two options are being considered by the Interstate Design Section. The first option is to construct a culvert for the brook and to build the embankment for the roadway. The building of the bridge for the crossing of the future railroad spur would be delayed until construction of the spur. This option would require 25 to 30 foot fills in this section. A stability analysis was conducted at Station 117+50 indicating that if the embankment were constructed to finish grade the safety factor again shearing would only be 1.15. This is believed unsatisfactory. The analysis also indicated that the underlying soils could only support 26 feet of fill. The embankment can be constructed to the proposed finish grade if stage construction is used. Long waiting periods (years) between stages will be required unless sand drains are installed. Another suitable means of constructing the embankment to the proposed finish grade is to use counter-balancing toe berms. The stability analysis at Station 117+50 indicated that it would require 15 by 60 foot toe berms to obtain adequate stability. The results of the stability analyses are shown on Sheet 64 of the illustrations.

The second option is to construct a bridge for the brook and the railroad spur during the initial construction of the Interstate roadway. The proposed

approach fills would vary in height from 25 to 30 feet. The stability along the centerline of the roadway was investigated assuming that the bridge would be constructed. The analysis indicated that a safety factor of 1.35 should result. The stability perpendicular to the roadway centerline in the approach areas is believed critical. Corrective measures such as stage construction or counter-balancing toe berms as discussed for Option No. 1 may be necessary. The results of the stability analysis along the roadway centerline is shown on Sheet 63 of the illustrations.

Stability problems are also predicted from Station 227+00 to 229+00. The maximum of 22 feet of fill height is proposed. A stability analysis was made at Station 227+50 which indicates that if embankment was built on proposed finish grade the factor of safety in shear would be only 1.16. The analysis also indicated that the embankment could only be built to a height of 18 feet while insuring adequate stability. The full proposed embankment height can be built only if counter-balancing toe berms are provided or if the embankment is constructed in stages. If stage construction is used, long waiting periods will be required between stages unless sand drains are installed. If toe berms are provided, the stability analysis indicated that to insure adequate safety factor against shearing, 10 by 75 foot toe berms would have to be constructed. Relocation of Goosefare Brook to 10 feet beyond the outer limits of the berms would also be required. The results of the stability analysis are shown on Sheet 66 of the illustrations.

Marginal stability is predicted between Station 94+00 and 102+00. A stability analysis at Station 101+50 indicated that with a fill height of 27 feet a safety factor of 1.26 would result. No corrective measures are being advocated.

A stability analysis was performed at Station 124+00 which indicated that a proposed 24 foot fill at that station should have an adequate safety factor of 1.3.

The underlying clay of the remaining sections of roadway exhibit good shear strength characteristics and no stability problems are anticipated.

SETTLEMENT ANALYSES

Settlement estimates were made at several locations where the washborings encountered clay. A settlement analysis was made at Station 101+50 approximately 50 feet behind the proposed abutment location. Calculations indicate that approximately ~~2.6~~ 4.0 feet of settlement may be anticipated at this location. Since the structure carrying I-195 over the Maine Turnpike will be pile supported, sand drains should be considered to hasten the settlement and minimize post-pavement settlement. ¶ Using the data from CT-11-75, settlement is estimated to be 7.5'± with a fill height of 30' at Station 104+50.

Calculations made utilizing data from the washboring CT-72-73 (Station 108+08 centerline) indicate that the proposed fill (31 feet) at this location should settlement about ~~1.2±~~ 6.0± feet. ¶ At station 117+50, estimates of 7.5'± of settlement is anticipated w/ a 30' fill. This was calculated using data from washboring CT-43-75

The preliminary settlement estimate based on washboring CT-64-73 made at Station 124+00 on centerline suggests that a settlement of 1.8 feet can be expected at this location.

While no consolidation tests were performed on samples from Boring CT-65-73 at Station 134+50, 25 feet left, a rough calculation using average values from other consolidations tests on the project indicate that the proposed fill of 25.5 feet at this location will cause nearly three feet of settlement.

Calculations based on information from boring CT-23-73 indicate that the 15 foot fill proposed at Station 214+90 should undergo 3.6 feet of settlement. This settlement is believed long term in nature and if the decision is made to use sand drains on this project they should be installed in this area.

The preliminary estimate is that about 4.7 feet of settlement can be anticipated at Station 227+50.

It is recommended that sand drains be considered in areas where the anticipated settlement exceeds two feet. The sand drains should hasten the settlement and minimize post-pavement settlement.

SUMMARY

Twenty-eight washborings have been completed to provide preliminary soils information along the proposed alignment for I-195 in Saco.

The preliminary gradeline requires a large amount of high fills as well as two substantial cut sections. Washboring locations were selected to determine the underlying soils stratification upon which the high fills are proposed, and to provide an indication of the soils stratification in the vicinity of the proposed structures. A washboring was also made in each of the substantial cut sections.

Near the beginning of the project adjacent to the Maine Turnpike more than 100 feet of clay was encountered by washborings. Very deep clay was also encountered near the end of the proposed I-195 alignment where it approaches Route 5. In addition, a 20± foot layer of clay was encountered near Station 124+00 and Station 134+50. At some locations this gray clay is overlain by sand. At others it is overlain by brown clay and at one location was overlain by surficial layer of peat. At all locations the gray clay is underlain by sand and/or gravel. Most of the borings which did not encounter the gray clay either encountered stiff brown clay over sand and gravel, or sand and gravel from the ground surface. One boring encountered surficial peat over gravel. Ledge is shallow between Station 145+75 and 157+00 and also between Station 164+00 and 203+00. Some ledge excavation is anticipated between Station 145+75 and 157+00

Stability analyses made using the information from the preliminary washborings indicate that there are three areas where severe embankment stability problems are anticipated with the presently proposed gradeline. These areas are from Station 102+00 to 113+00, Station 116+50 to 118+50, and Station 227+00 to 229+00. The stability analyses indicate that the full proposed embankment height can only be built if counter-balancing toe berms are provided or if the

embankment is constructed in stages with waiting periods between fill stages. With stage construction, the waiting periods can be minimized if sand drains are installed.

Calculations based on preliminary washborings indicate that in fill sections where the washborings encountered clay, significant settlement can be expected. These preliminary settlement estimates vary from 1.7± feet in the vicinity of Station 124+00 to ~~5.25~~ 7.5 feet in the vicinity of Station ~~108~~ 104+50+00. The use of sand drains should be considered in areas where the anticipated settlement exceeds two feet. The sand drains should hasten the settlement and minimize post-pavement settlement.

A preliminary materials inventory, prepared in June, 1974, by Geologist George Eaton, is included as Appendix A.

Appendix B contains soils mapping of the project and the results of a drainage study conducted by Soils Research Scientist Ray Woodman.

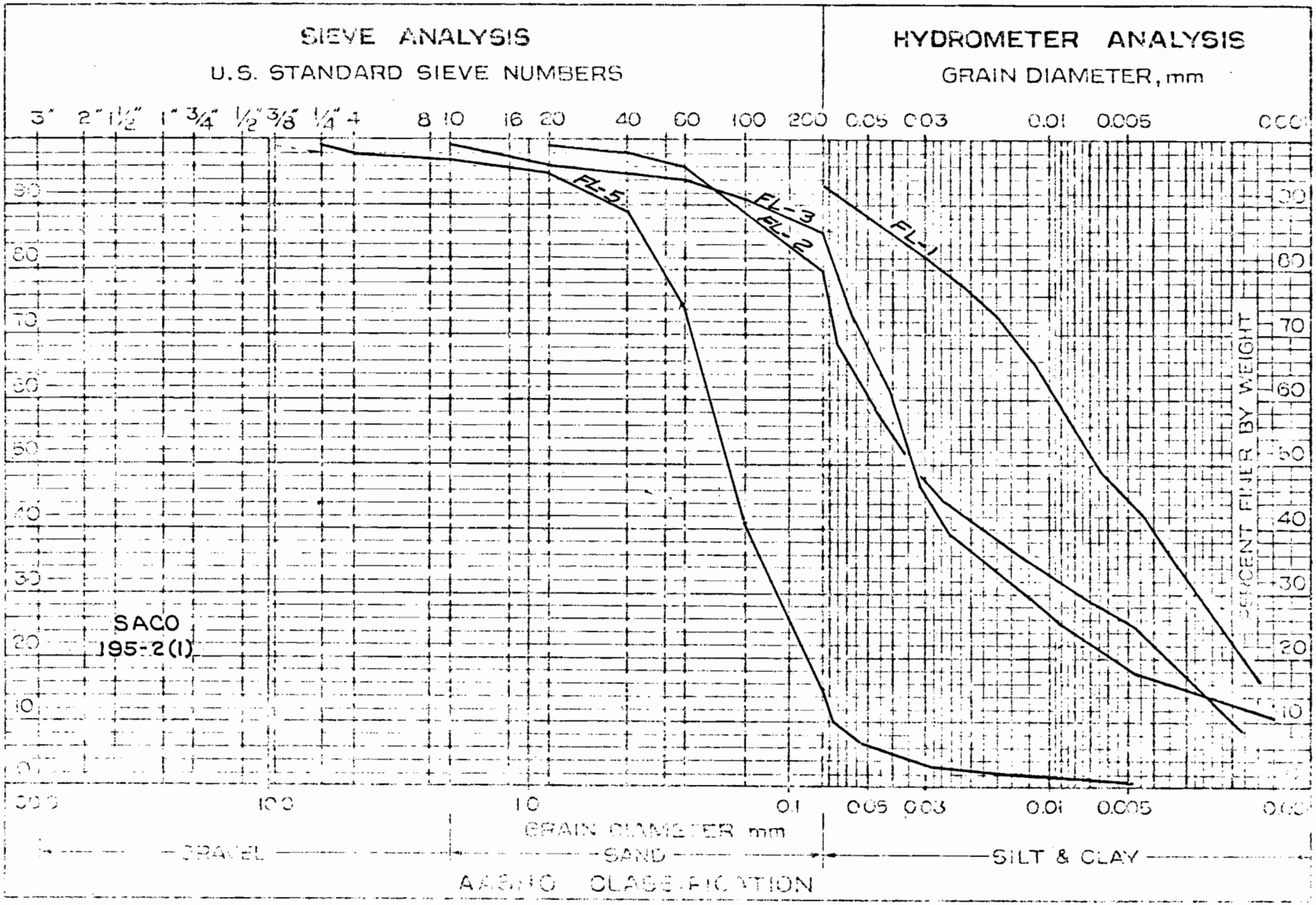
Prepared by Robert M. Harmon
Robert M. Harmon
CE-I

Approved by Melvin W. Morgan
Melvin W. Morgan
Soils Engineer

TOWN SACO PROJ. NO. 195-2(1)

STATION	OFFSET	DEPTH	SAMPLE NO.	G.S. SHEET	W.C.	L.L.	P.I.	IGN.	CLASSIFICATION AASHO	CLASSIFICATION FROST
117+40	15' LT.	15.0-16.5	CT-43-75 3U	3	20				A-4	IV
117+40	15' LT.	25.0-27.0	CT-43-75 2D	3	14				A-4	IV
117+40	15' LT.	105-107	CT-43-75 12U	3	38				A-4	IV
145+00	℄	0.0-5.0	FL-1	1	5	35.5	13.3		A-6	III
149+00	℄	1.6-2.4	FL-2	1	36	43.8	19.5		A-7-6	III
149+50	℄	0.7-4.1	FL-8	2	31	40.4	17.1		A-7-6	III
151+50	℄	0.3-3.0	FL-7	2	20		NP		A-3	0
153+50	℄	2.7-5.0	FL-6	2	13		NP		A-2-4	III
157+00	℄	1.2-2.4	FL-3	1	17	32.1	7.8		A-4	IV
157+50	℄	1.0-3.0	FL-4	2	32	41.4	18.9		A-7-6	III
157+50	℄	3.0-4.3	FL-5	1	16				A-2-4	II
219+00	℄	10.0-11.5	CT-82-75 2D	3	9				A-3	0

SML-108 (12/55)



STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

GRAIN SIZE DISTRIBUTION CURVES

BUREAU OF HIGHWAYS
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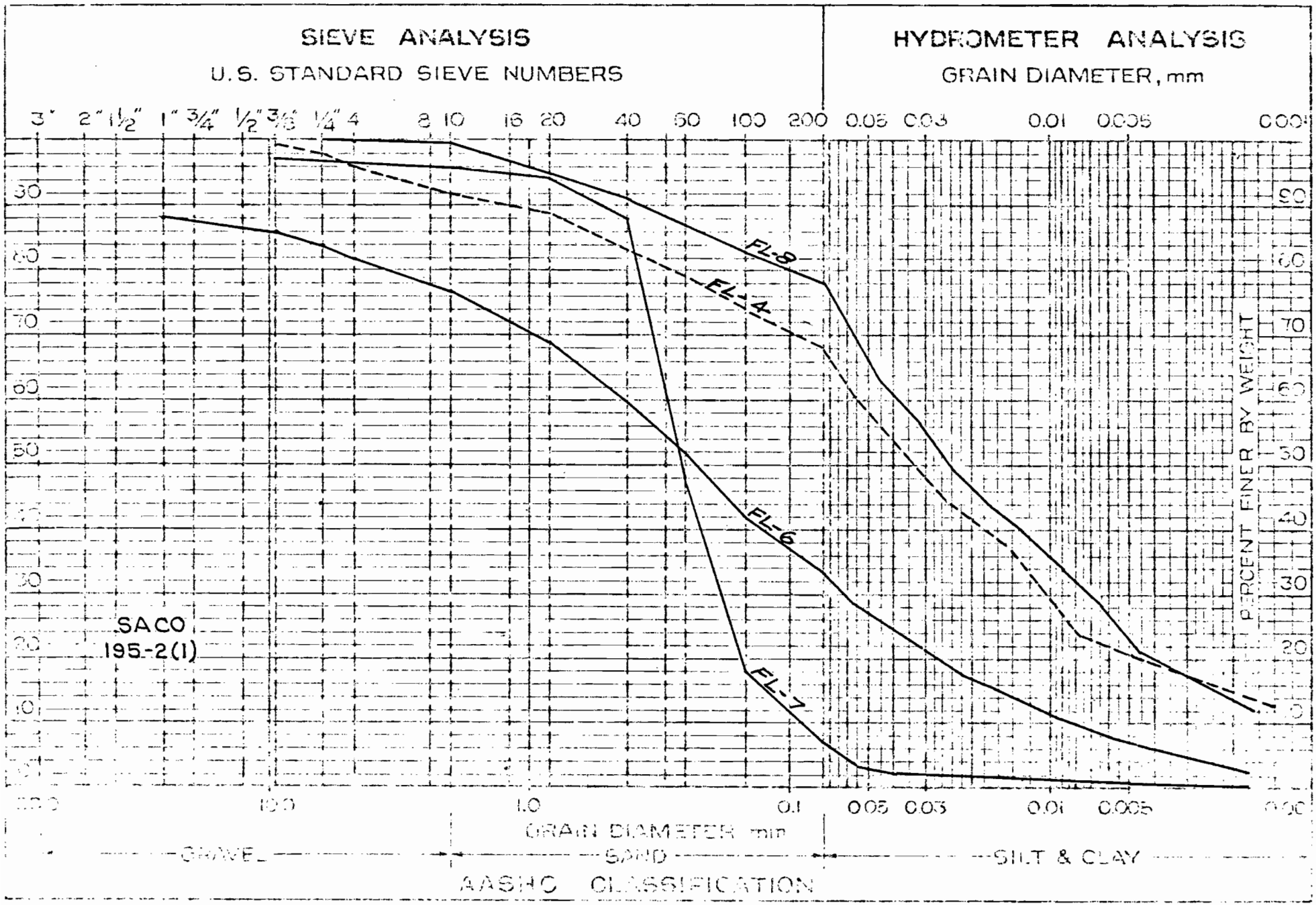
FML-105 (12/66)



STATE OF MAINE
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GRAIN SIZE DISTRIBUTION CURVES

BUREAU OF HIGHWAYS
MATERIALS & RESEARCH DIVISION

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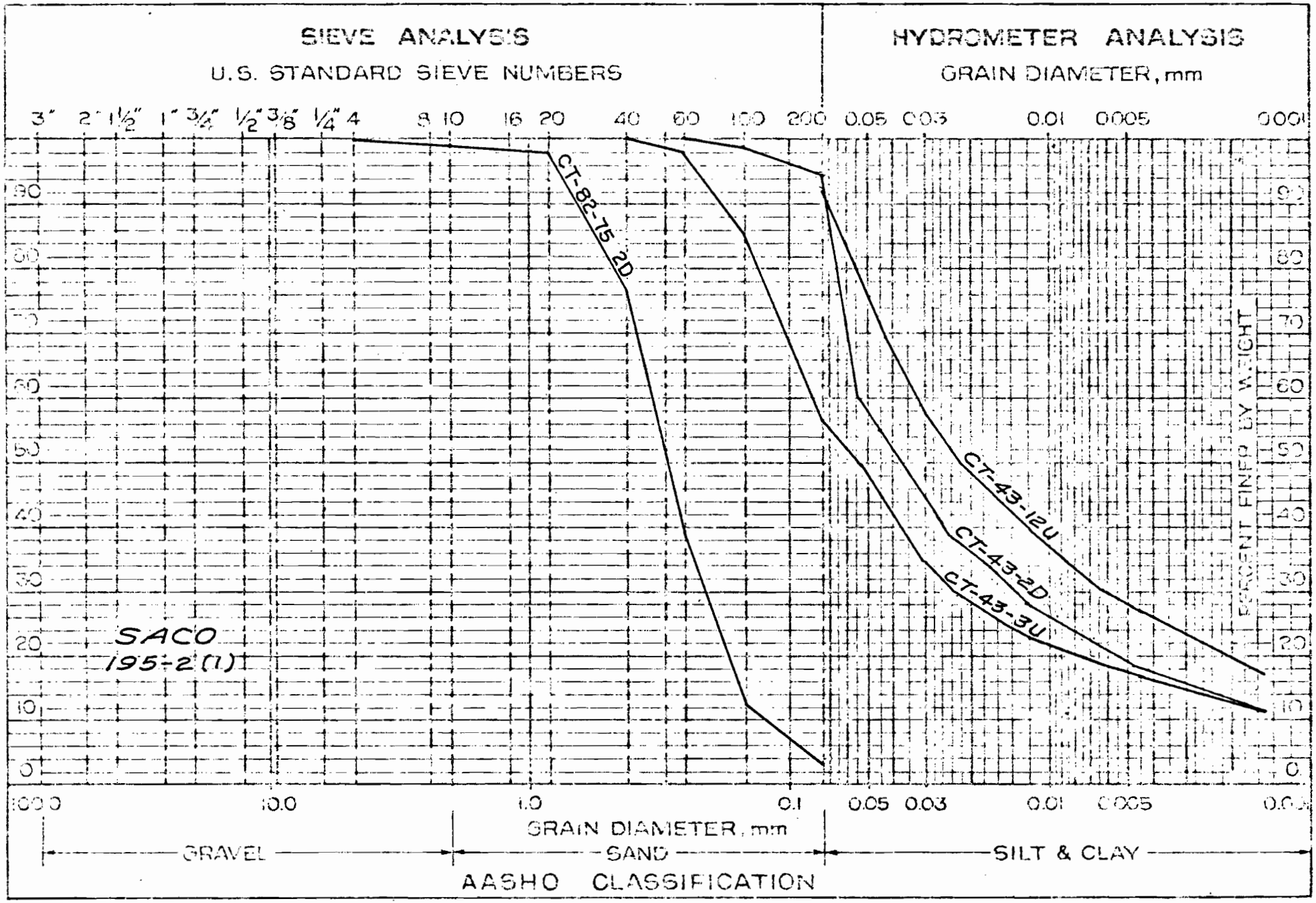


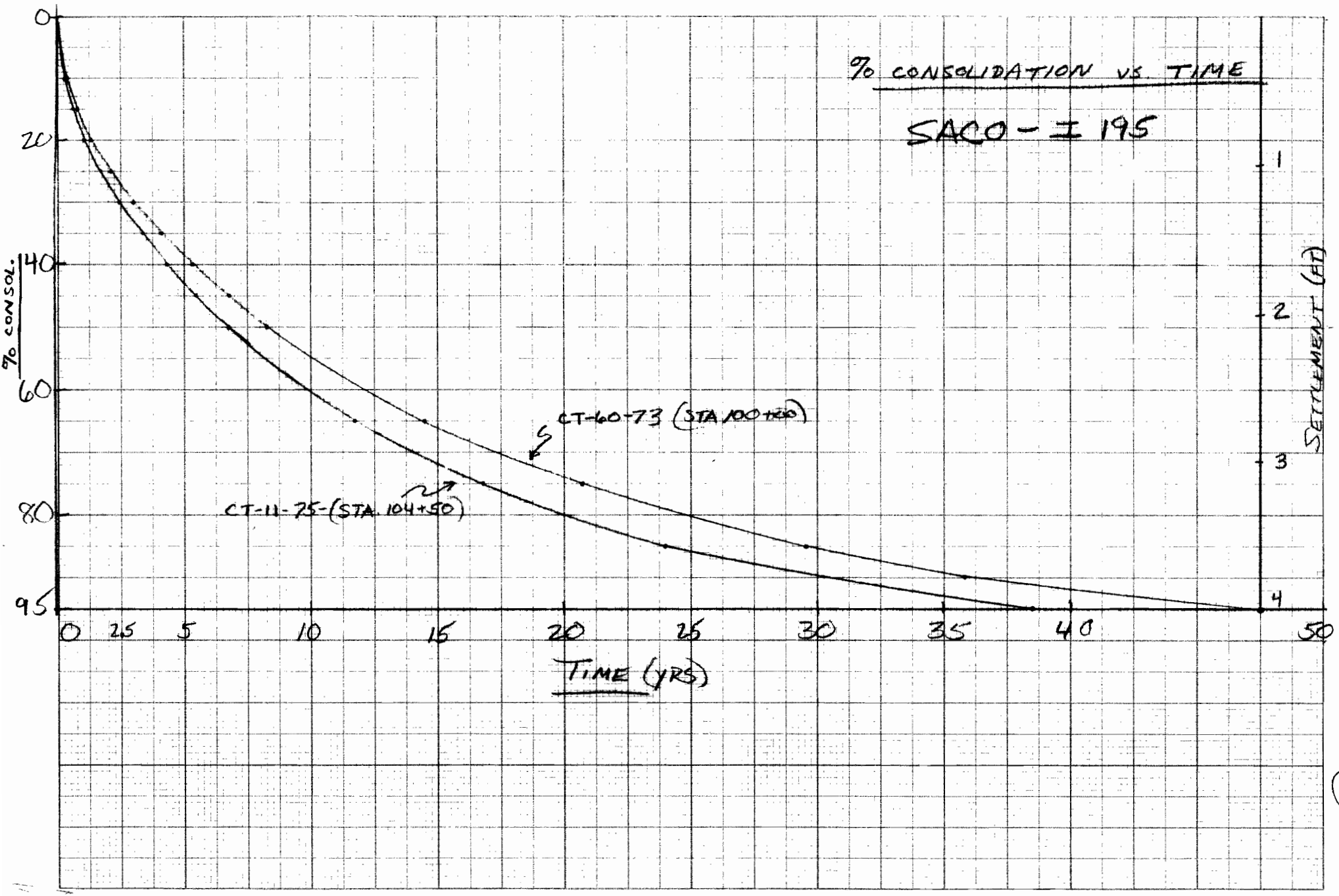
STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

GRAIN SIZE DISTRIBUTION CURVES

BUREAU OF HIGHWAYS
MATERIALS & RESEARCH DIVISION

SHEET NO. 3

K+E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.



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K+E 20 X 20 TO THE INCH 46 1242
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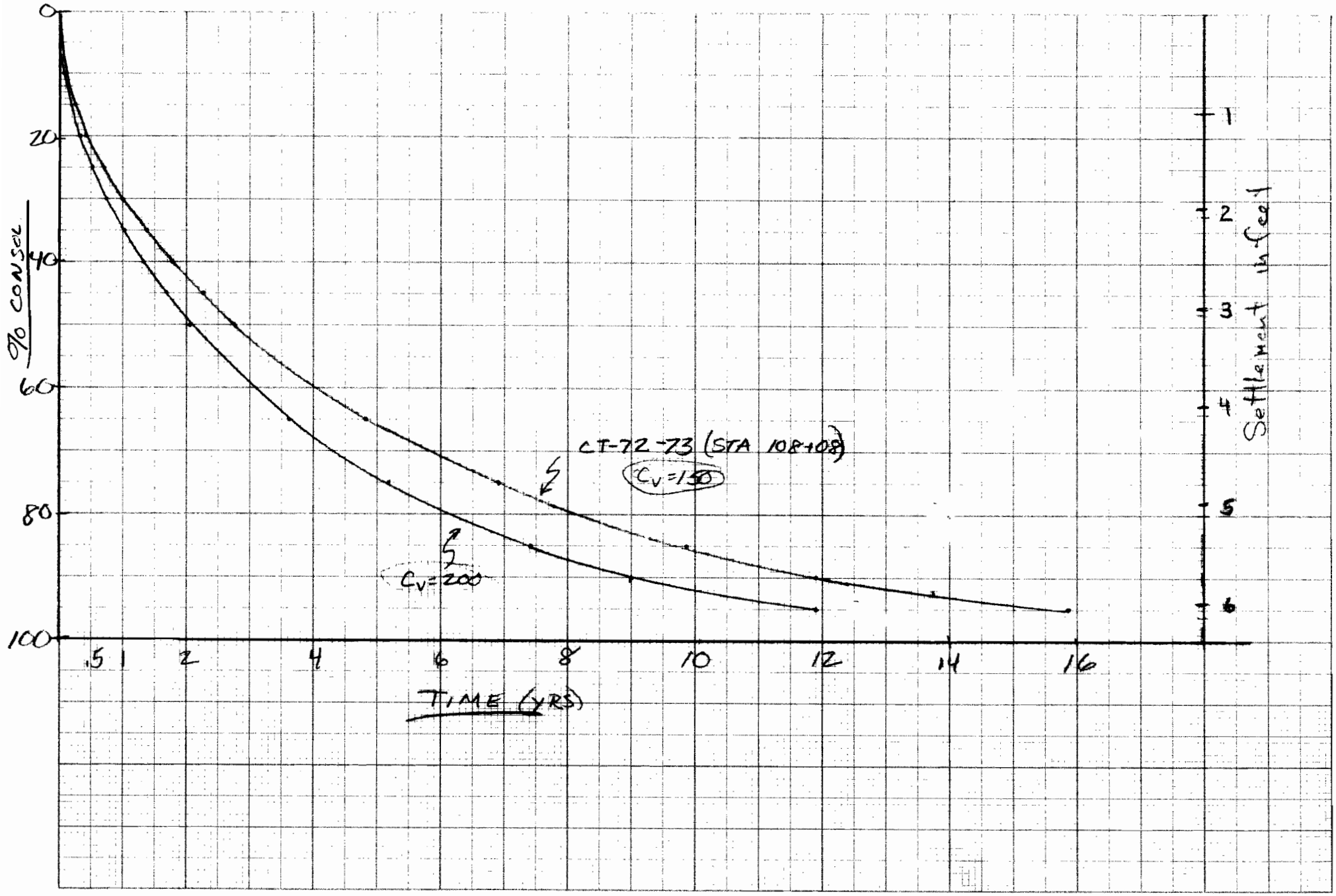

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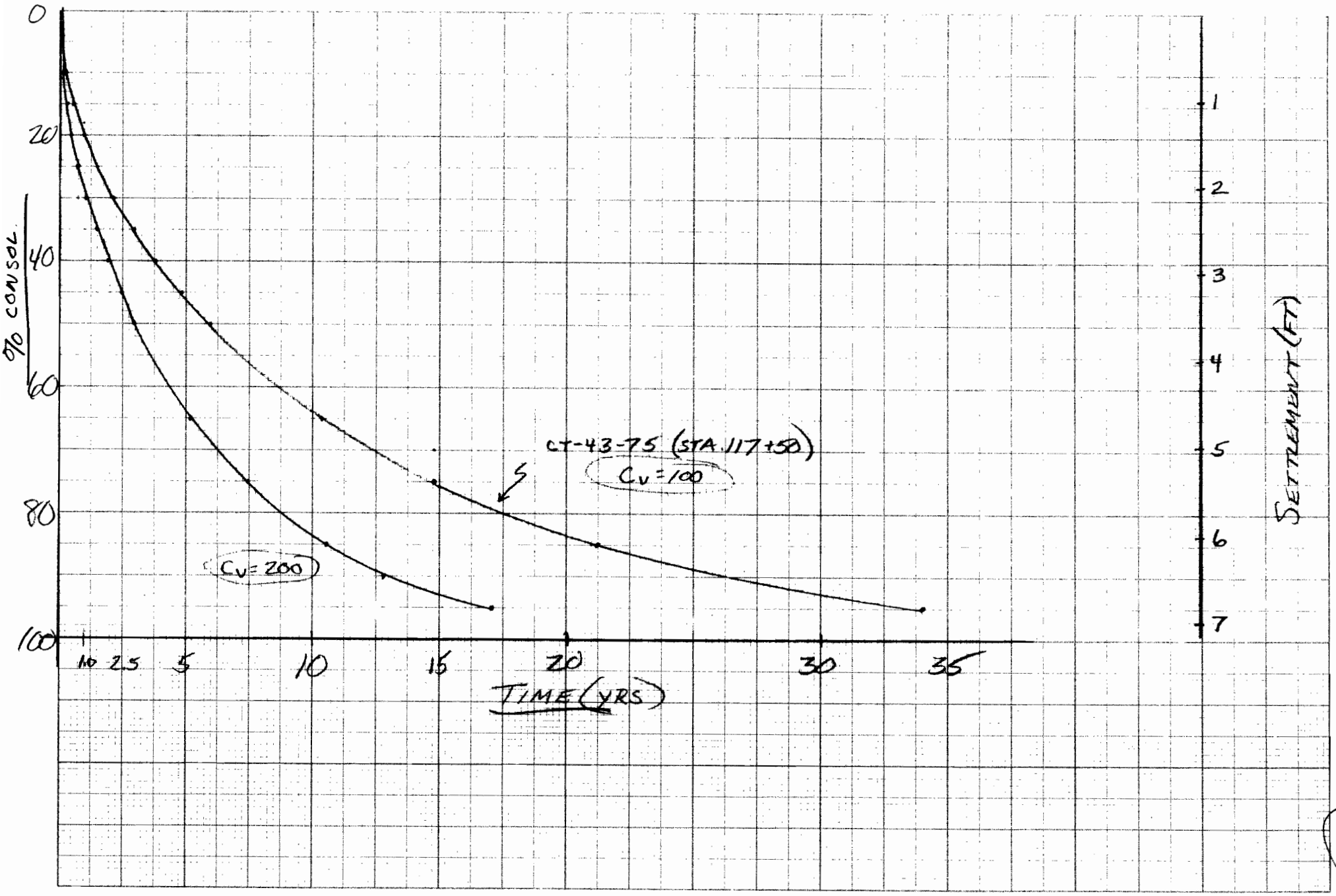

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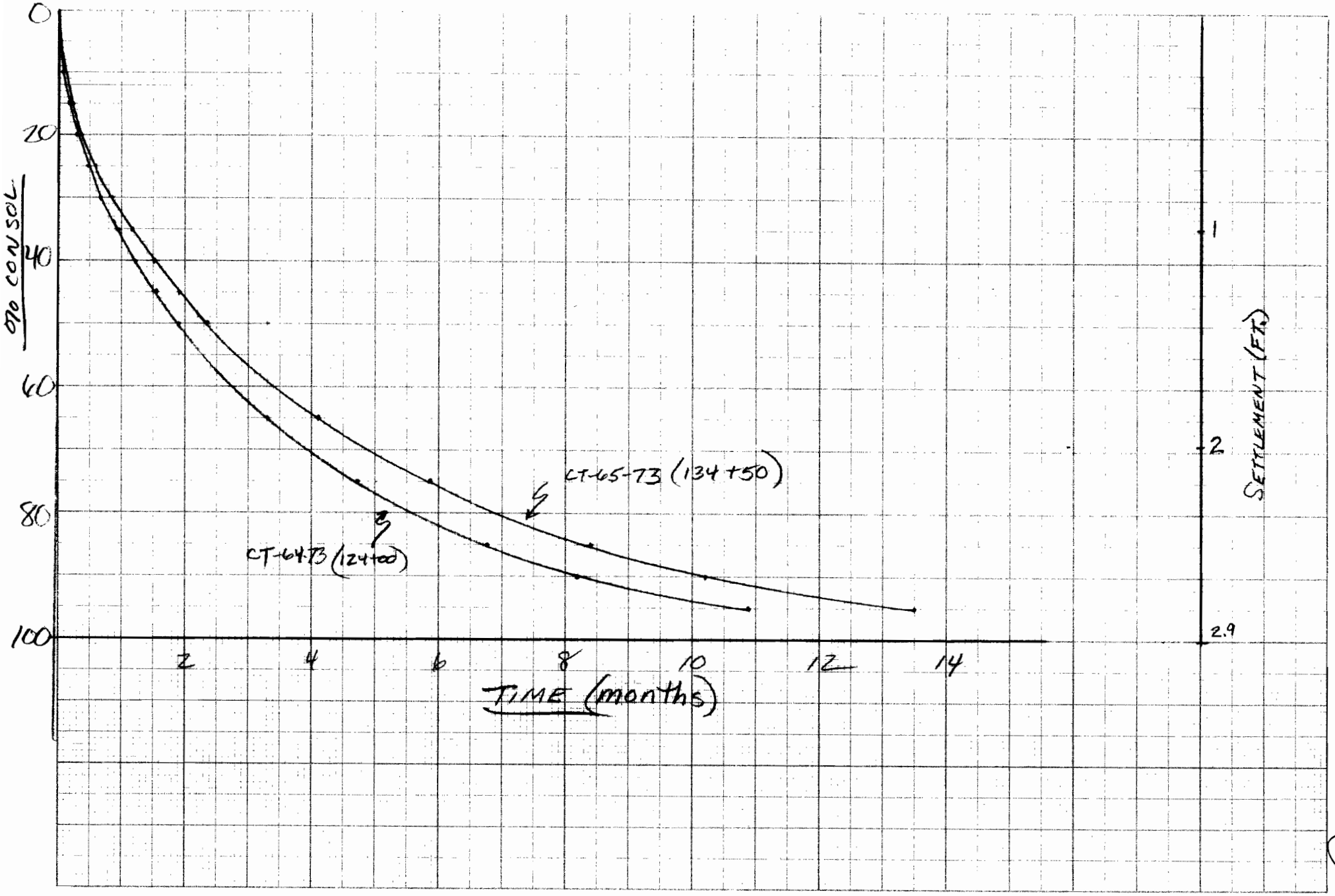

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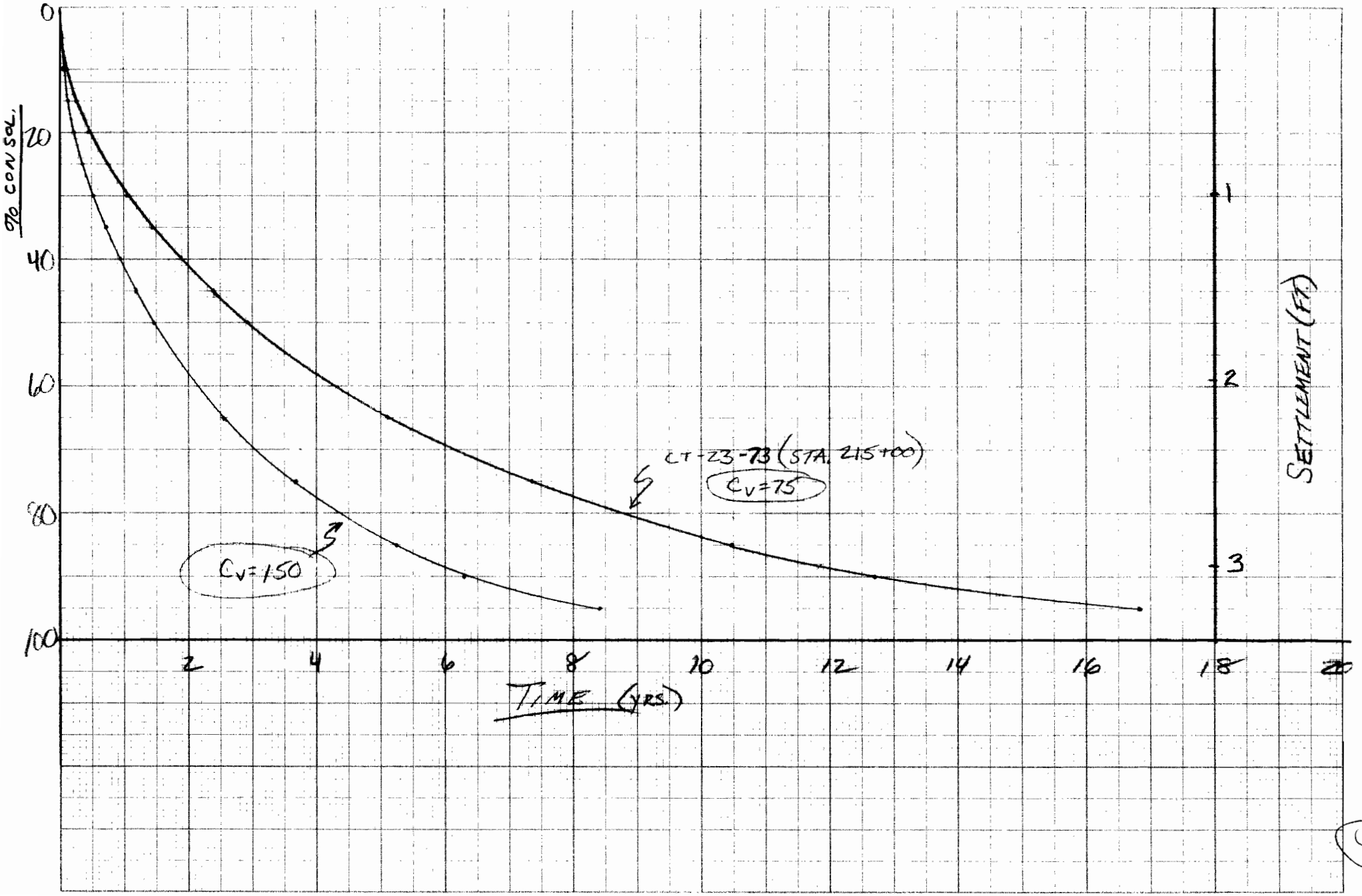

K+E 20 X 20 TO THE INCH
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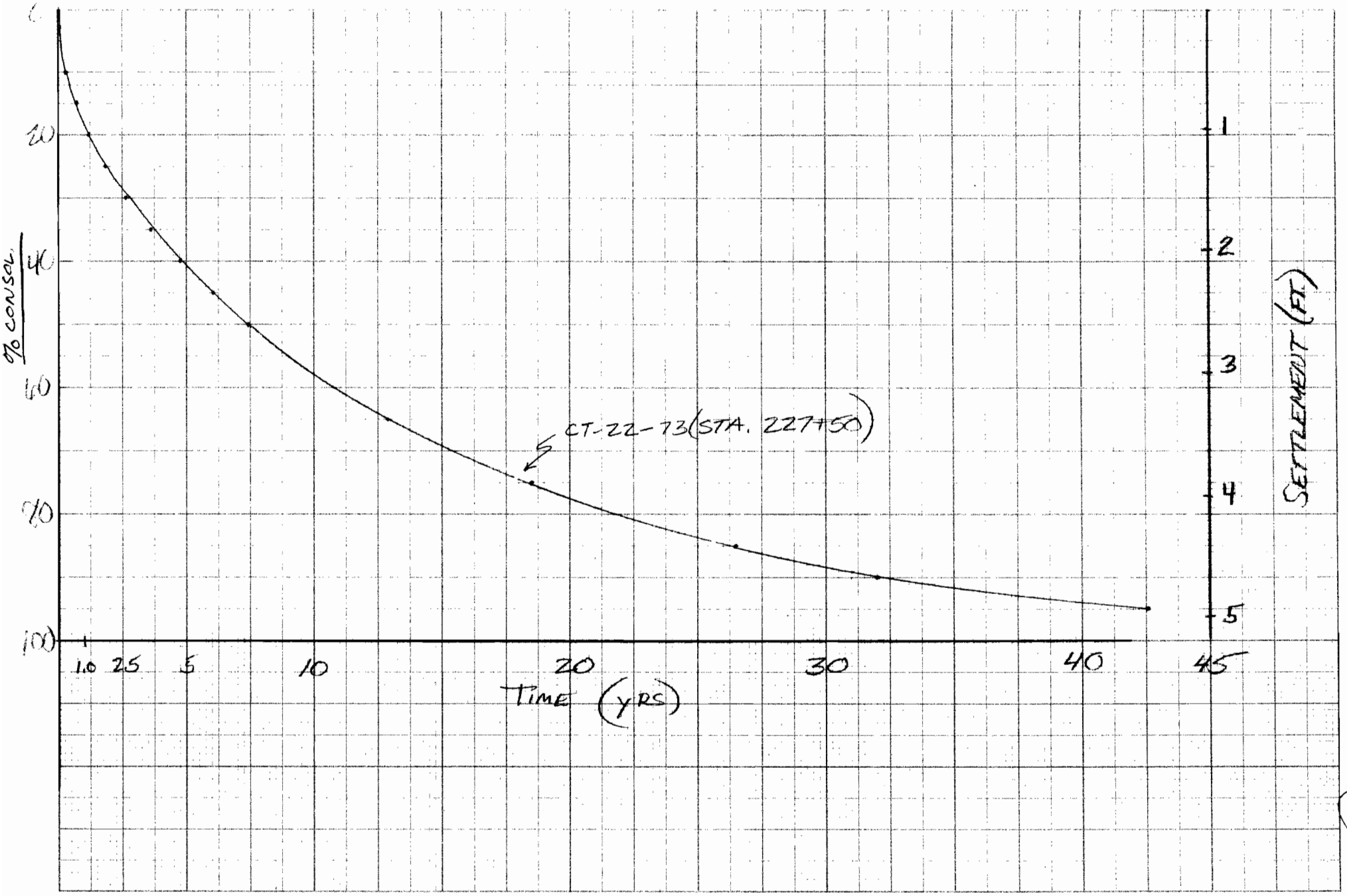

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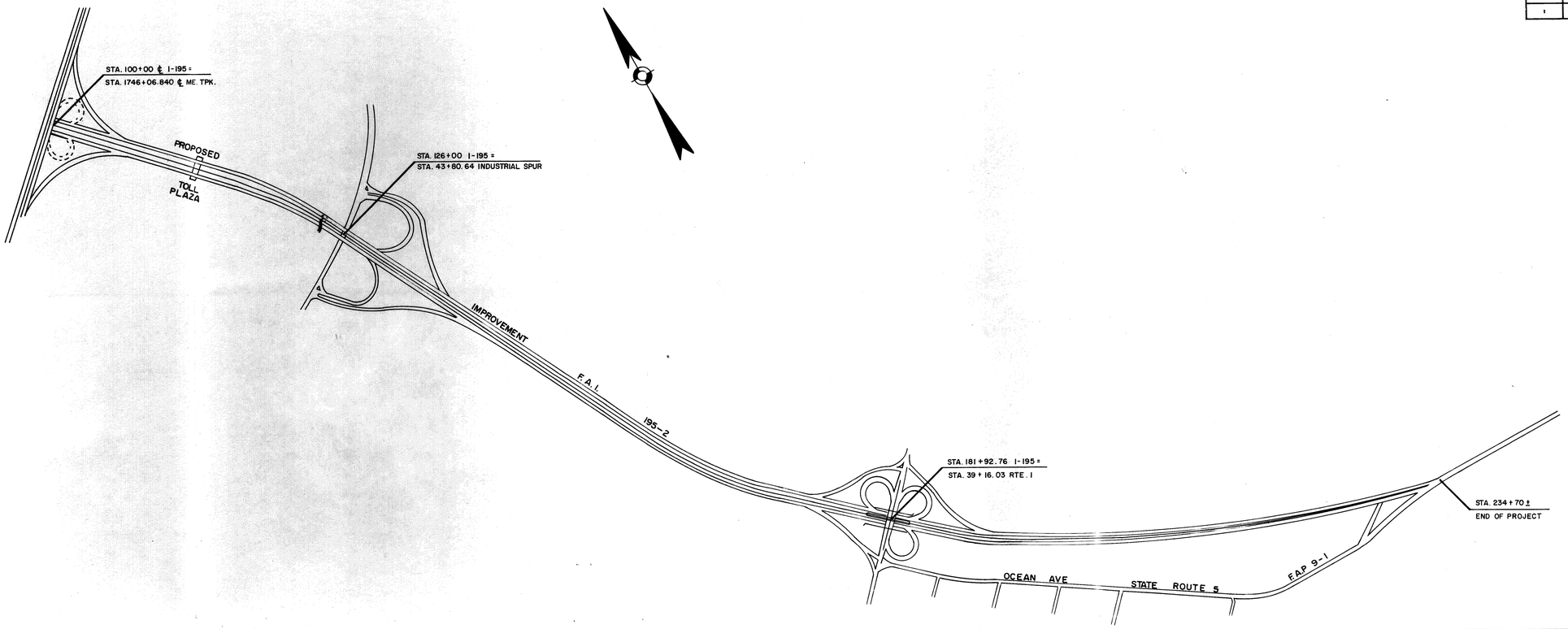
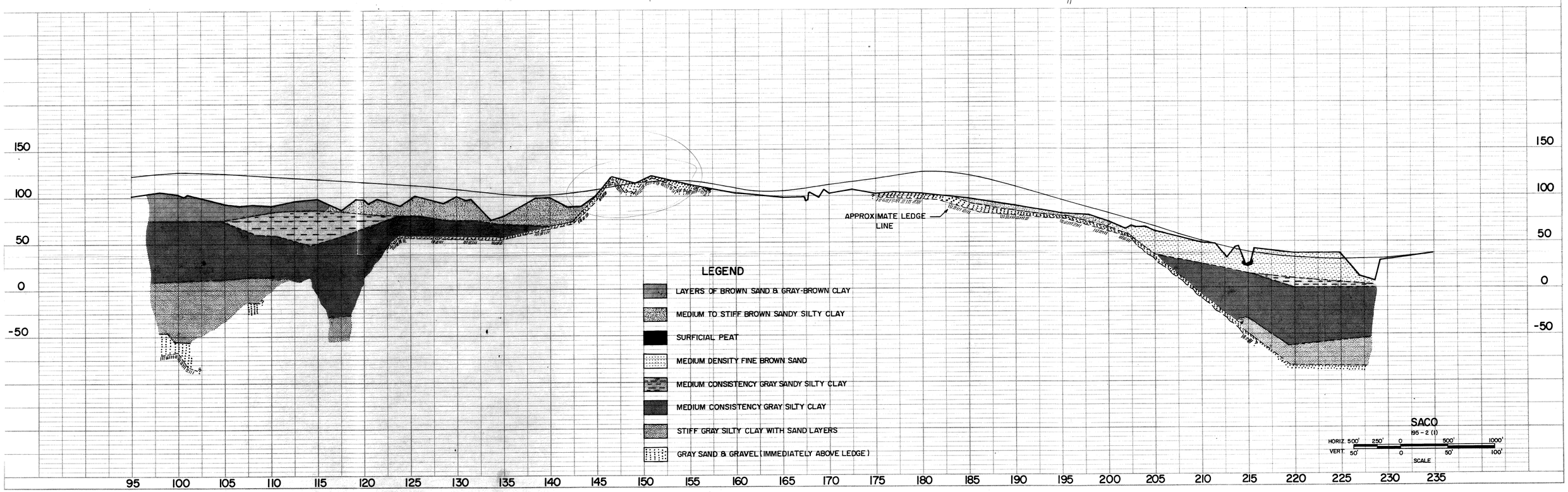
B. P. R. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE		4	

see new sheet





PROJECT SUMMARY

SECTION	AMOUNT C/F	STABILITY	SETTLEMENT	STRUCTURES	REMARKS
94+00 – 102+00	F – 27' MAX.	ANALYSIS AT STA. 101+50 SF = 1.261	ANALYSIS AT STA. 101+50 PRELIMINARY S = ~~2.5'~~ ± 4.0	I-195 OVER MAINE TURNPIKE	MARGINAL STABILITY
102+00 – 113+00	F – 33' MAX.	ANALYSIS AT STA. 108+00 FINISHED GRADE: SF=0.976 F.G. – 8.3': SF = 1.25 F.G. WITH 14X70 BERM: SF=1.197 F.G. WITH 14X90 BERM: SF = 1.330	ANALYSIS AT STA. 108+00 PRELIMINARY S = ~~5.25'~~ 6.0'	CULVERT AT STA. 111+00	STABILITY AND SETTLEMENT PROBLEMS IF CONSTRUCTED AS PROPOSED
113+00 – 116+50	F – 25' MAX.	MARGINAL STABILITY BASED ON ANALYSIS AT STA. 108+00		TOLL PLAZA	FURTHER STUDY REQUIRED FOR TOLL PLAZA
116+50 – 118+50	F – 30' MAX.	ANALYSIS AT STA. 117+50 F.G.: SF = 1.15 F.G. – 3.5': SF = 1.25 F.G. WITH 15 X 60 BERM: SF = 1.296 LONGITUDINAL STABILITY: SF = 1.348	ANALYSIS AT STA 117+50, PRELIMINARY S = 7.5' ±	OPTION #1 CONSTRUCT CULVERT FOR RUN AT STA. 117+50 BUILD BRIDGE FOR FUTURE RAILROAD SPUR LATER OPTION #2 CONSTRUCT BRIDGE FOR RUN AND RAILROAD CROSSING	STABILITY AND SETTLEMENT PROBLEMS IF CONSTRUCTED AS PROPOSED
118+50 – 125+00	F – 23' MAX.	ANALYSIS AT STA. 124+00 SF = 1.30	ANALYSIS AT STA. 124+00 PRELIMINARY S = 1.77'	CULVERT AT STA. 124+00	
125+00 – 132+00	F – 16' MAX.	GOOD SHEAR STRENGTH		I-195 OVER INDUSTRIAL SPUR	
132+00 – 137+80	F – ~~26~~ 29' MAX.	GOOD SHEAR STRENGTH	ANALYSIS AT STA. 134+50 PRELIMINARY S = 3'	CULVERT AT 133+75	
137+80 – 140+40	C – SHALLOW	NO PROBLEM			LEDGE EXCAVATION IS NOT EXPECTED
140+40 – 145+75	F – 15' MAX.	GOOD SHEAR STRENGTH		CULVERT AT STA. 142+00	
145+75 – 157+00	C – 15' MAX.	NO PROBLEM – PRIMARILY LEDGE			LEDGE EXCAVATION: 145+75 TO 148+50 12' MAX. 149+50 TO 153+50 8' MAX. 155+75 TO 156+25 1' MAX.

SHEET NO. 5

Sheet 36

PROJECT SUMMARY (CONT.)

SECTION	AMOUNT C/F	STABILITY	SETTLEMENT	STRUCTURES	REMARKS
157+00 — 164+00	SHALLOW CUT — FILL	NO PROBLEM	WITH SURFICIAL PEAT REMOVED — VERY LITTLE SETTLEMENT EXPECTED		SUBGRADE AT OR BELOW GROUND ELEVATION NO LEDGE EXCAVATION
164+00 — 203+00	F-27' MAX	GOOD SHEAR STRENGTH	NO PROBLEM - LEDGE SHALLOW	CULVERTS AT 167+50 & 202+00 I-195 OVER U.S. RTE. 1	MAY BE ABLE TO SUPPORT I-195 BRIDGE OVER U.S. RTE. 1 ON FOOTINGS ON LEDGE
203+00 — 212+00	C-SHALLOW	NO PROBLEM			LEDGE EXCAVATION NOT ANTICIPATED
212+00 — 213+20	F-12' MAX.	GOOD SHEAR STRENGTH			
213+20 — 214+40	C-4' TO F.G.	NO PROBLEM			
214+40 — 215+50	F-15' MAX.	GOOD SHEAR STRENGTH	ANALYSIS AT STA. 214+90 PRELIMINARY S = 3.6'	CULVERT AT 214+75	SURFICIAL PEAT AT STA. 214+90 ℄
215+50 — 225+50	C-9' TO F.G.	NO PROBLEM			LEDGE — DEEP
225+50 — 227+00	F-17' MAX.	O.K. BASED ON ANALYSIS AT STA. 227+50			
227+00 — 229+00	F-22' MAX.	ANALYSIS AT STA. 227+50 F.G.: SF = 1.16 F.G.-2': SF = 1.24 F.G.-3': SF = 1.295 F.G. WITH 10 X 75' BERM RELOCATED BROOK SF = 1.246	ANALYSIS AT STA. 227+50 PRELIMINARY S = 4.74'	CULVERT AT 228+50	STABILITY AND SETTLEMENT PROBLEMS IF CONSTRUCTED AS PROPOSED
229+00 - 229+50	F-16' MAX.	O.K. BASED ON ANALYSIS AT STA. 227+50			
229+50 - 234+00	C - SHALLOW	NO PROBLEM			LEDGE EXCAVATION IS NOT EXPECTED

SHEET NO. 6

LEGEND

PLAN SYMBOLS

○ _____ ROD SOUNDING

⊗ _____ AUGER BORING

⊗ _____ BORING & SOUNDING

⬡ _____ POWER AUGER

◉ _____ WASH BORING

◇ _____ SEISMIC: SHOT LOCATION

◆ _____ RESISTIVITY: TEST LOCATION

⊠ _____ TEST PIT

_____ LEDGE ON SURFACE

EXPLORATION NOTES

▽ _____ WATER LEVEL

10
18 _____ BLOWS PER FOOT - ROD SOUNDINGS

CLAY
B-160 _____ MATERIAL & SAMPLE NO. - AUGER BORING

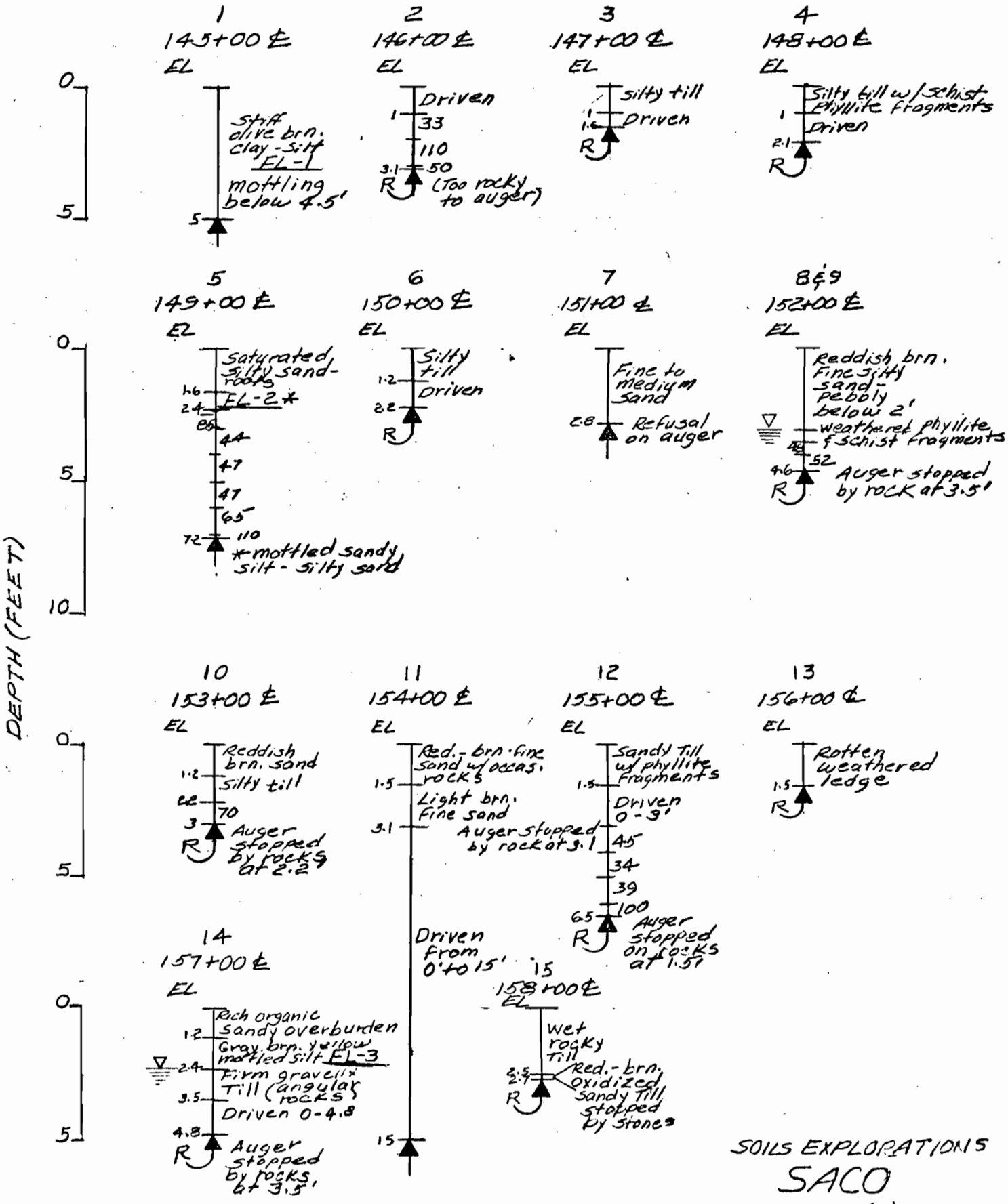
2'
5' _____ DEPTH OF MATERIAL CHANGE (IN FEET)

_____ BOTTOM OF EXPLORATION

R _____ REFUSAL

_____ LEDGE

EXPLORATIONS 1-15
BORINGS & SOUNDINGS



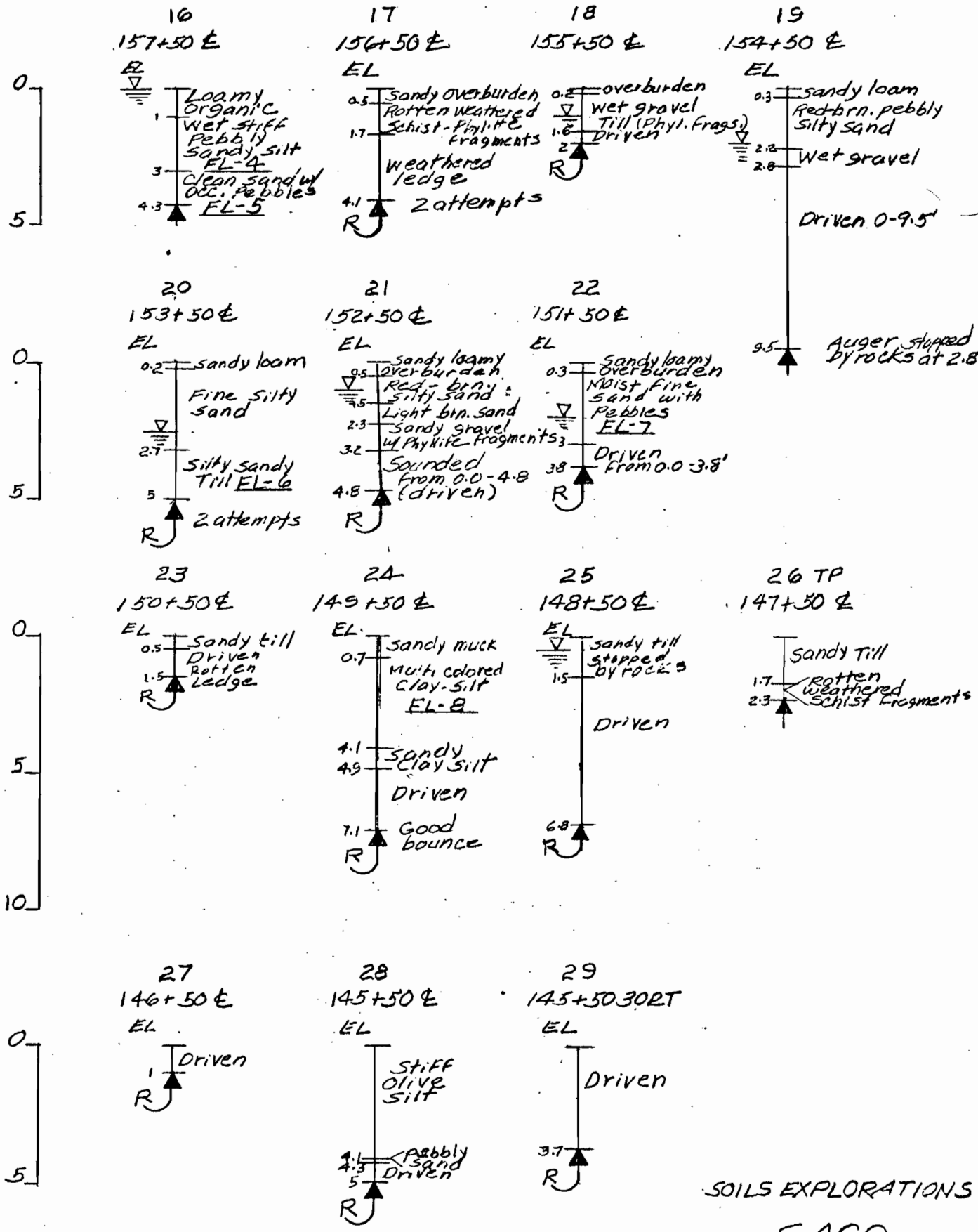
SOILS EXPLORATIONS

SACO

195-2(1)

JANUARY 1976

EXPLORATIONS 16-29
BORINGS & SOUNDINGS



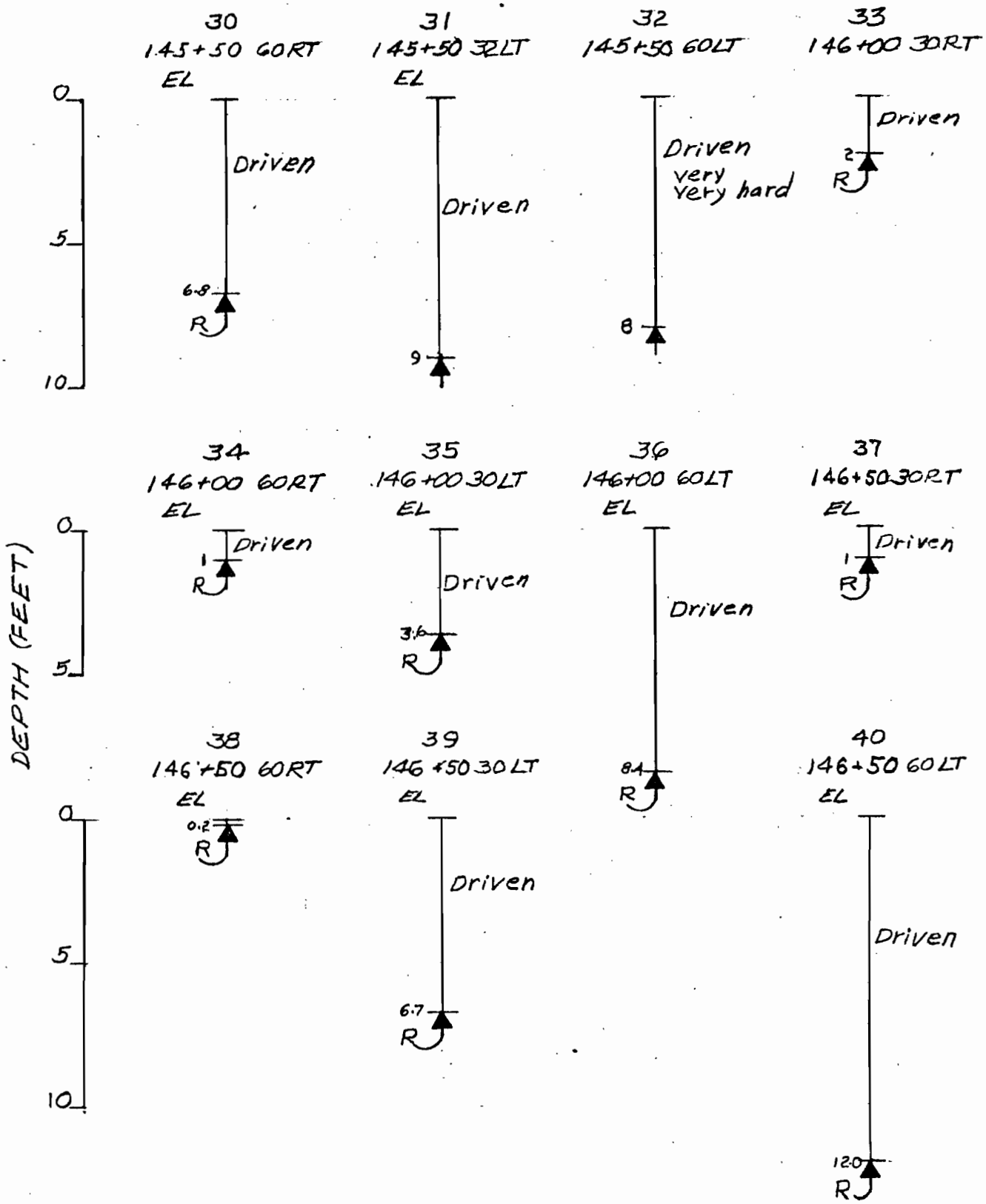
SOILS EXPLORATIONS

SACO

195-2 (1)

JANUARY 1976

EXPLORATION 30-40
SOUNDINGS



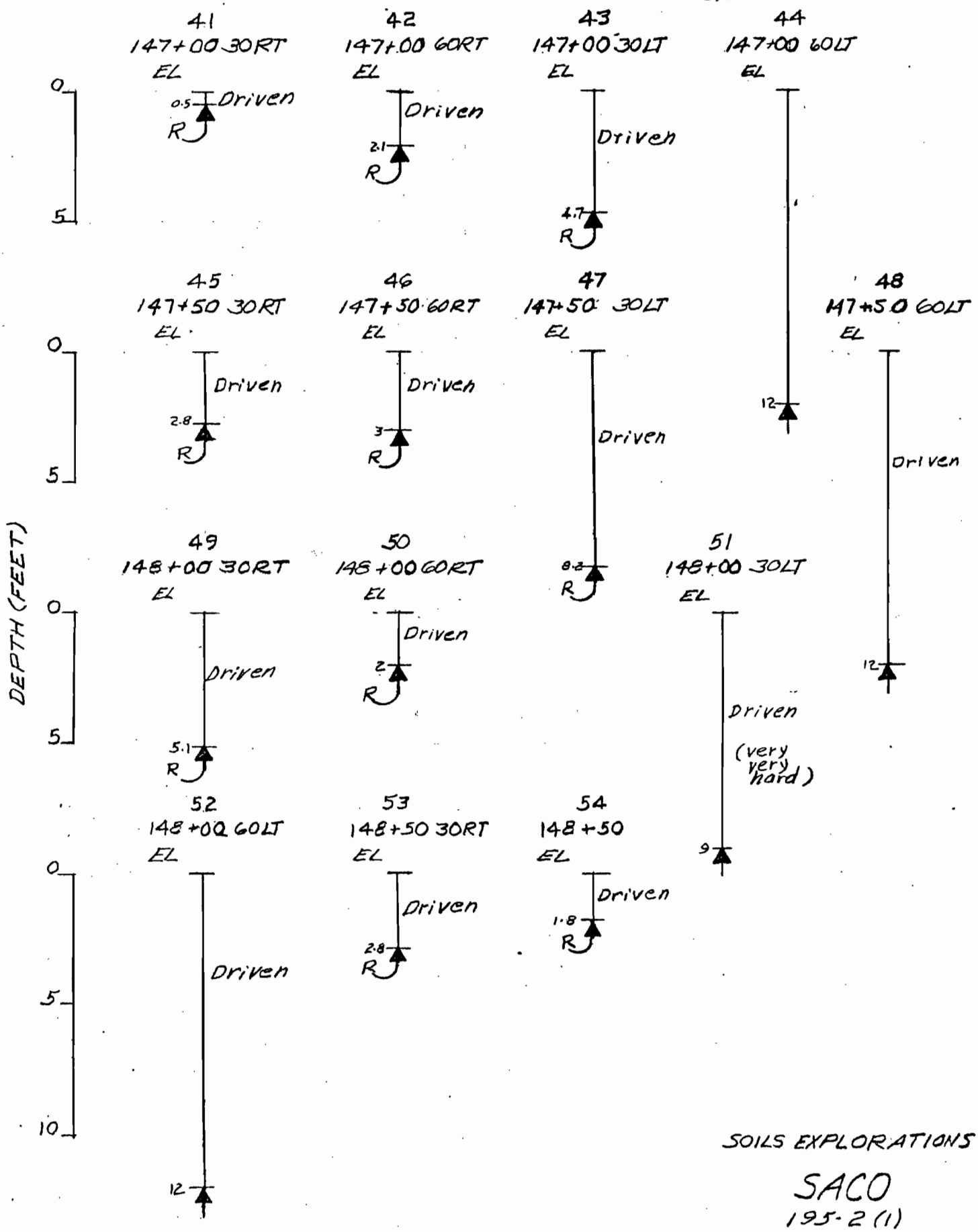
SOILS EXPLORATIONS

SACO
195-2(1)

JANUARY 1976

SHEET NO. 11

EXPLORATIONS 41-54
SOUNDINGS

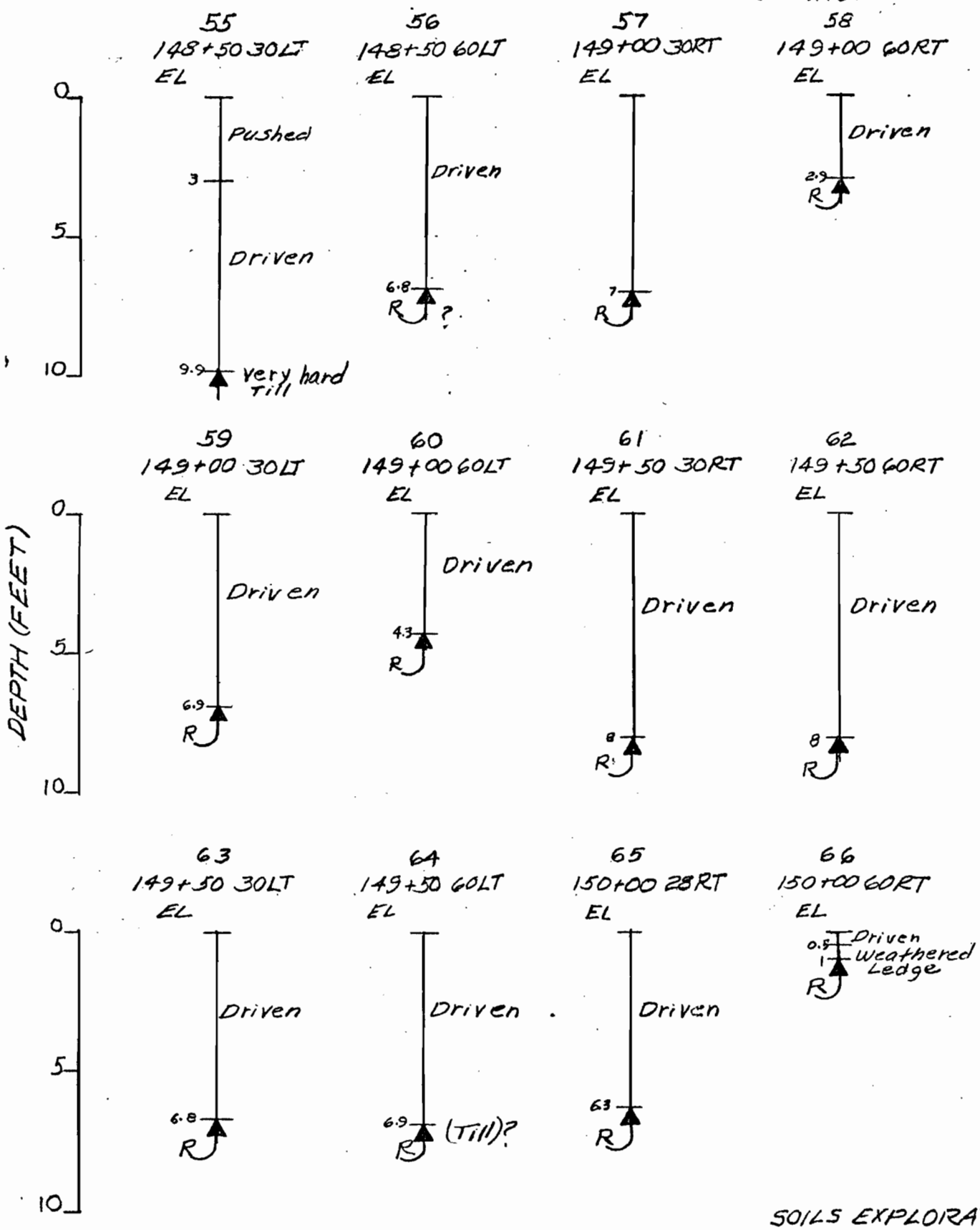


SOILS EXPLORATIONS

SACO
195-2 (1)

JANUARY 1976

EXPLORATIONS 55-66
SOUNDINGS

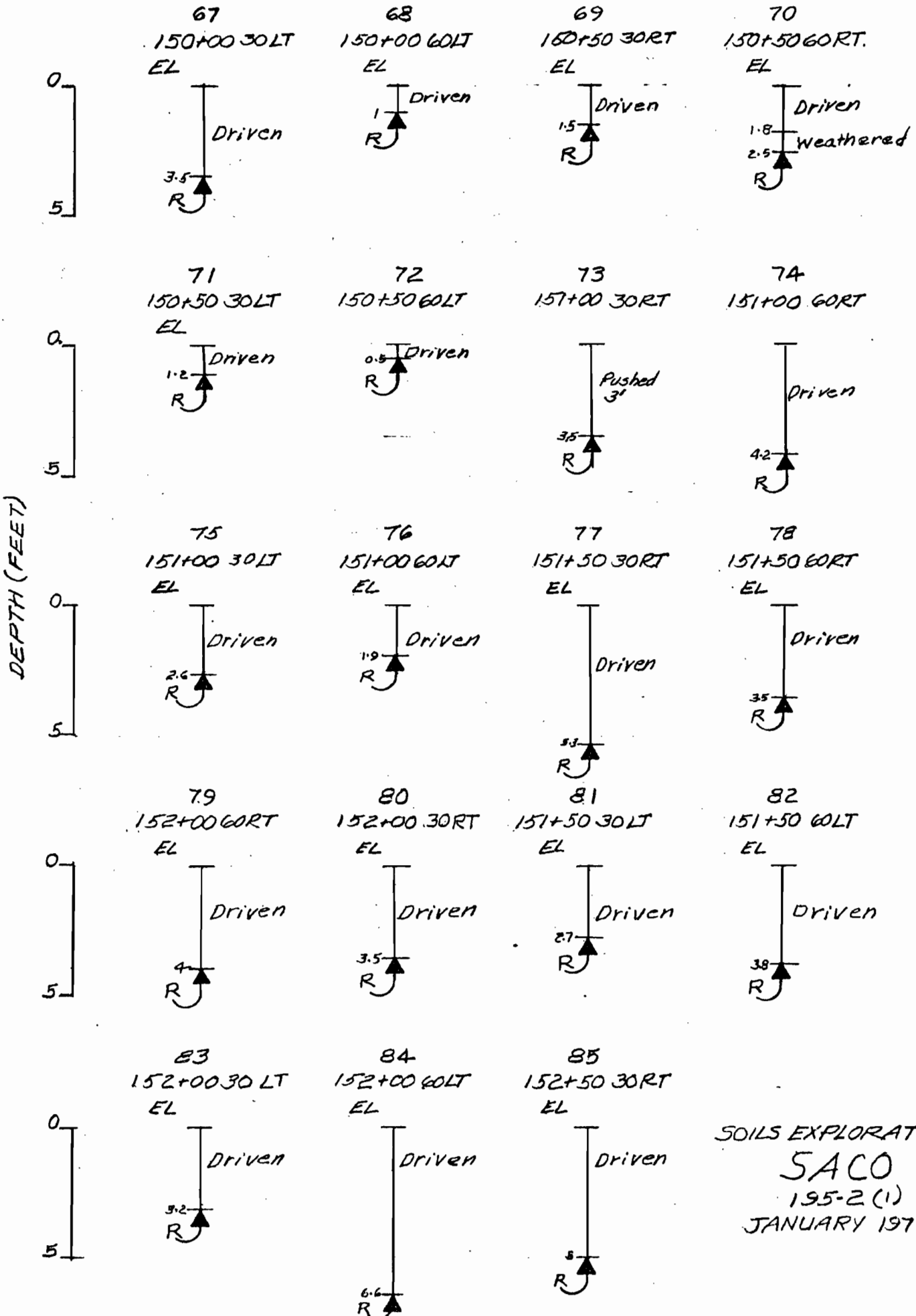


SOILS EXPLORATIONS

SACO
195-2 (1)

JANUARY 1976

EXPLORATIONS 67-85
SOUNDINGS

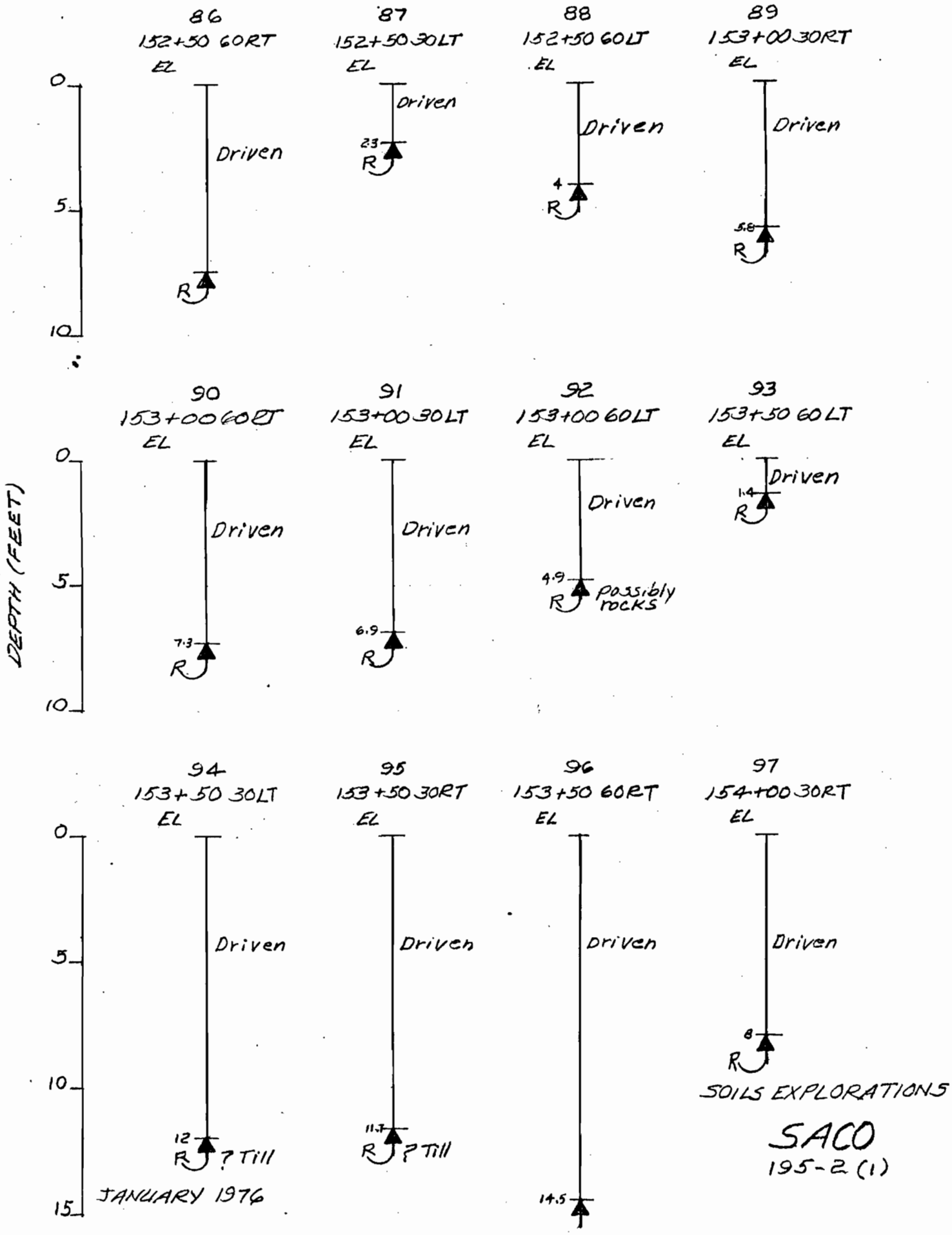


SOILS EXPLORATIONS
SACO
195-2 (1)
JANUARY 1976

SHEET NO. 14

EXPLORATIONS 86-97

SOUNDINGS



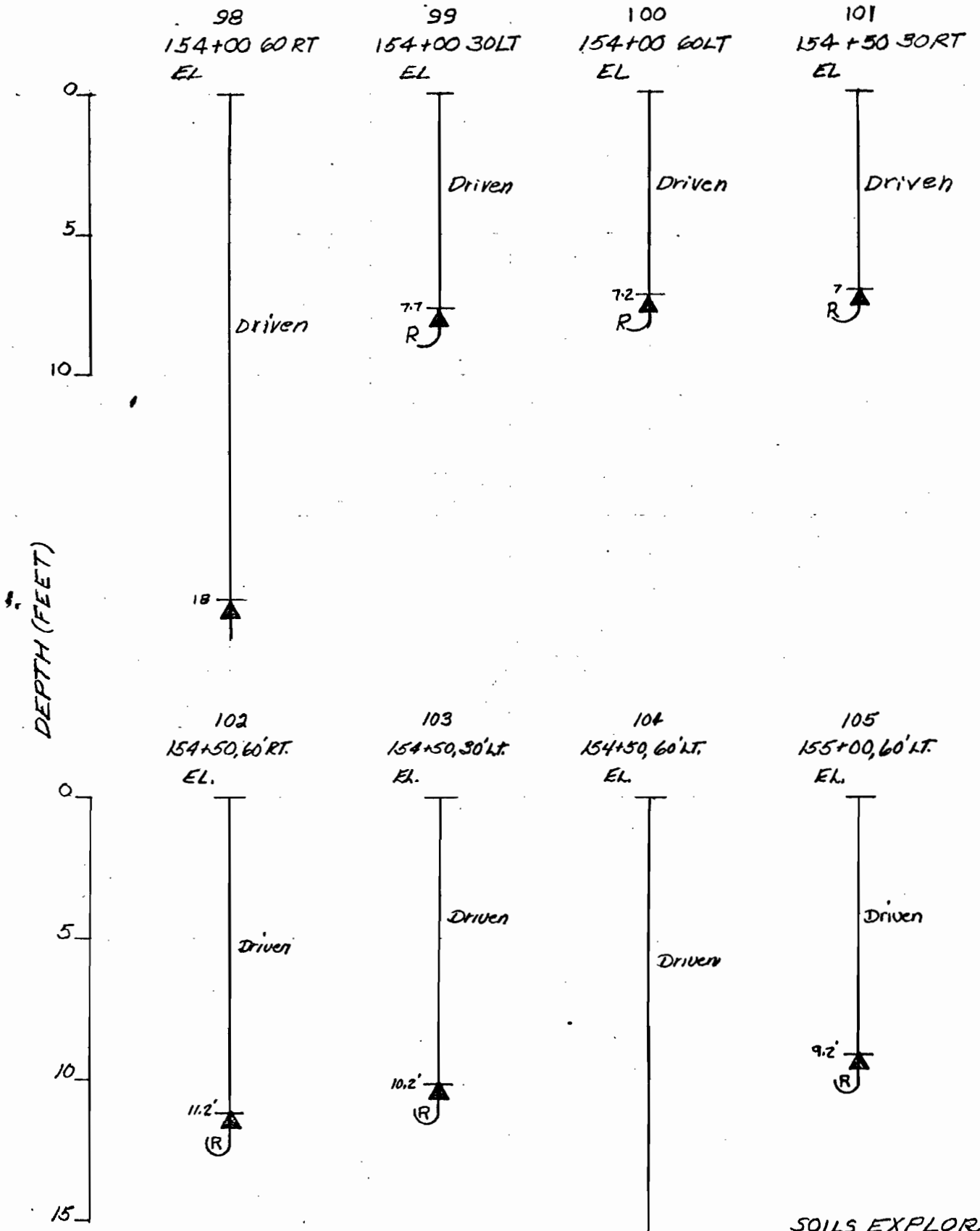
JANUARY 1976

SOILS EXPLORATIONS

SACO

195-2 (1)

EXPLORATIONS 98-105

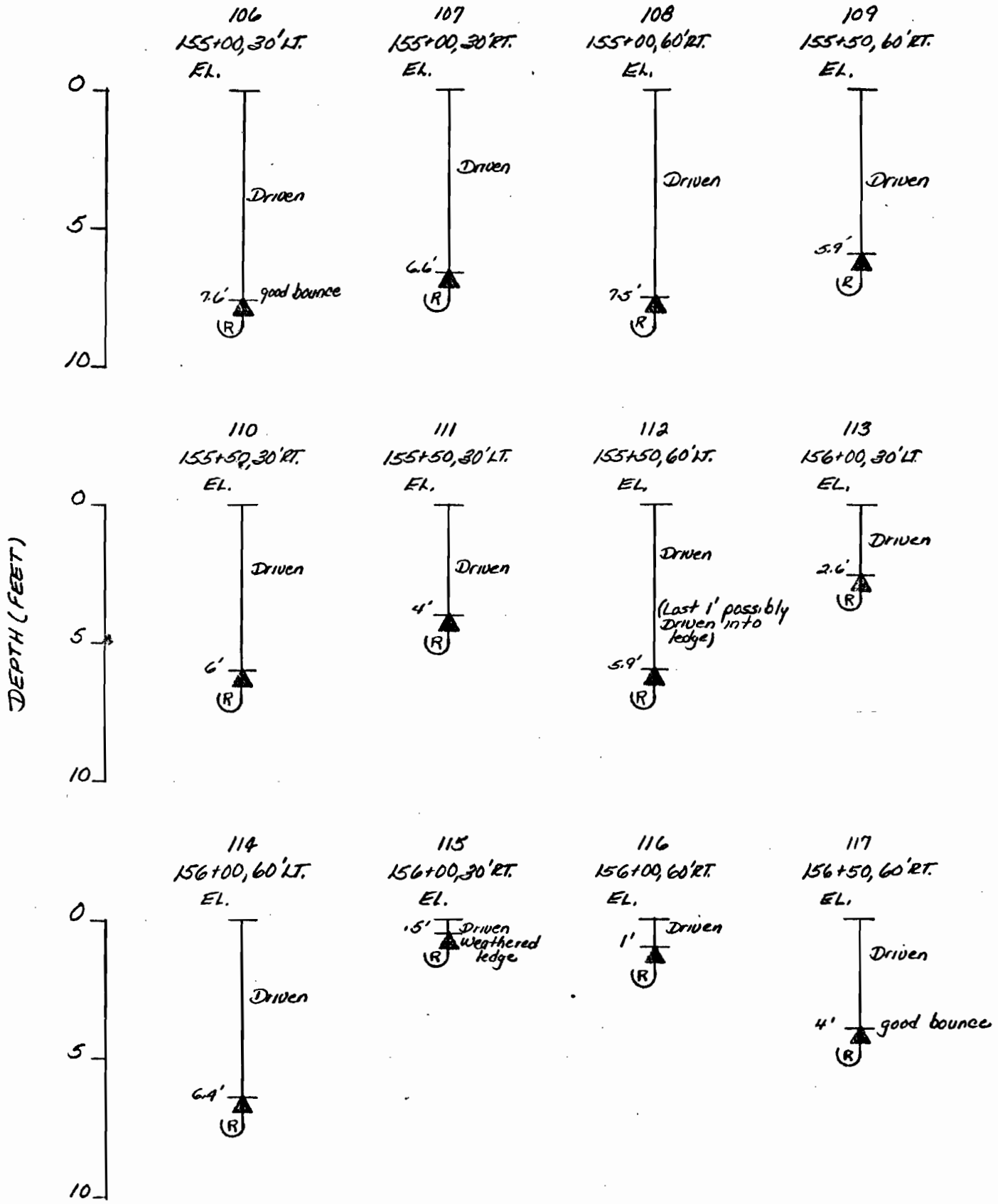


SOILS EXPLORATIONS

SACO

195-2(1)

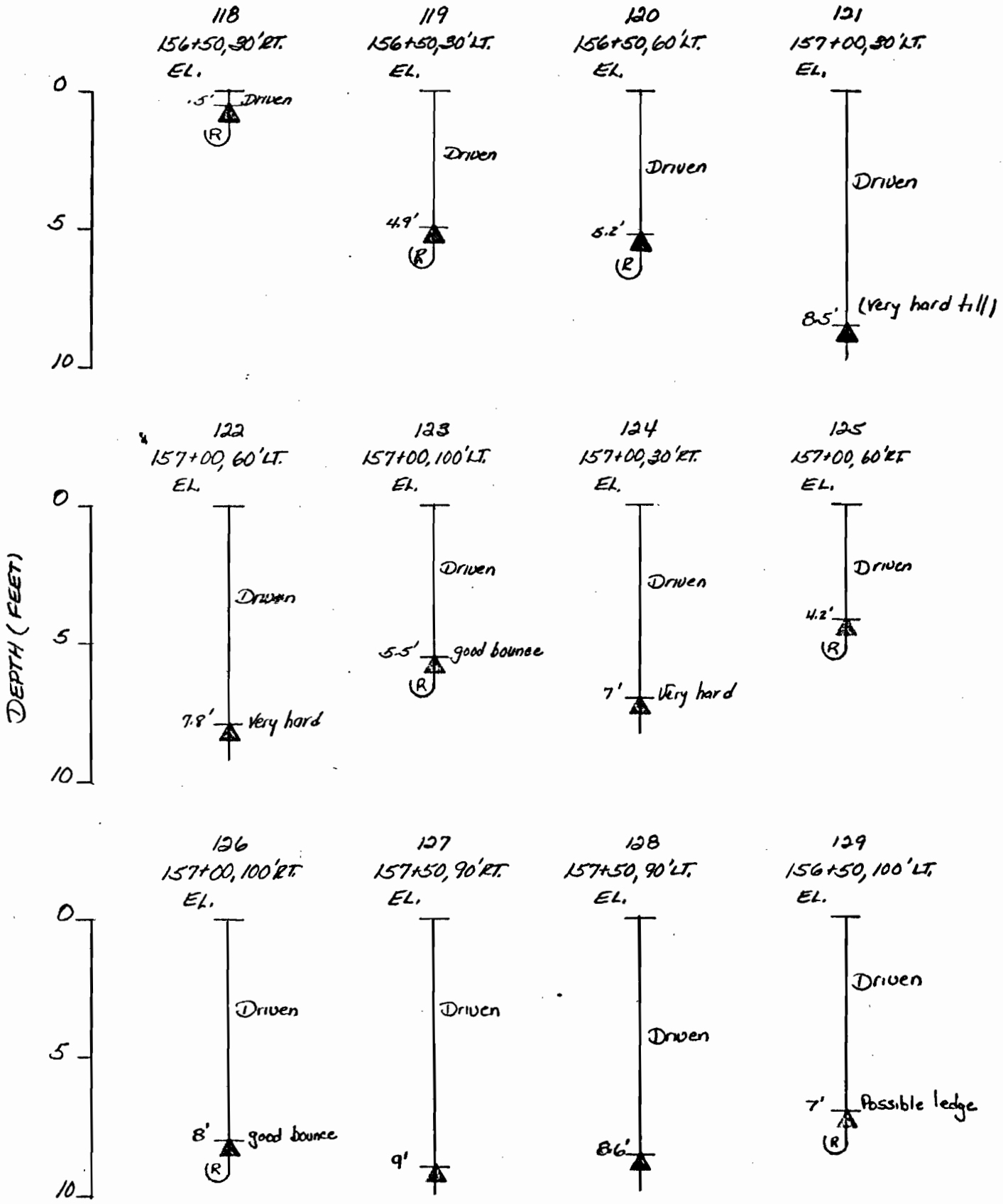
FEBRUARY, 1976



FEBRUARY, 1976

SOILS EXPLORATIONS
SACO
195-2 (1)

EXPLORATIONS 118 - 129



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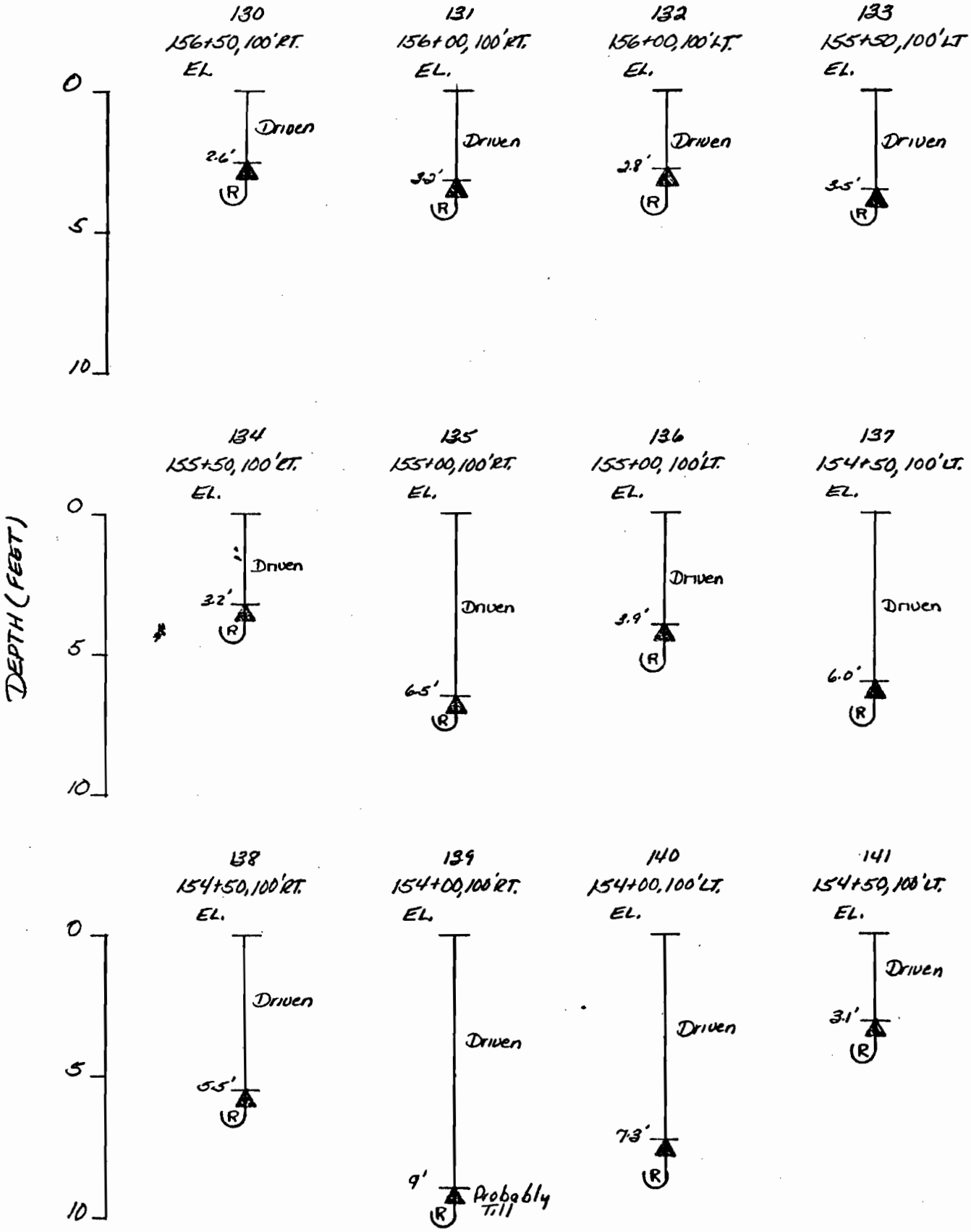
SOILS EXPLORATIONS

SACO

195-2 (1)



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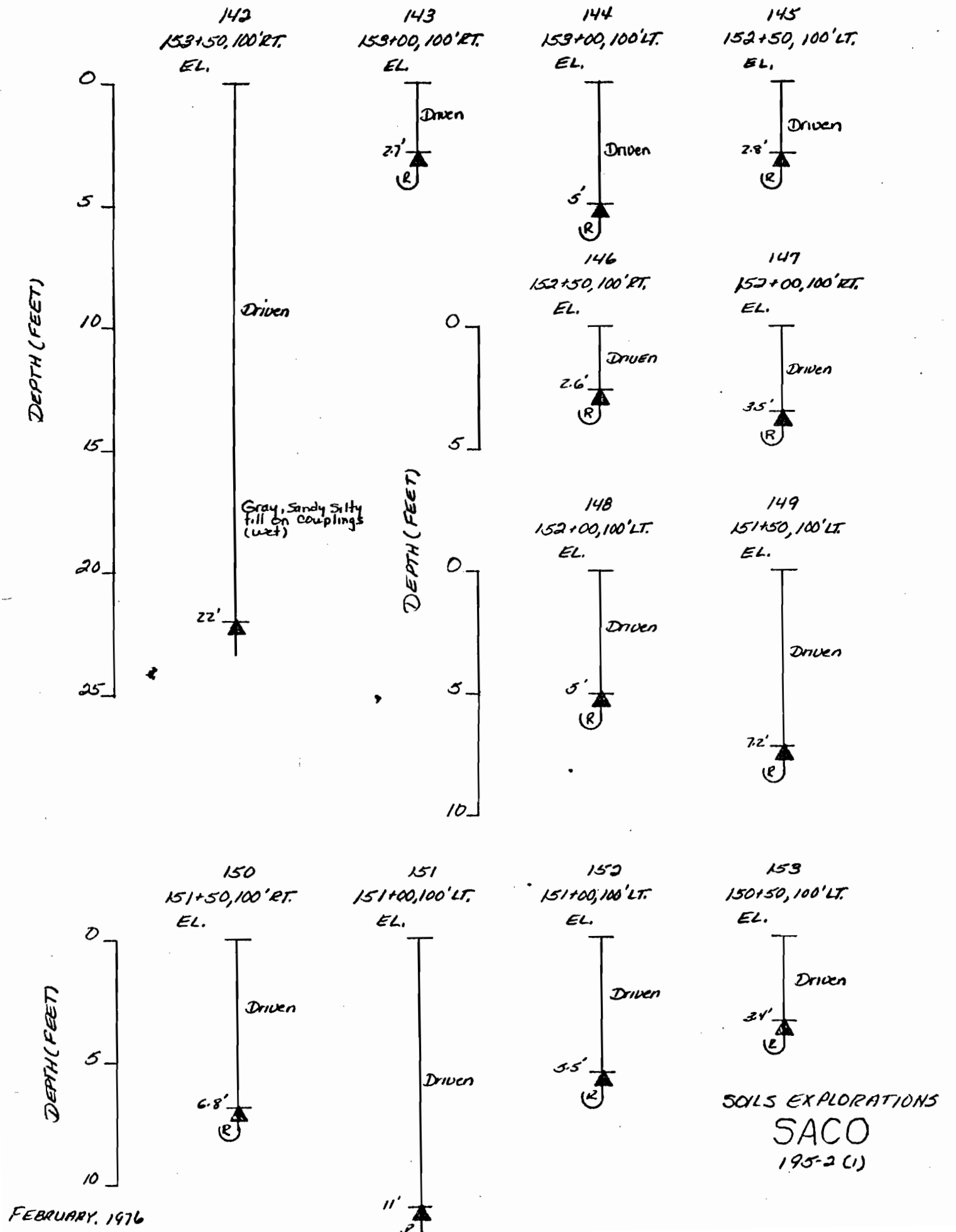
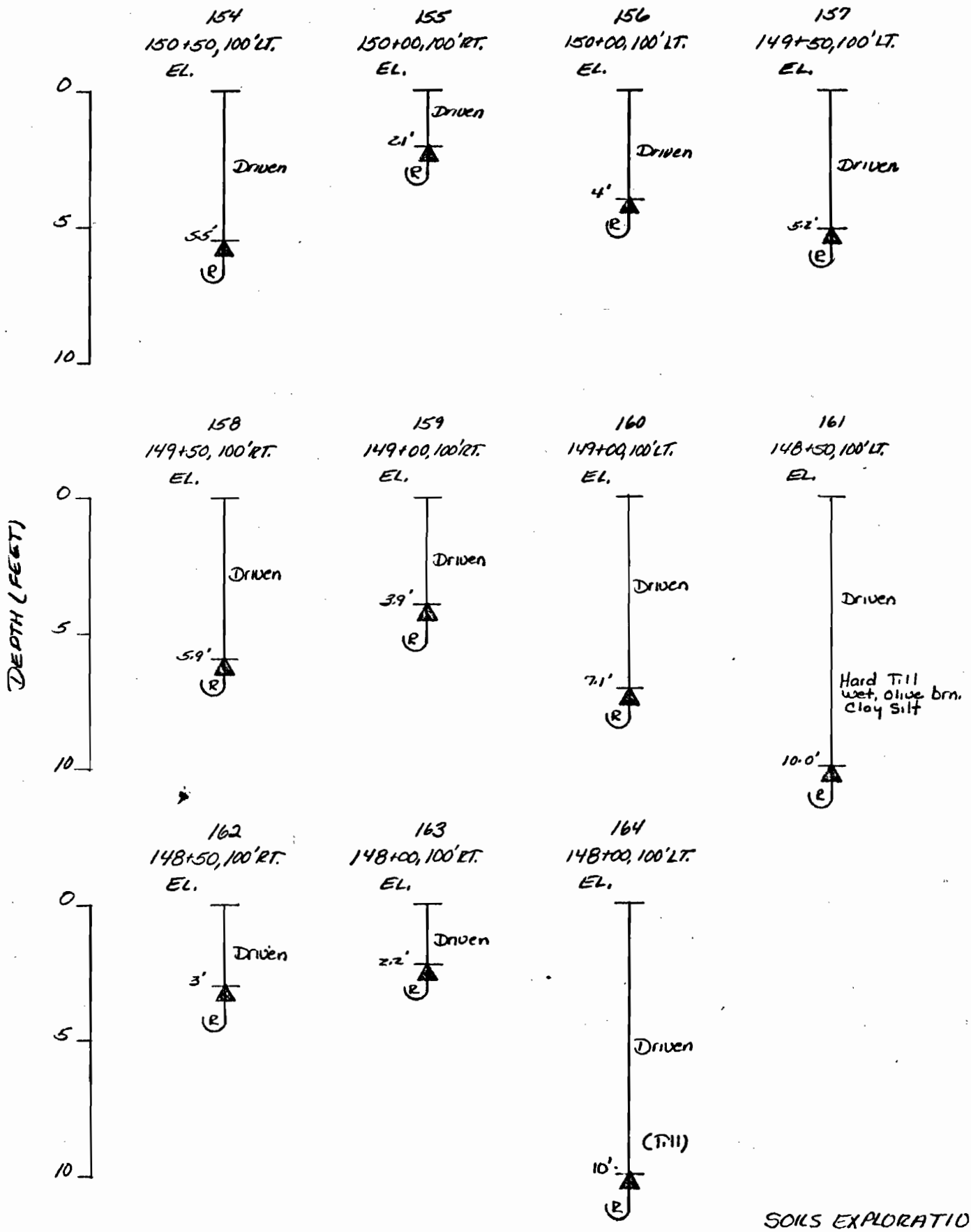
SOILS EXPLORATIONS
SACO
195-2 (1)



SOILS EXPLORATIONS
SACO
195-2 (1)

FEBRUARY, 1976

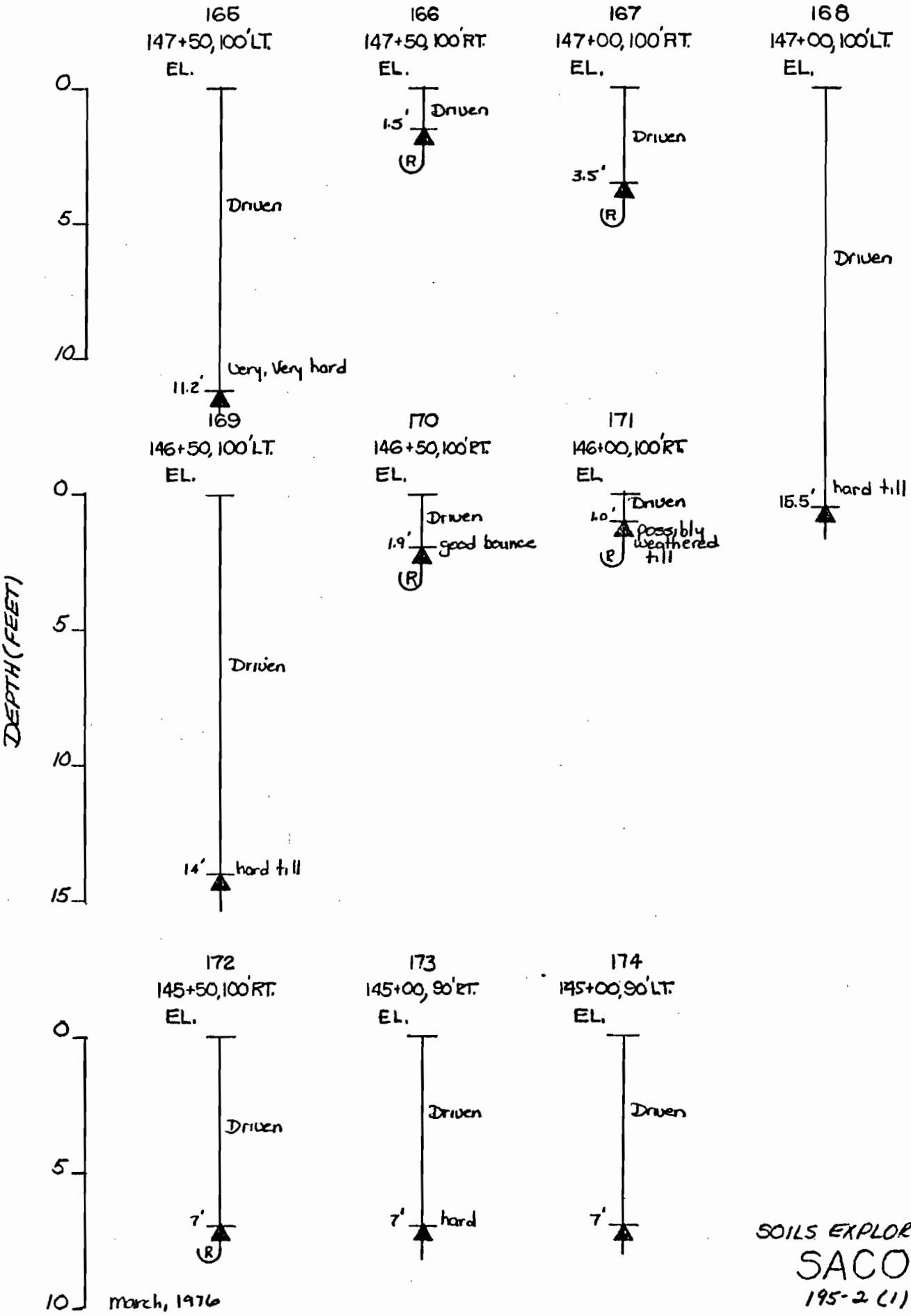
EXPLORATIONS 154-164



FEBRUARY, 1976

SOILS EXPLORATIONS
SACO
195-2 (1)

EXPLORATIONS 165-174

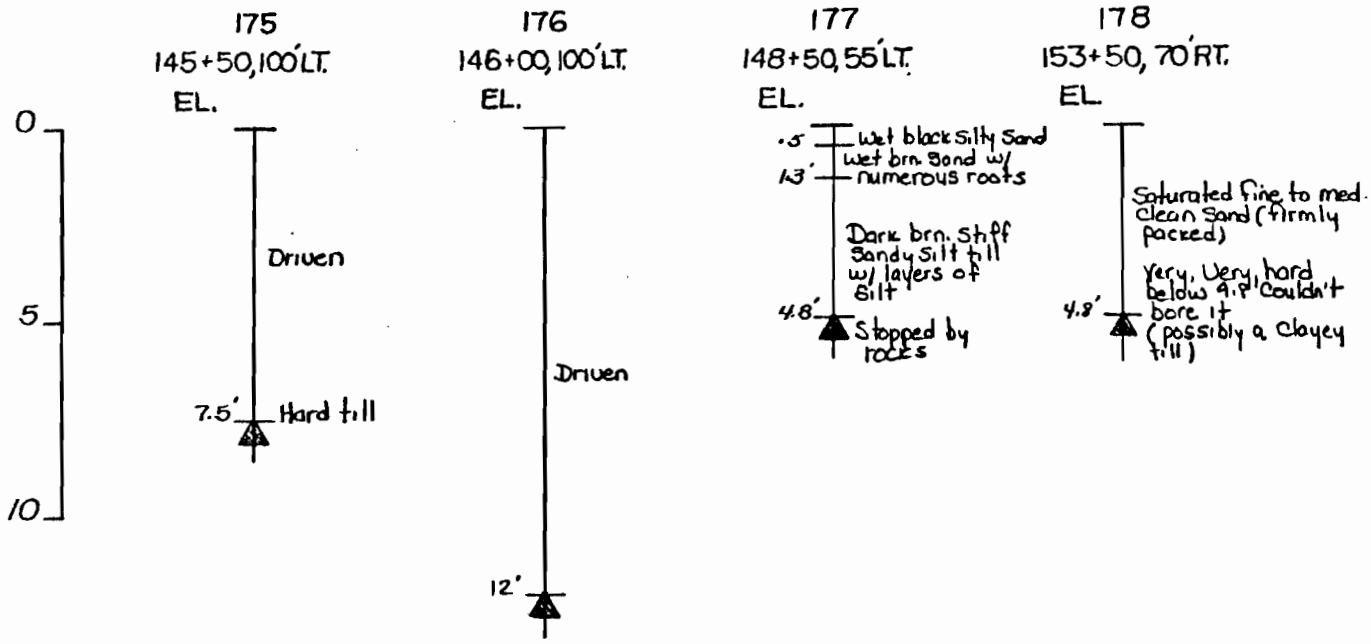


SOILS EXPLORATIONS

SACO

195-2 (1)

March, 1976



SOILS EXPLORATIONS
SACO
195-2 (1)

BORING NOTES

All samples and vanes are made ahead of casing

Water elevation

Number of blows required to drive extra heavy casing one foot with 400 ft. lbs. of energy per blow

Location of sample or sample attempt

Number and type of dry sample

1D 5 ¢ H Sampler # 1290's

1C 2" O.D. 16 ga. seamless tubing

1U 3½" O.D 16 ga. seamless tubing

1W Wash sample and number

MD Unsuccessful sample attempt and type of sampler

Number of blows required to drive spoon or tubing one foot with 350 ft. lbs. of energy per blow

H Sampling spoon or seamless tubing driven by static weight of drill rods and hammer

P Piston sampler

Field vane test

Bottom of boring (may not be bottom of soil strata)

Refusal of drill rods or casing (may not be ledge)

71% Locations cored by diamond bit and per cent recovery of rock

SHEAR NOTES

● Field vane shear strengths

X Laboratory vane shear strengths

→ Shear strengths in excess of capacity of equipment

O One half unconfined compressive strengths

WATER CONTENT NOTES

O Natural water contents, given as per cent of dry weight

●--X Plastic and liquid limits

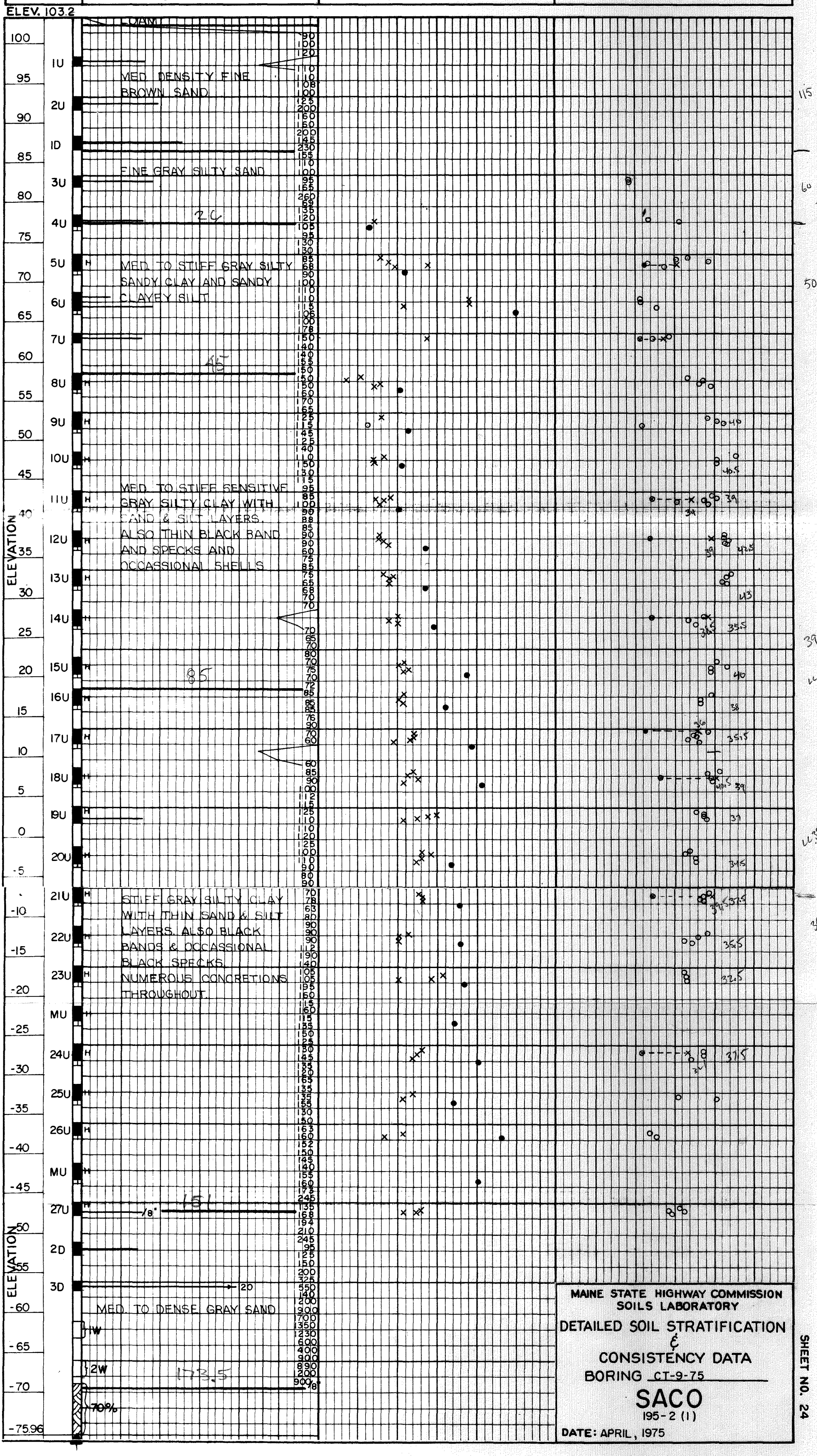
Ignition losses are given as per cent of dry weight

SML-201(9-62)

BORING CT-9-75 STATION 98+80, 75' RT.

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40

ELEV. 103.2



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-9-75

SACO

195-2 (1)

DATE: APRIL, 1975

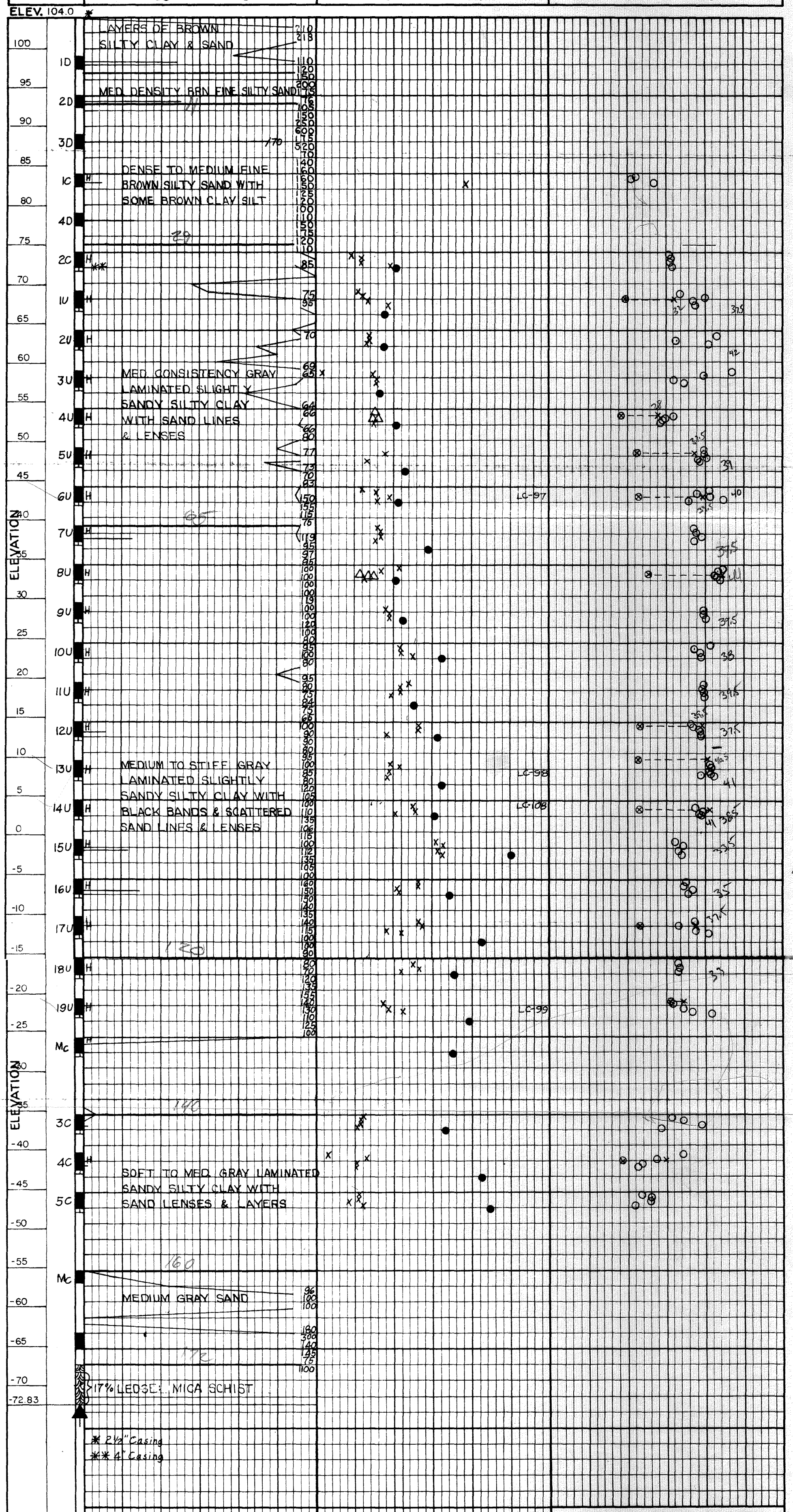
SHEET NO. 24

SML-201(9-62)

BORING CT-60 (73) STATION 100+00 2'LT.

CASING SIZE 2½ & 4"	DRIVING RESISTANCE Blows/Ft. 20 40	VANE SHEAR STRENGTH Tons/Sq.Ft. 0.4 0.8	WATER CONTENT Percent 20 40

ELEV. 104.0



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-60

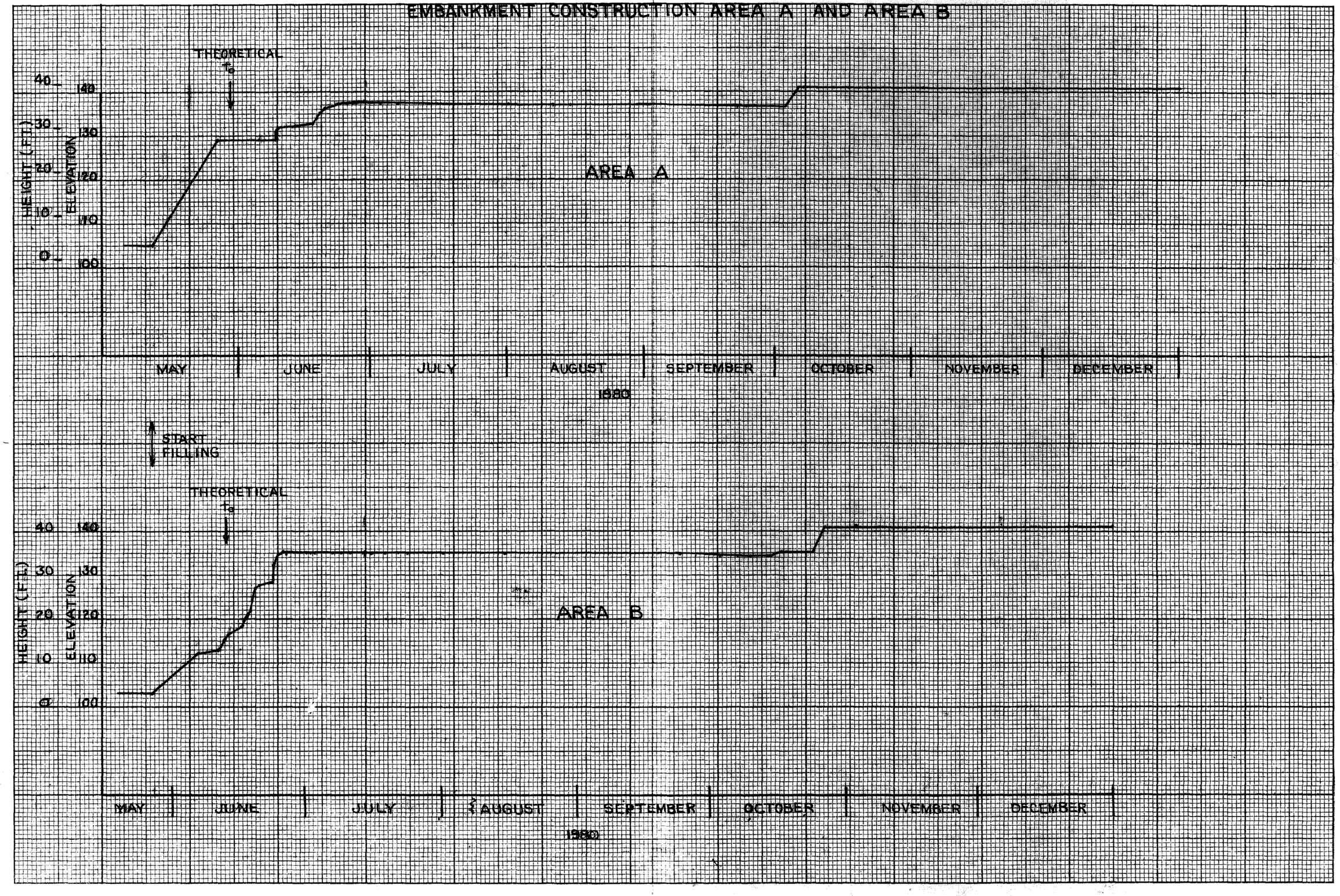
SACO

195-2(1)

DATE: NOV. 1973

SHEET NO. 25

EMBANKMENT CONSTRUCTION AREA A AND AREA B



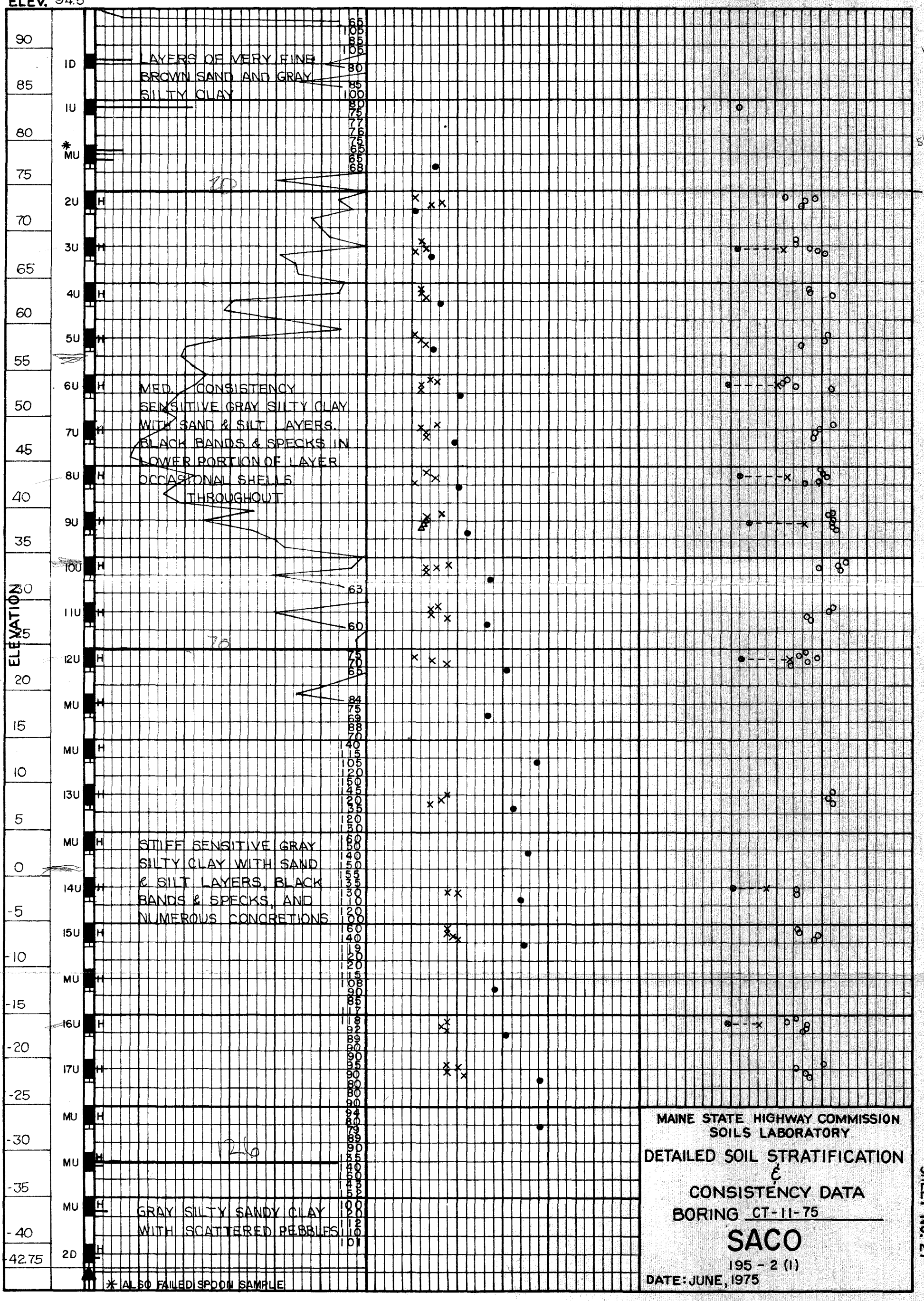
K+E 20 X 20 TO THE INCH 47 1242
10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

SML-201(9-62)

BORING CT-11-75 STATION 104+50, ℄

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40

ELEV. 94.5



* ALSO FAILED SPOON SAMPLE

MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

BORING CT-11-75

SACO

195 - 2 (1)

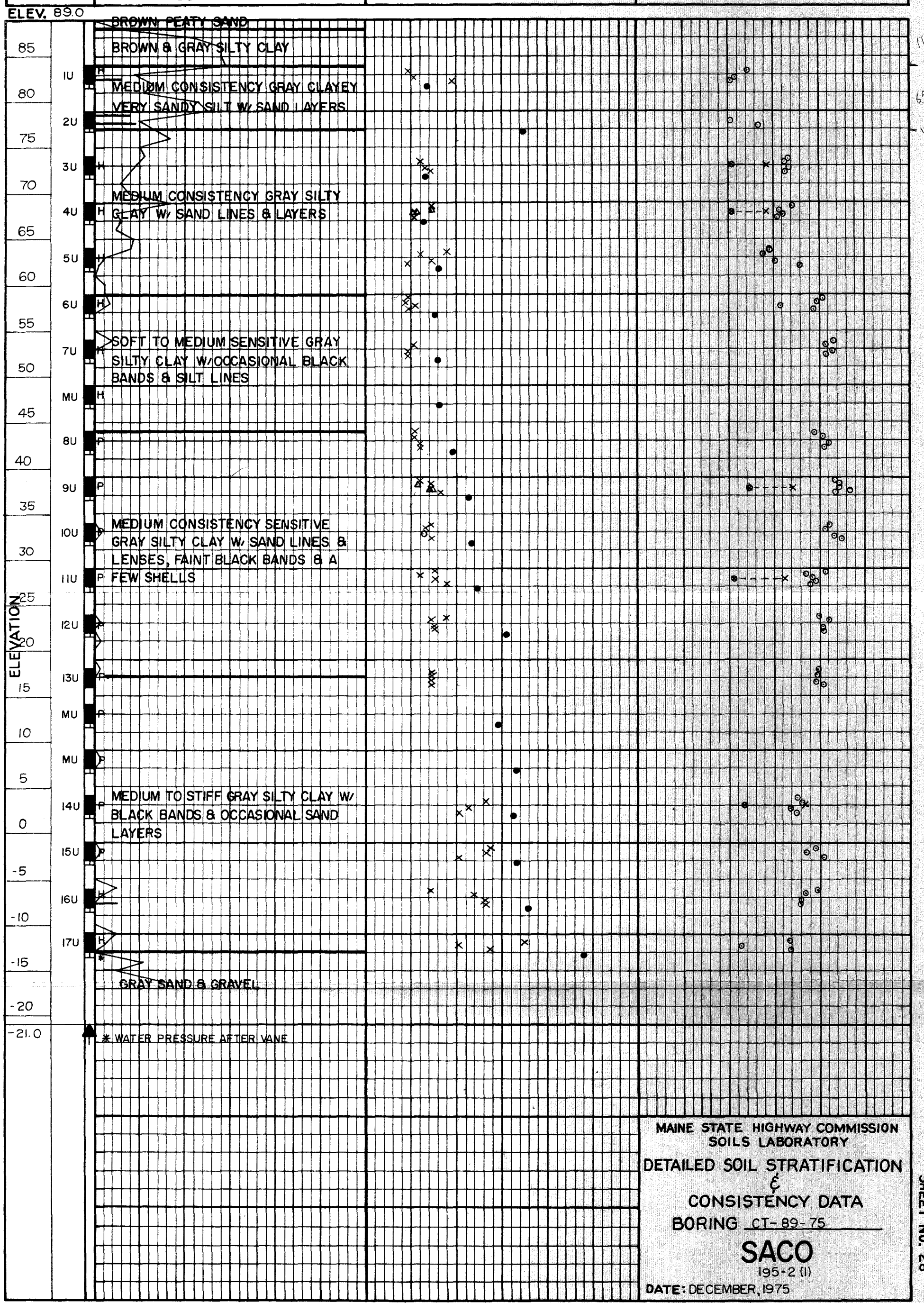
DATE: JUNE, 1975

SHEET NO. 27

SML-201(0-62)

BORING CT-89-75 STATION 108+00, 60' RT.

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-89-75

SACO

195-2 (1)

DATE: DECEMBER, 1975

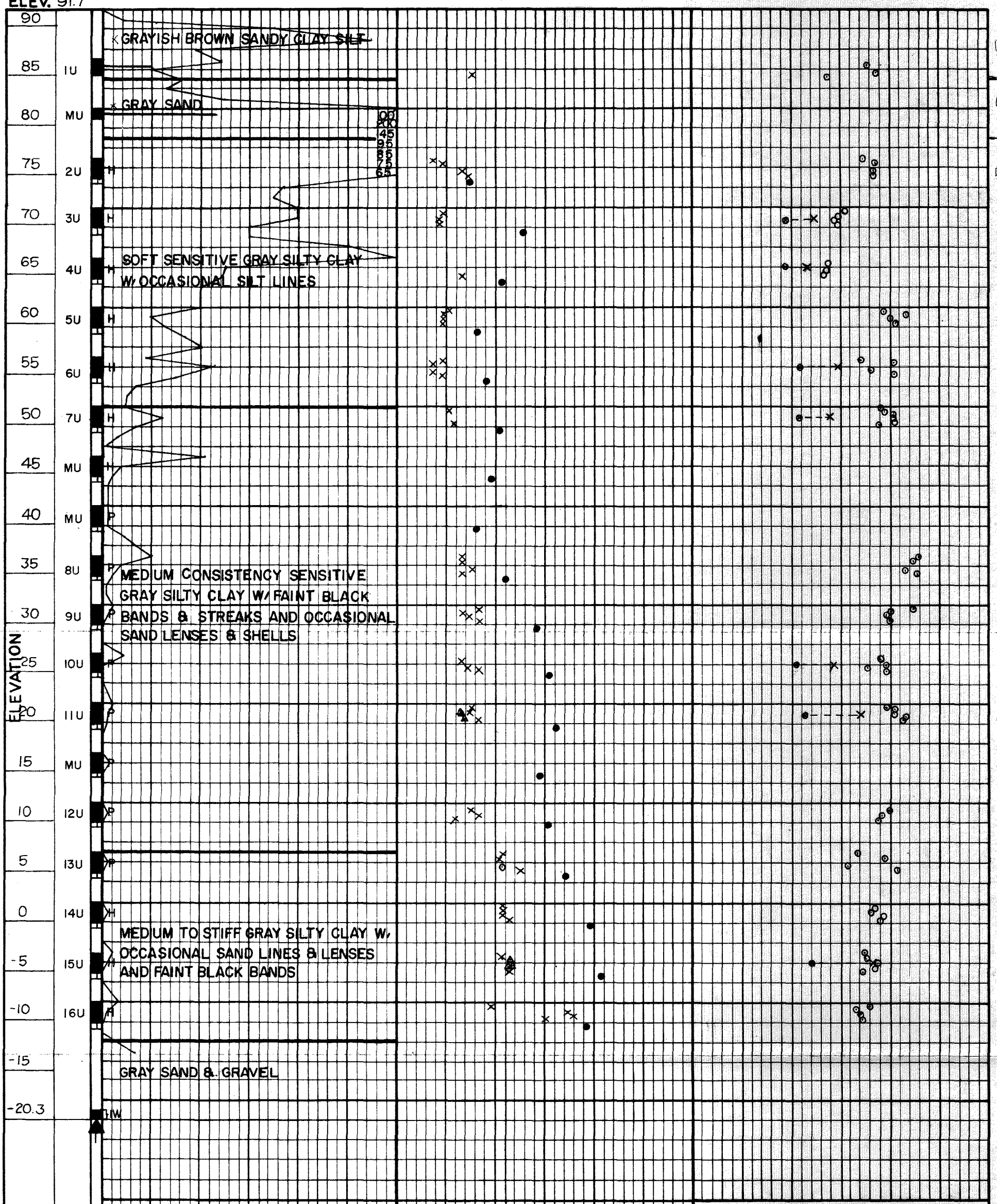
SHEET NO. 28

SML-201 (9-62)

BORING CT-90-75 STATION 108+00, 60' LT

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40

ELEV. 91.7



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-90-75

SACO

195-2 (1)

DATE: DECEMBER, 1975

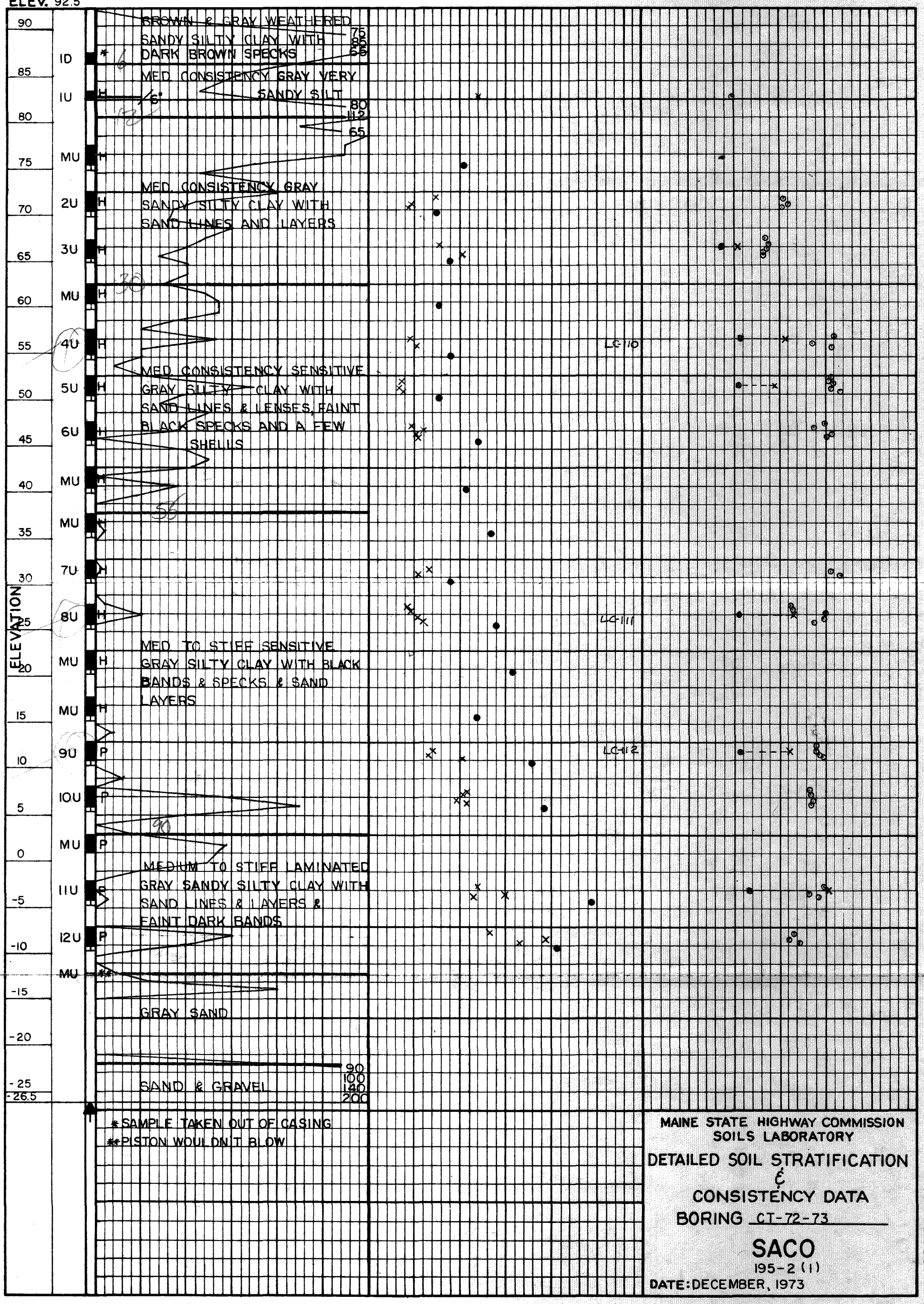
SHEET NO. 29

SML-201(9-62)

BORING CT-72-73 STATION 108 + 08 ℄

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40

ELEV. 92.5



*SAMPLE TAKEN OUT OF CASING
**PISTON WOULDN'T BLOW

MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

BORING CT-72-73

SACO
195-2 (1)

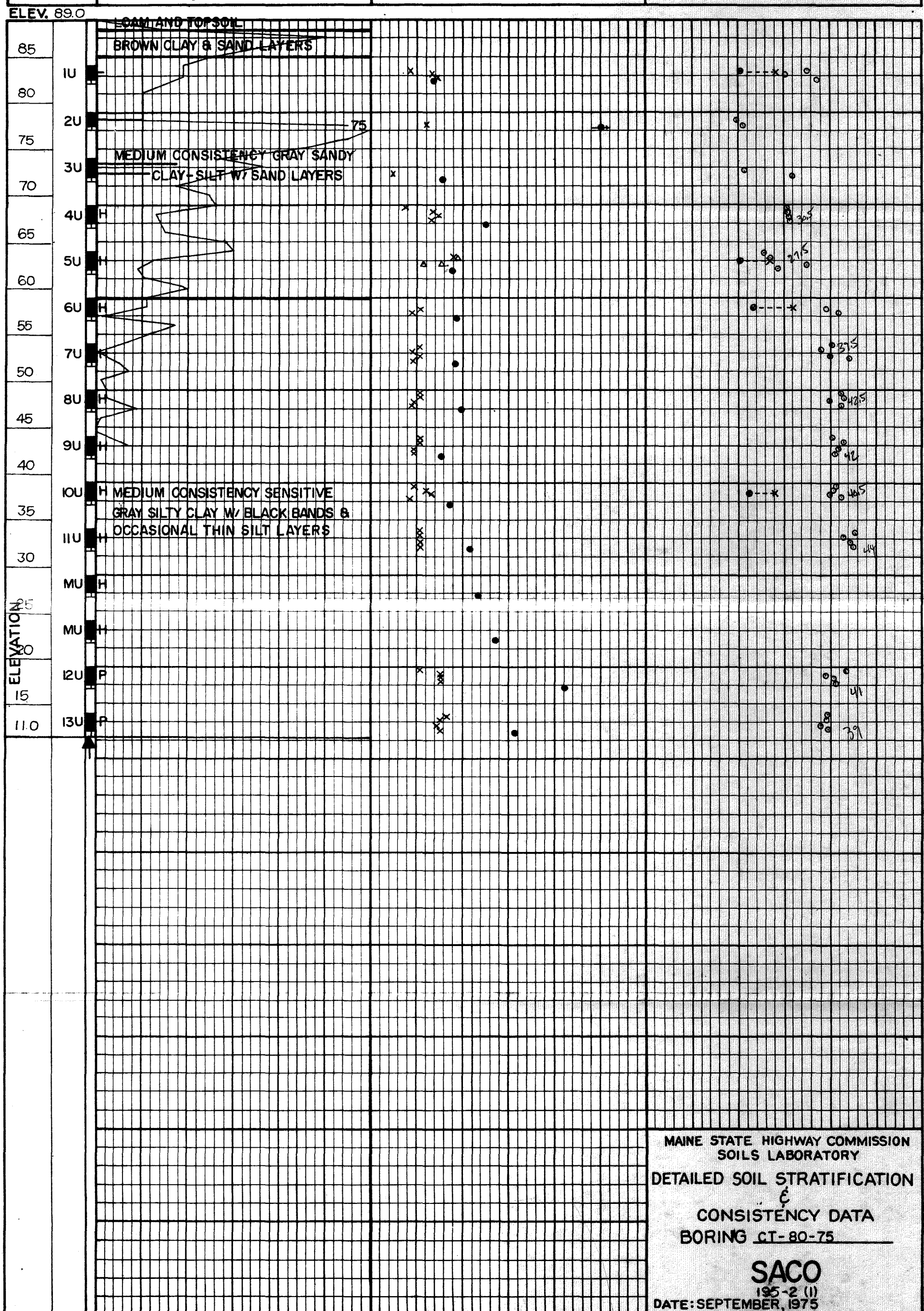
DATE: DECEMBER, 1973

SHEET NO. 30

SML-201(9-62)

BORING CT-80-75 STATION 111+00 ℄

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-80-75

SACO

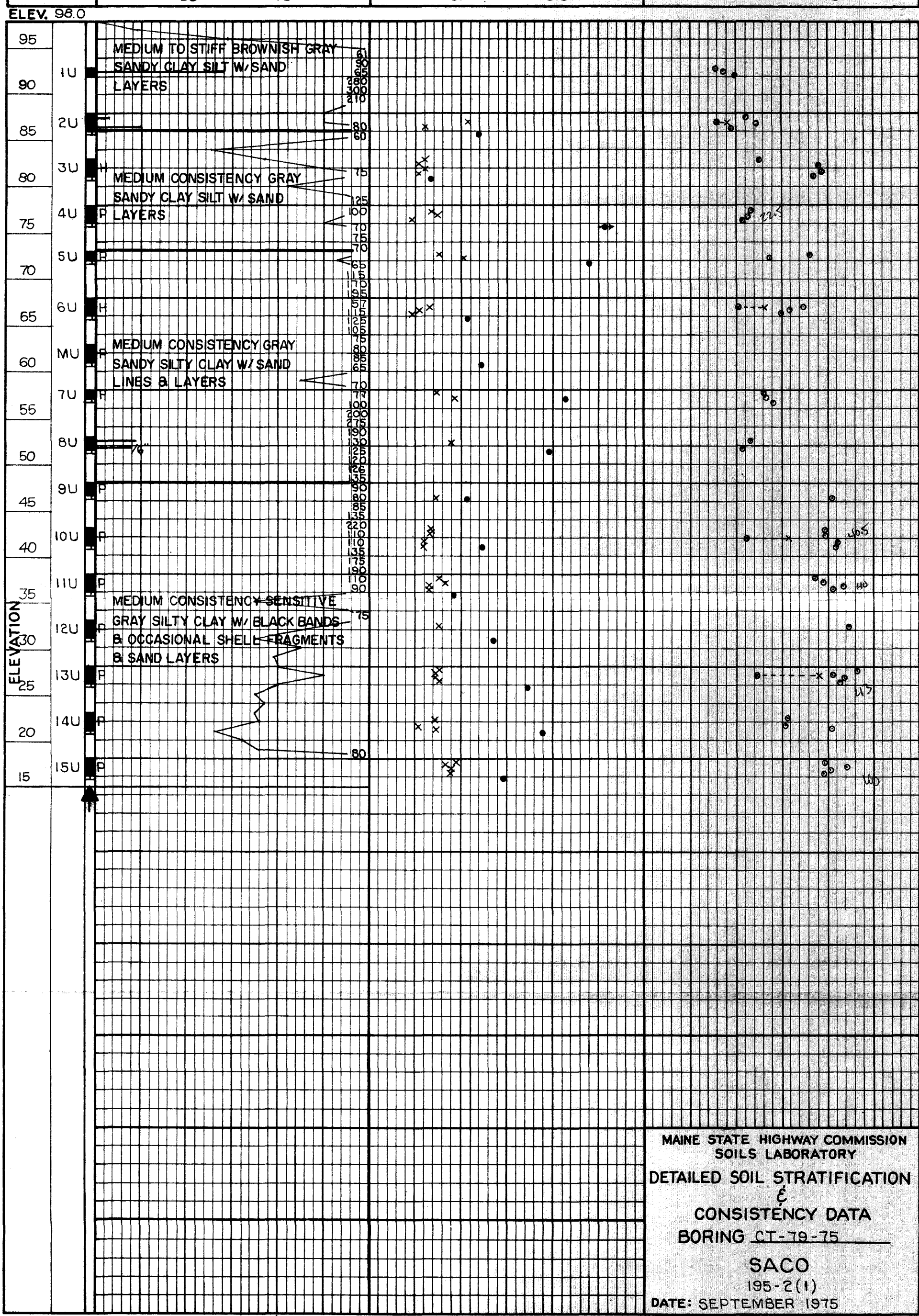
195-2 (1)

DATE: SEPTEMBER, 1975

SHEET NO. 31

BORING CT-79 (75) STATION 114+00 ℄

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

BORING CT-79-75

SACO
195-2(1)

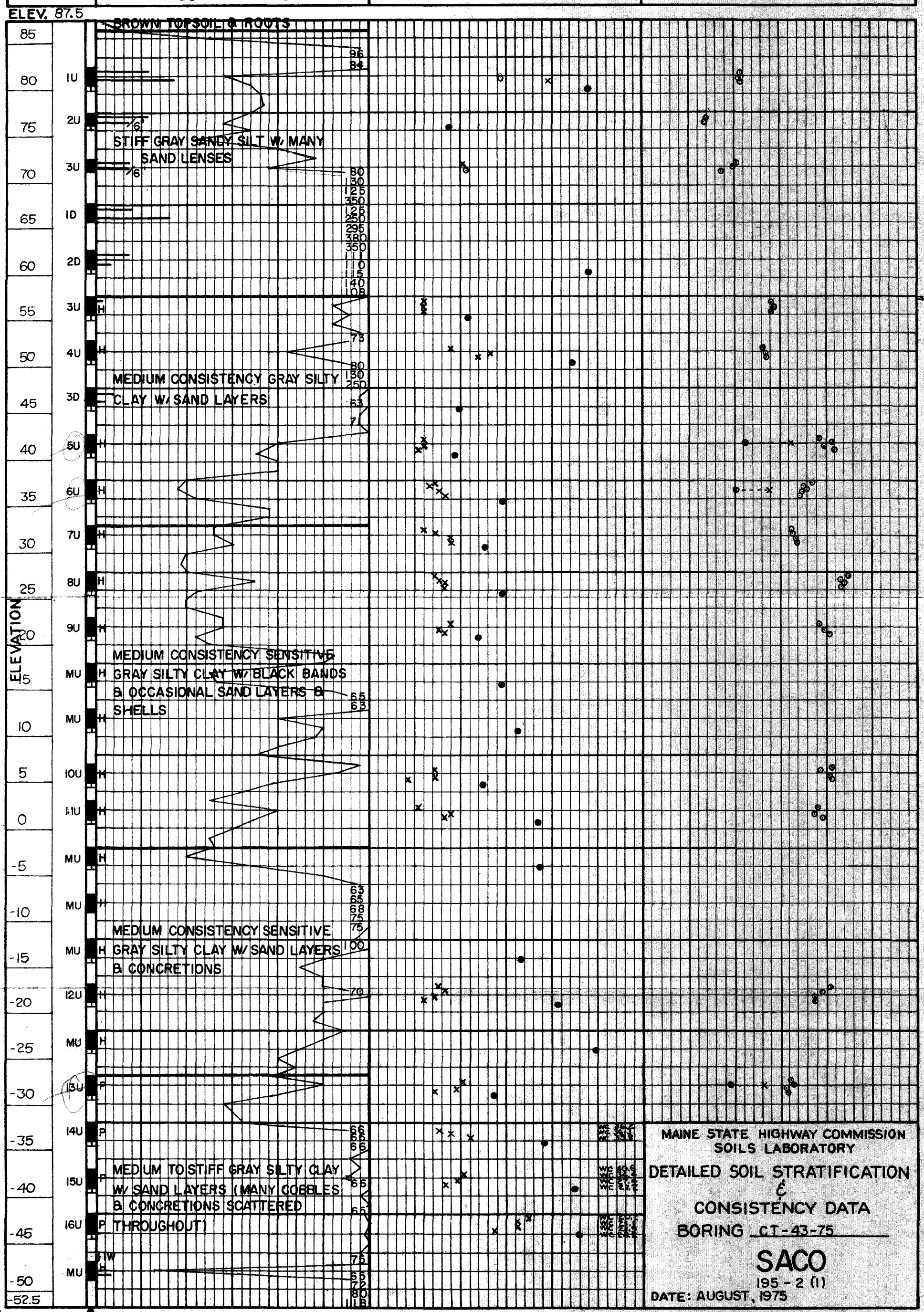
DATE: SEPTEMBER 1975

SHEET NO. 32

SML-201(9-62)

BORING CT-43-75 STATION 117+40, 15' LT.

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-43-75

SACO

195 - 2 (1)

DATE: AUGUST, 1975

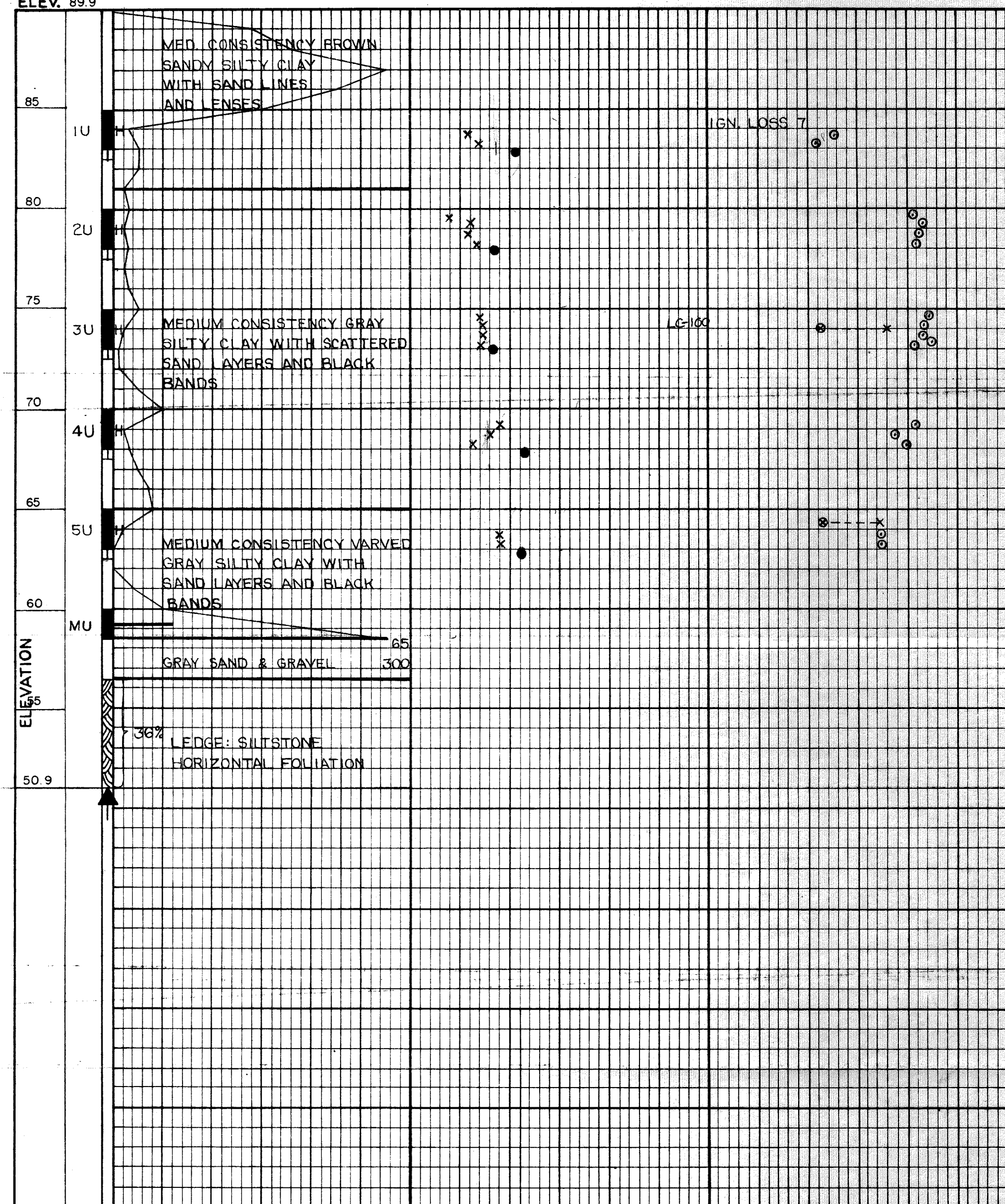
SHEET NO. 33

SML-201(9-62)

BORING CT-64 (73) STATION 124+00 ℄

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40

ELEV. 89.9



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-64-73

SACO

195-2(1)

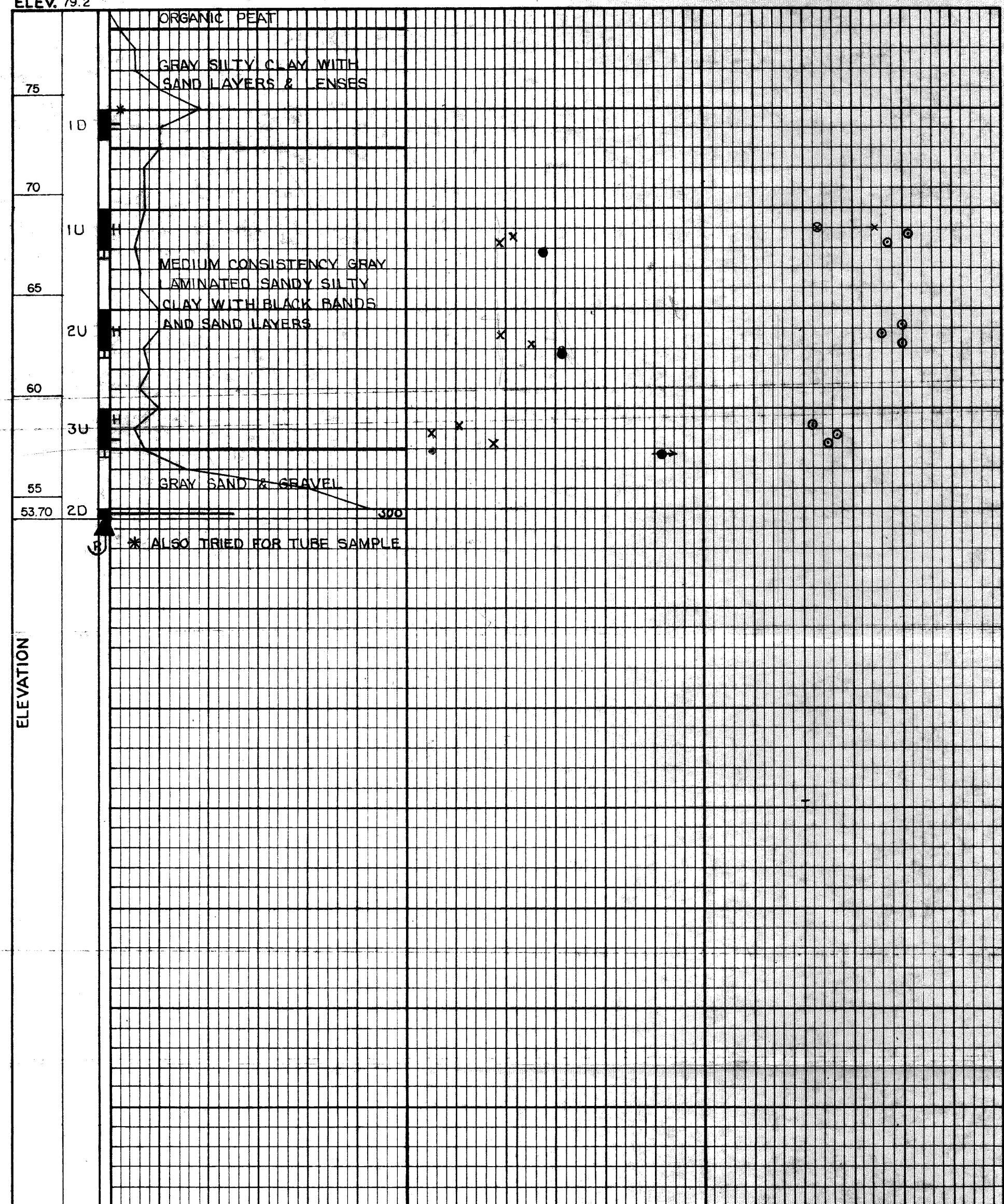
DATE: NOVEMBER 1973

SHEET NO. 34

SML-201(9-62)

BORING CT-65 (73) STATION 134+50 25' LT.

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-65-73

SACO
195-2(1)

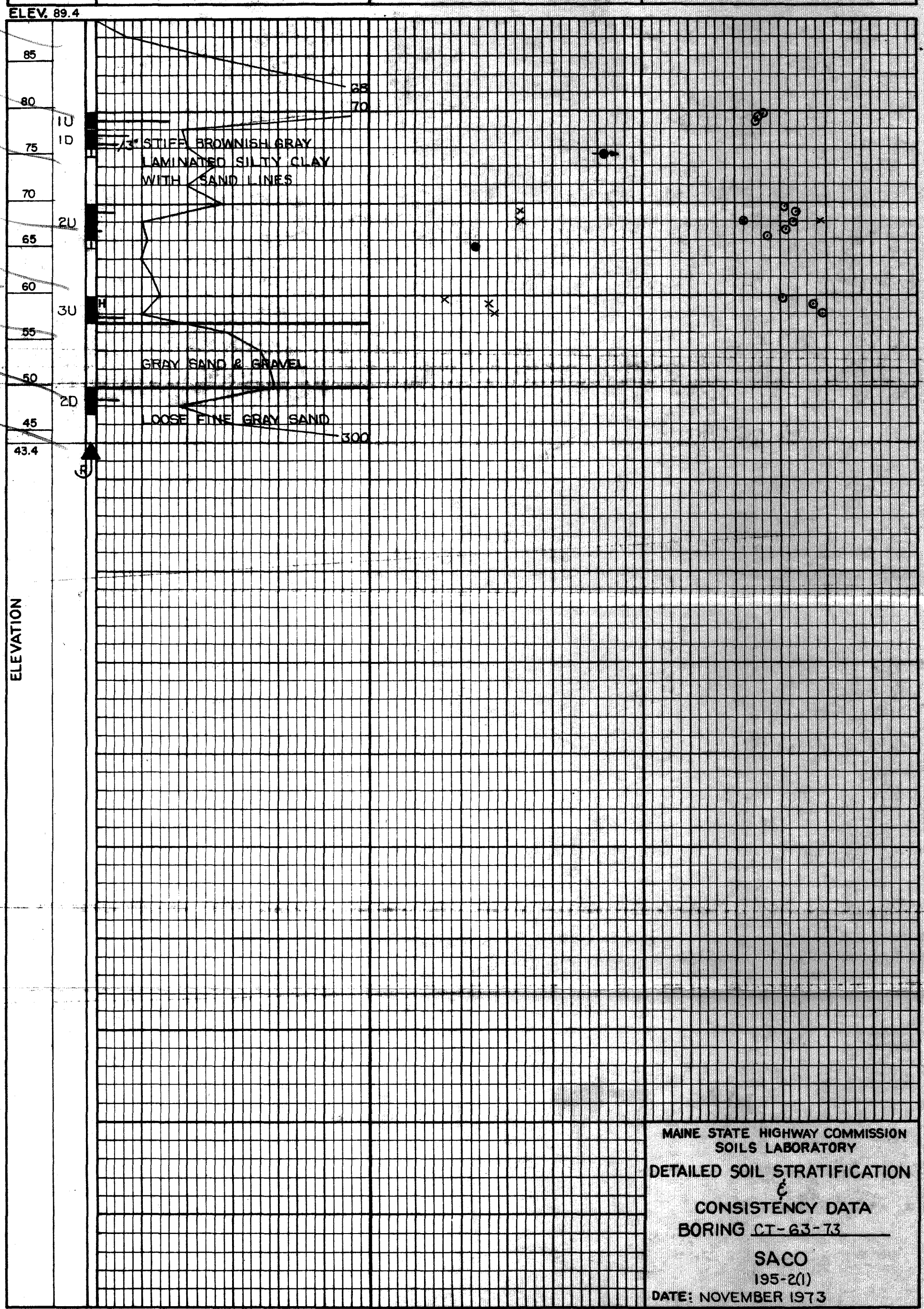
DATE: NOVEMBER 1973

SHEET NO. 35

SML-201(9-62)

BORING CT-63 (73) STATION 142+30 ℄

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-63-73

SACO

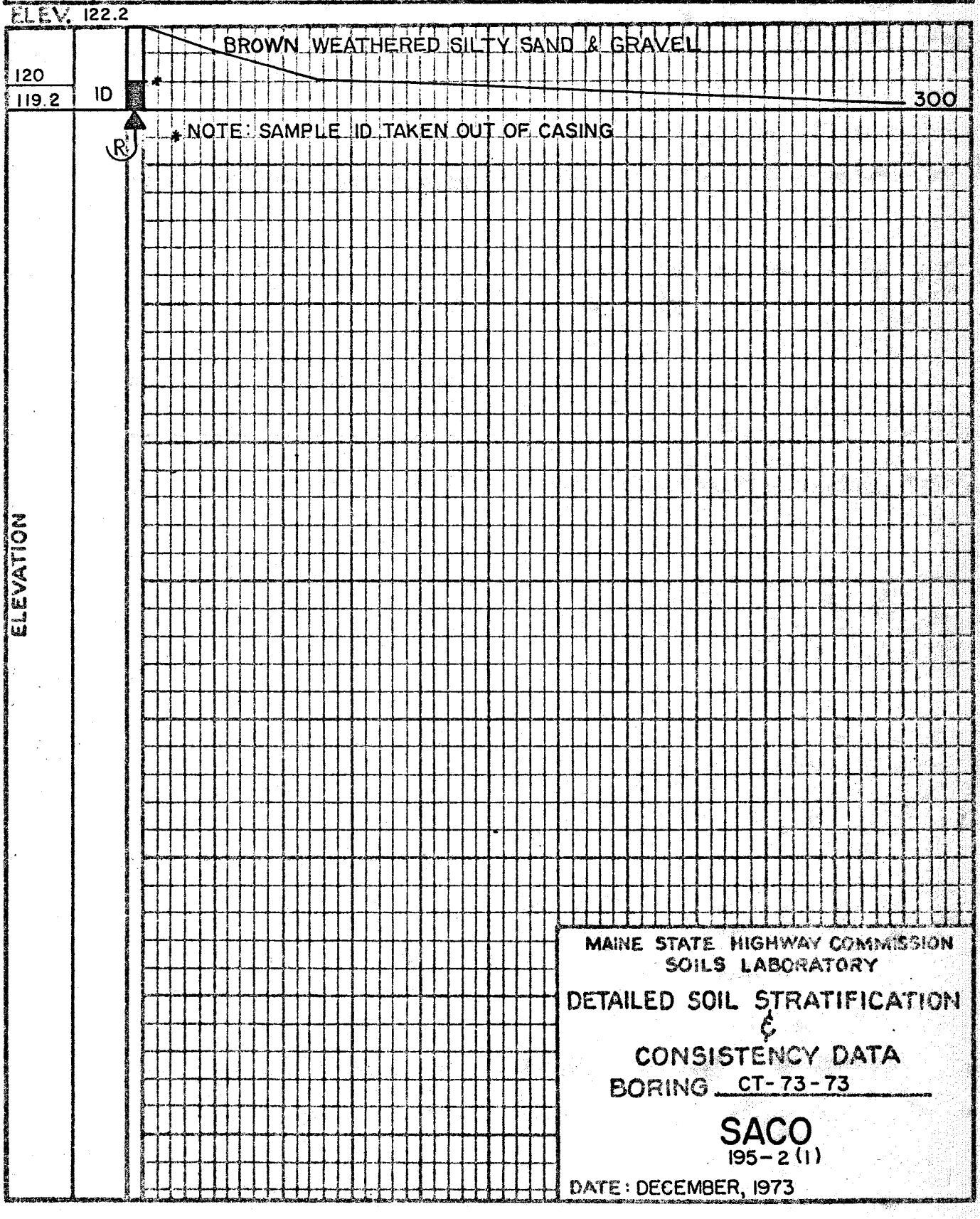
195-2(1)

DATE: NOVEMBER 1973

SHEET NO. 36

BORING CT-73-73 STATION 151+00, 4' LT.

CASING SIZE 2½"	DRIVING RESISTANCE — Blows/Ft.



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

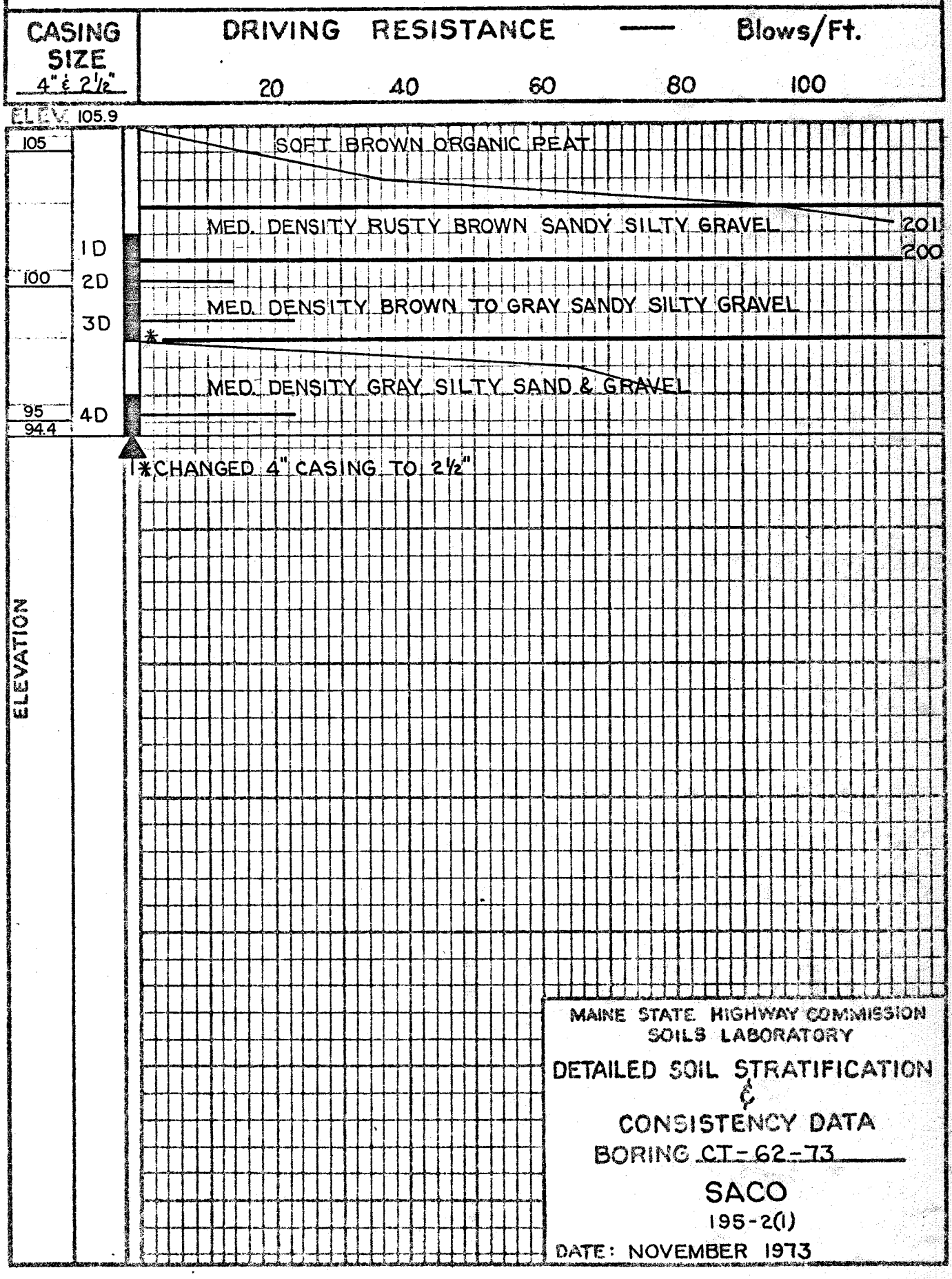
DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

BORING CT-73-73

SACO
195-2 (1)

DATE: DECEMBER, 1973

BORING CT-62(73) STATION 158+00 10' LT.



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

BORING CT-62-73

SACO
195-2(1)

DATE: NOVEMBER 1973

BORING CT-81-75 STATION 176+15 ℄

CASING SIZE 4"

DRIVING RESISTANCE — Blows/Ft.

20 40 60 80 100

ELEV. 100.0

LOAM

GRAY PEBBLY SILT

97.42 ID

150/5"

175

350/2"

(R)

ELEVATION

MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

BORING CT-81-75

SACO
195-2 (1)

DATE: SEPTEMBER, 1975

BORING CT-19(73) STATION 186+00 ℄

CASING SIZE 4"

DRIVING RESISTANCE —— Blows/Ft.

20 40 60 80 100

ELEV. 95.9

95

LOOSE GRAY CLAYEY SILTY SANDY GRAVEL — 145

90 — 1D

DENSE GRAY & BROWN SILTY PEBBLY SAND WITH SANDY SILTY CLAY — 150, 300

85 — 2D

82.4 — 3D — 3"

REFUSAL ON SPOON

BORING CT-20(73) STATION 181+50 ℄

CASING SIZE 2½"

ELEV. 102.5

100

MEDIUM DENSITY BROWN SAND & GRAVEL — 500

ELEVATION

95 — 1D

50%

LEDGE: GRAY PHYLLITE WITH QUARTZITE ZONES 30°-45° FOL. ANGLE

90

100%

85.75

BORING CT-21(73) STATION 195+50 ℄

CASING SIZE 2½"

ELEV. 81.2

80

BROWN & GRAY CLAY.

75 — 1D

MED. DENSITY FINE BROWN SILTY SAND

73.04

R

MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

BORING CT-19, 20, & 21

SACO

195-2(1)

DATE: JULY 1973

SML-201(3-62)

BORING CT-83 (75) STATION 202+00 15'LT.

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40

ELEV. 68.0

65

60

55.33

1U

2U

R

LOAM

HARD GRAYISH BROWN SLIGHTLY SANDY SILT W/ OCCASIONAL THICK SAND LAYERS

GRAYISH BROWN PEBBLY SILTY SAND

15
210
200
185
75
85
100
140
200

MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

BORING CT-83-75

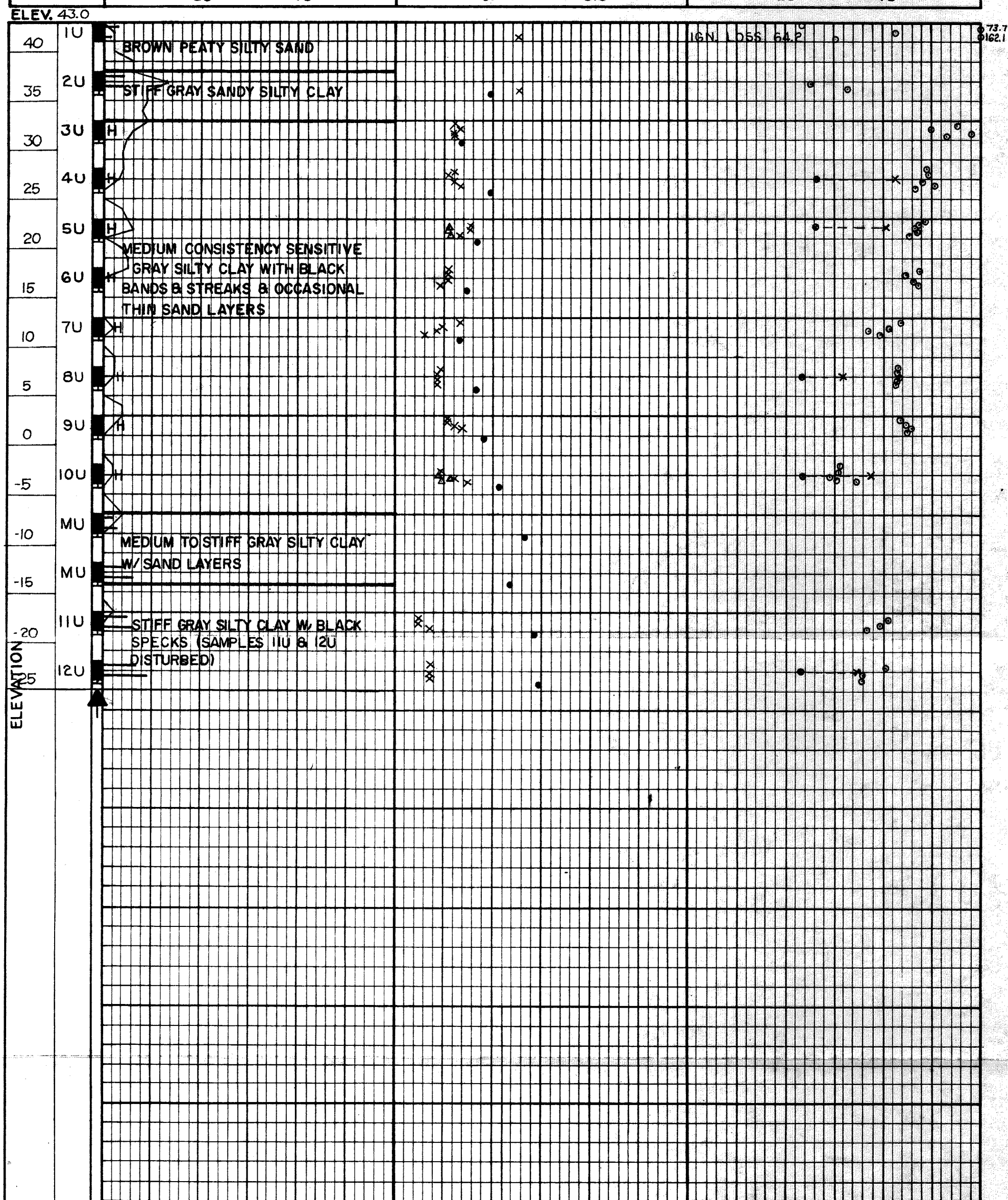
SACO
195-2(1)

DATE: SEPTEMBER 1975

SHEET NO. 41

BORING CT-86(75) STATION 214+45 75' LT.

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-86-75

SACO
195-2(1)

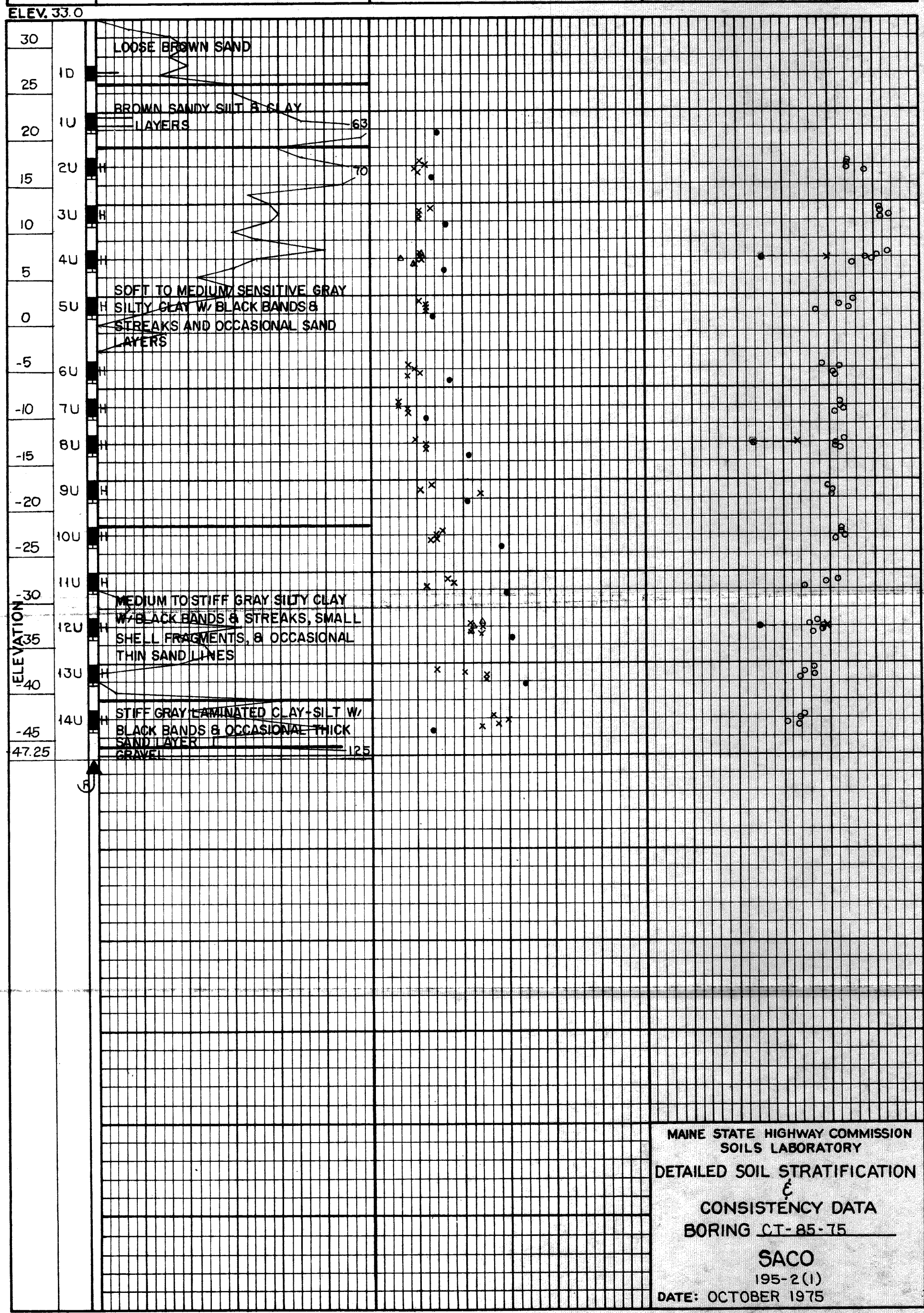
DATE: OCTOBER 1975

SHEET NO. 42

SML-201(9-62)

BORING CT-85(75) STATION 214+80 75'RT.

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-85-75

SACO

195-2(1)

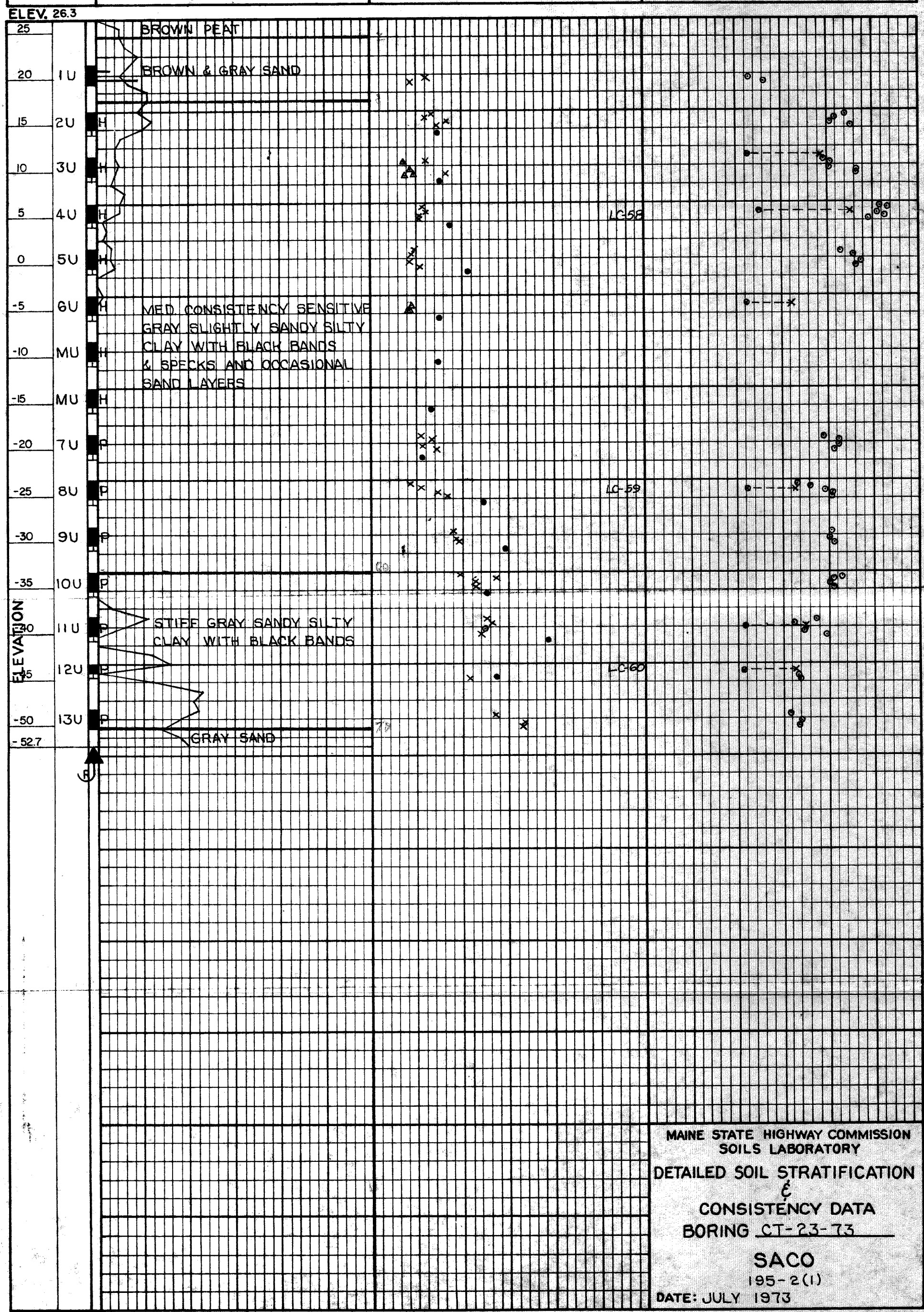
DATE: OCTOBER 1975

SHEET NO. 43

SML-201(9-62)

BORING CT-23 (73) STATION 214+90 ℄

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

BORING CT-23-73

SACO
195-2(1)

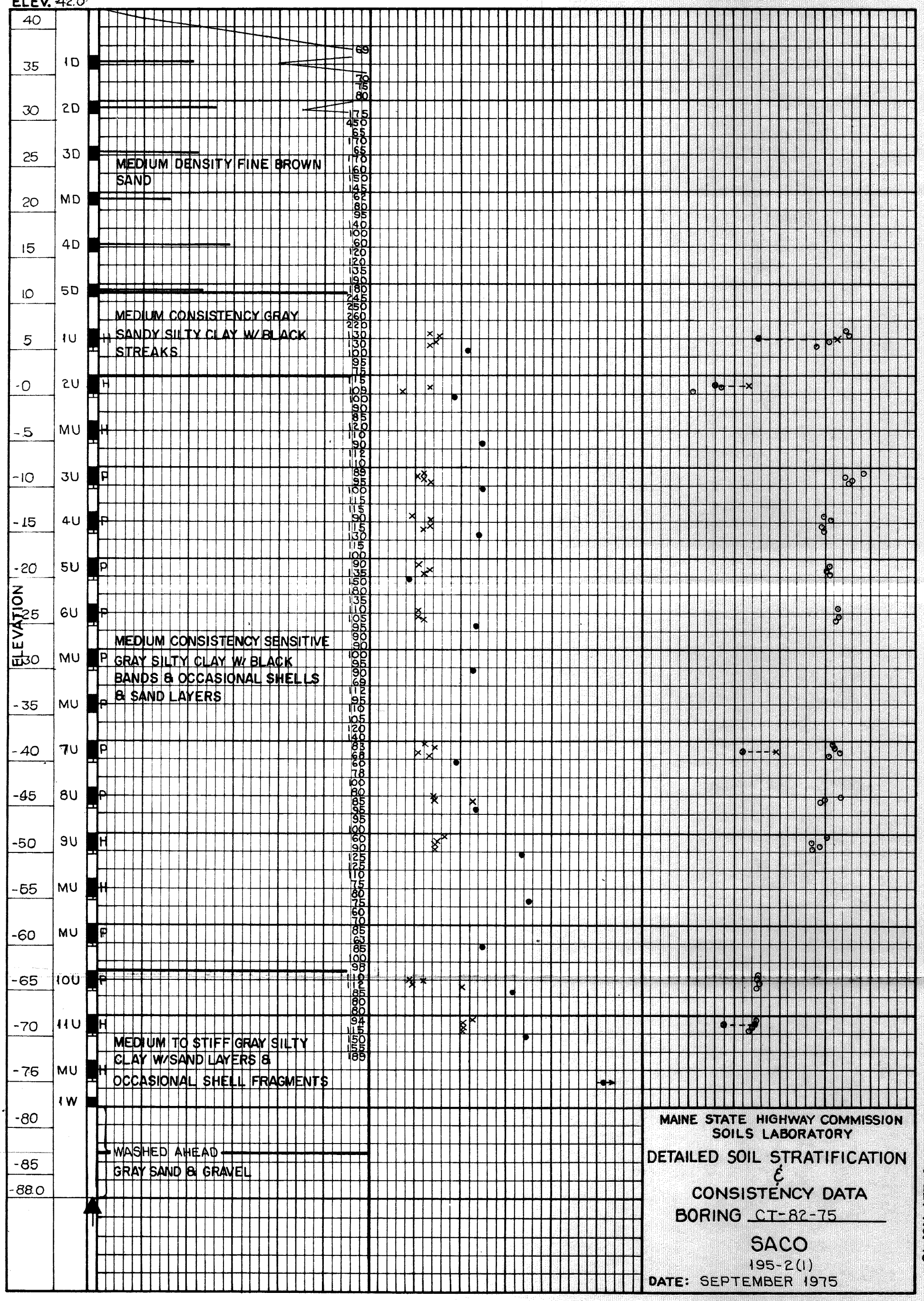
DATE: JULY 1973

SHEET NO. 44

SML-201(9-62)

BORING CT-82(75) STATION 219+00 ℄

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

BORING CT-82-75

SACO

195-2(1)

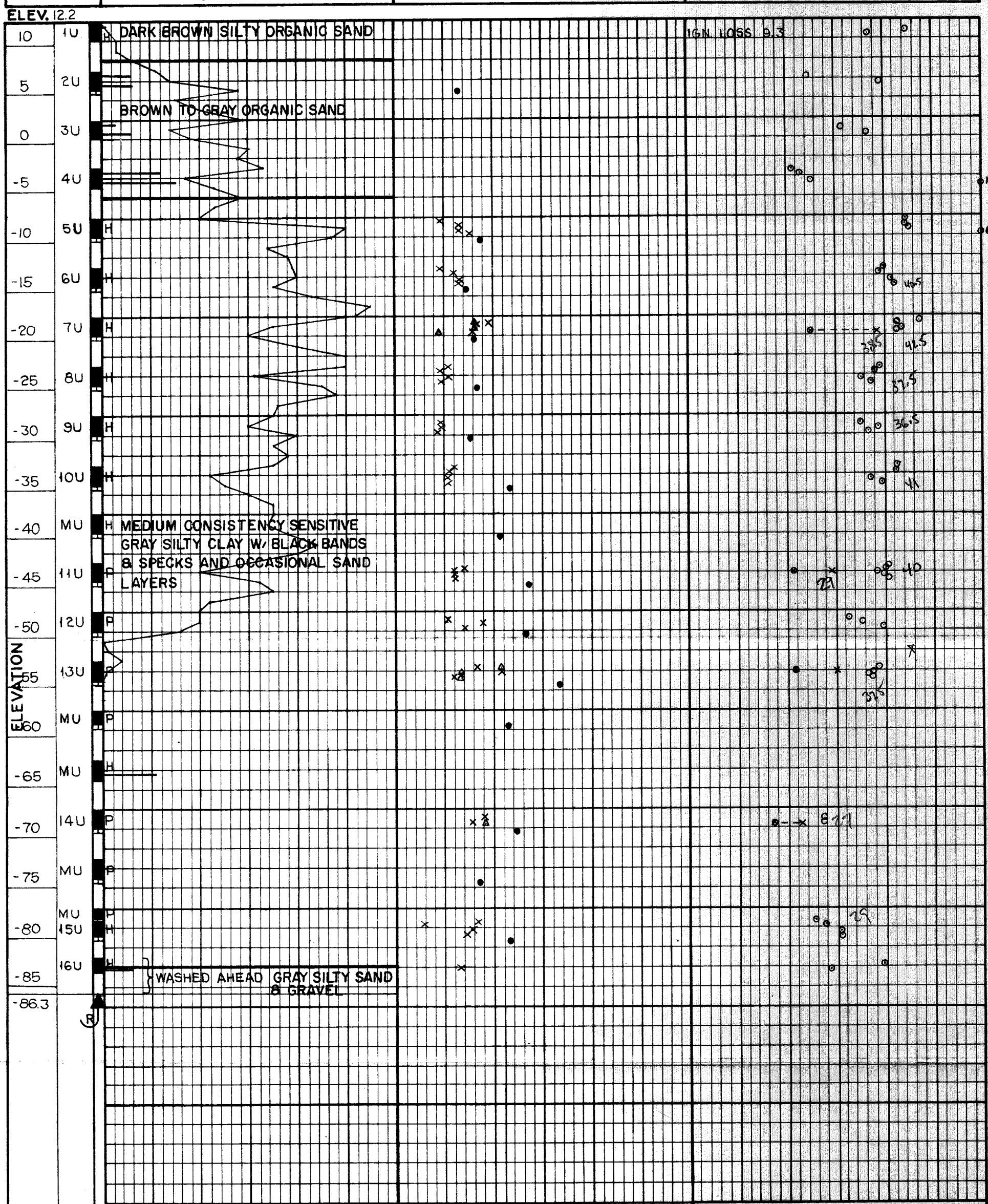
DATE: SEPTEMBER 1975

SHEET NO. 45

SML-201(9-62)

BORING CT-84 (75) STATION 227+42 80' LT.

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

BORING CT-84-75

SACO

195-2(1)

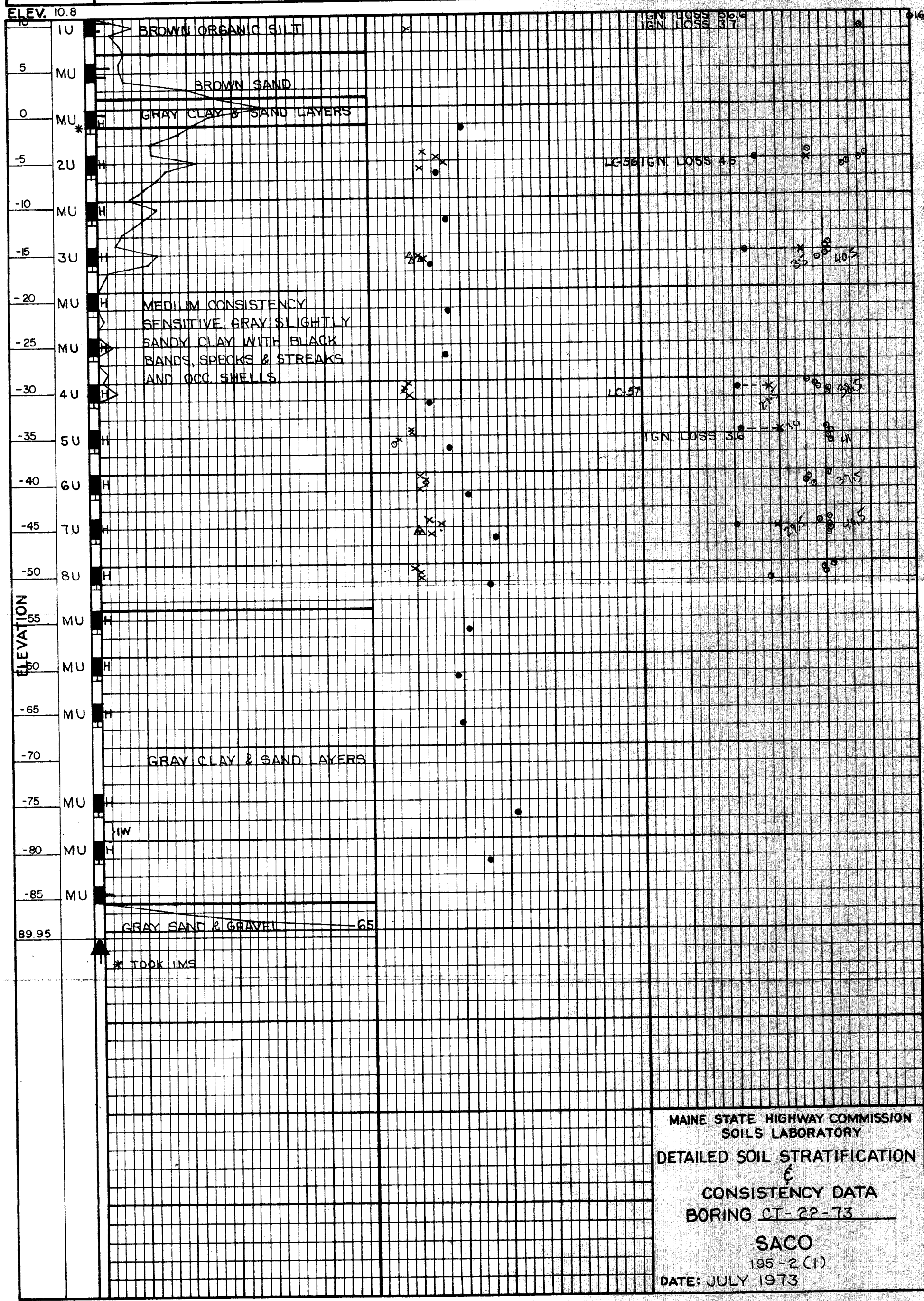
DATE: OCTOBER 1975

SHEET NO. 46

SML-201(9-62)

BORING CT-22 (73) STATION 227+50 ℄

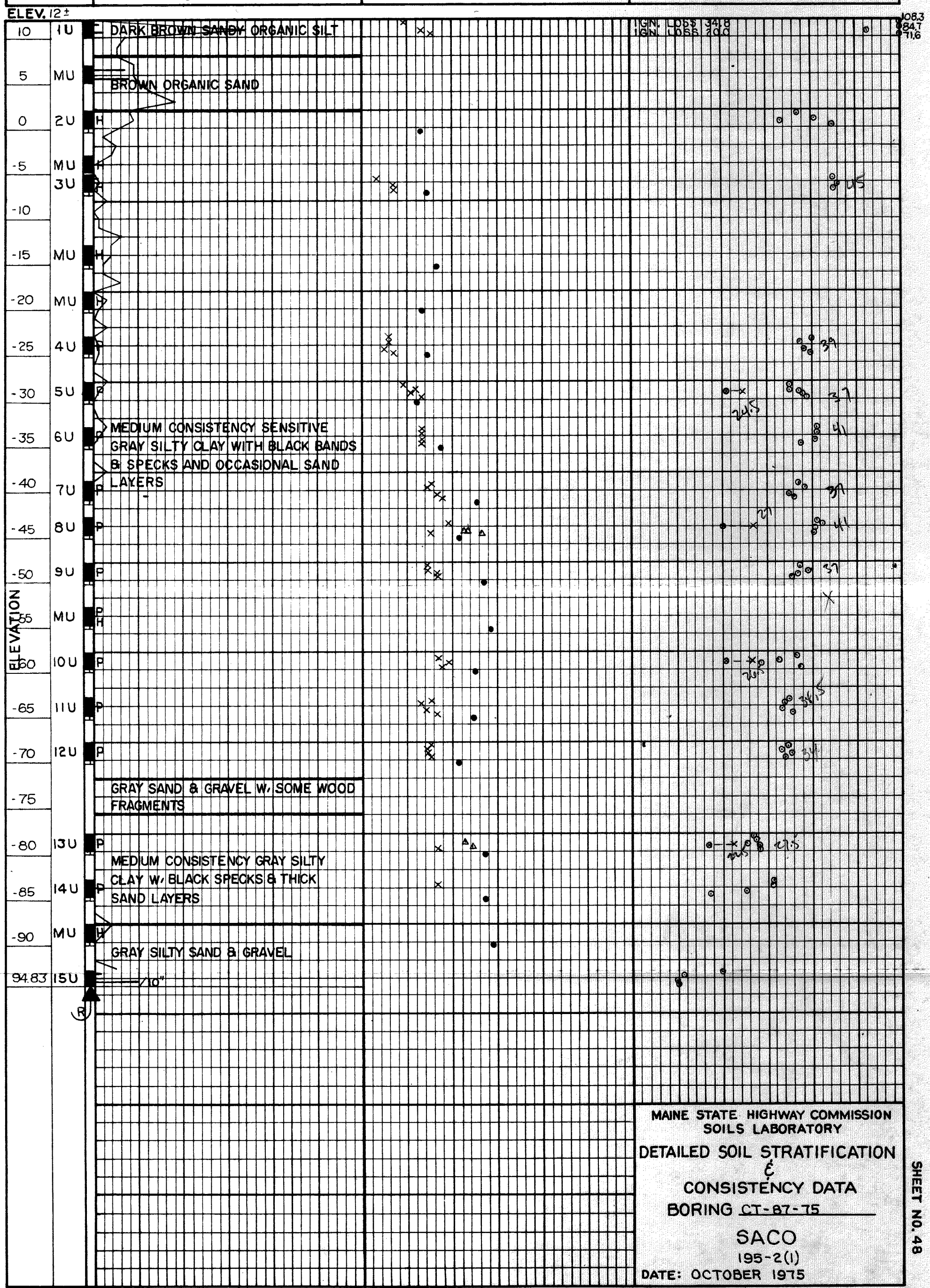
CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40



SML-201(9-62)

BORING CT-87 (75) STATION 227+50 172'LT.

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4"	20 40	0.4 0.8	20 40

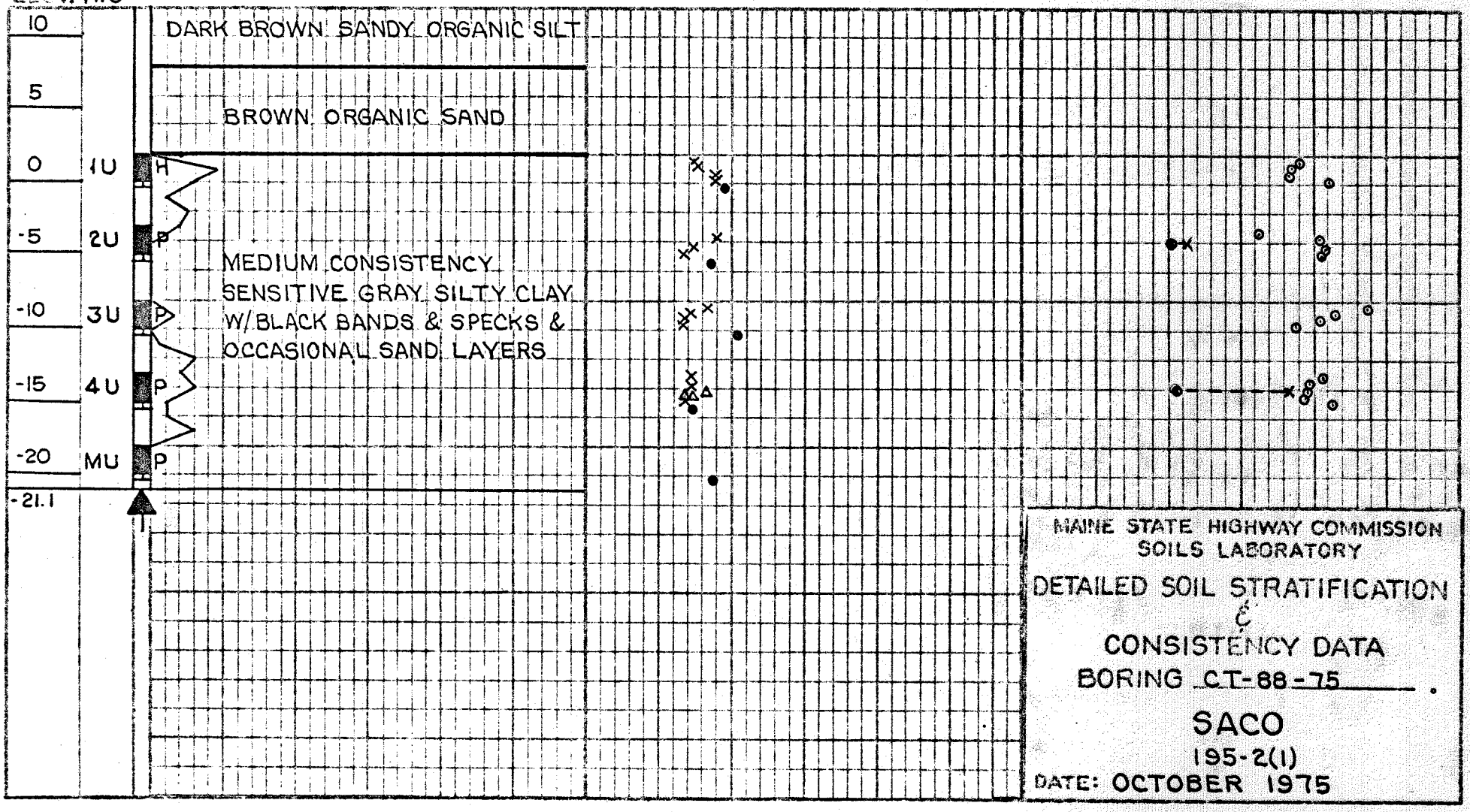


SHEET NO. 48

SML-201(9-62)

BORING CT-88 (75) STATION 227+50 170' LT.

CASING SIZE	DRIVING RESISTANCE Blows/Ft.	VANE SHEAR STRENGTH Tons/Sq.Ft.	WATER CONTENT Percent
4	20 40	0.4 0.8	20 40



MAINE STATE HIGHWAY COMMISSION
SOILS LABORATORY

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

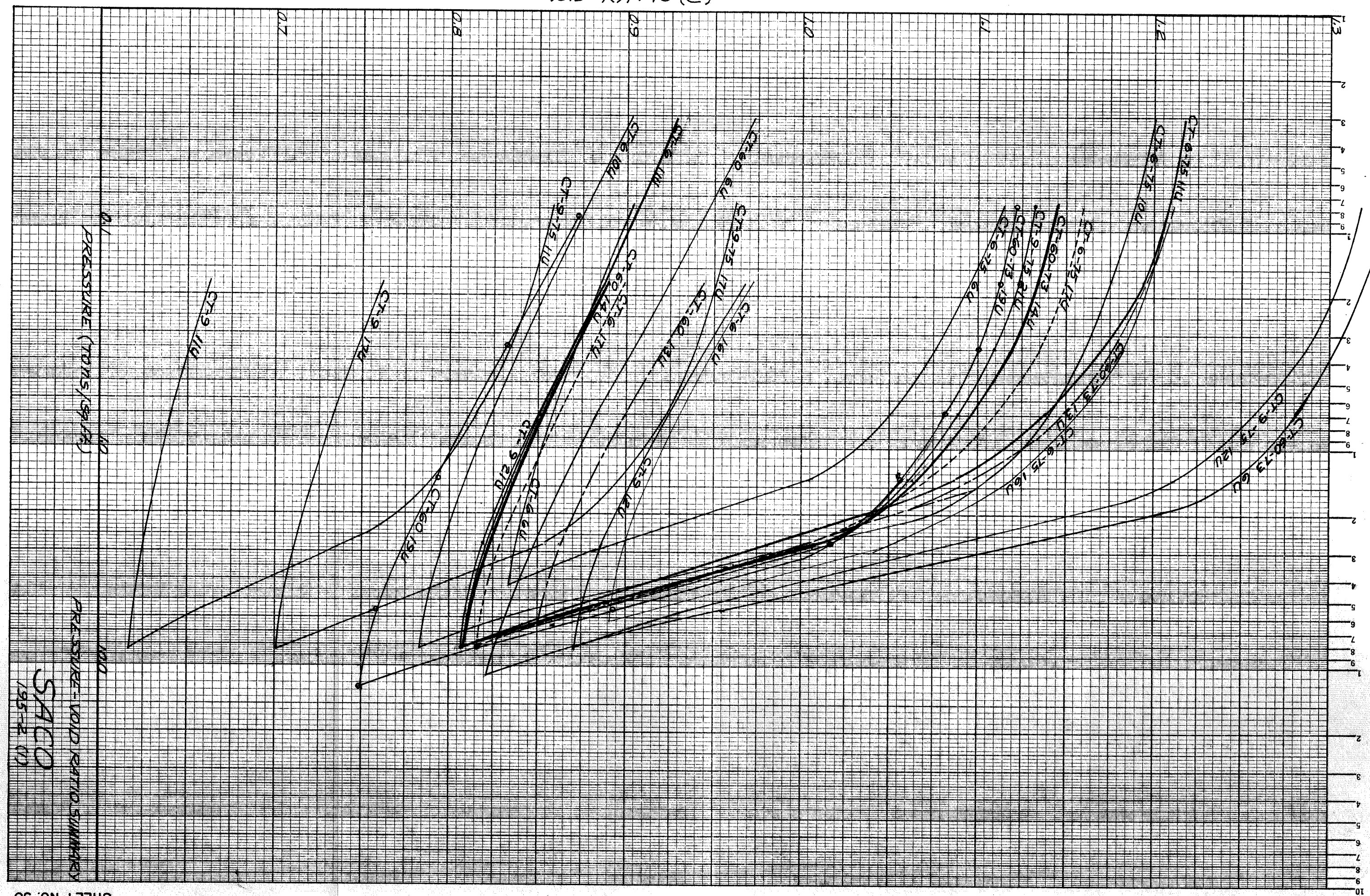
BORING CT-88-75

SACO

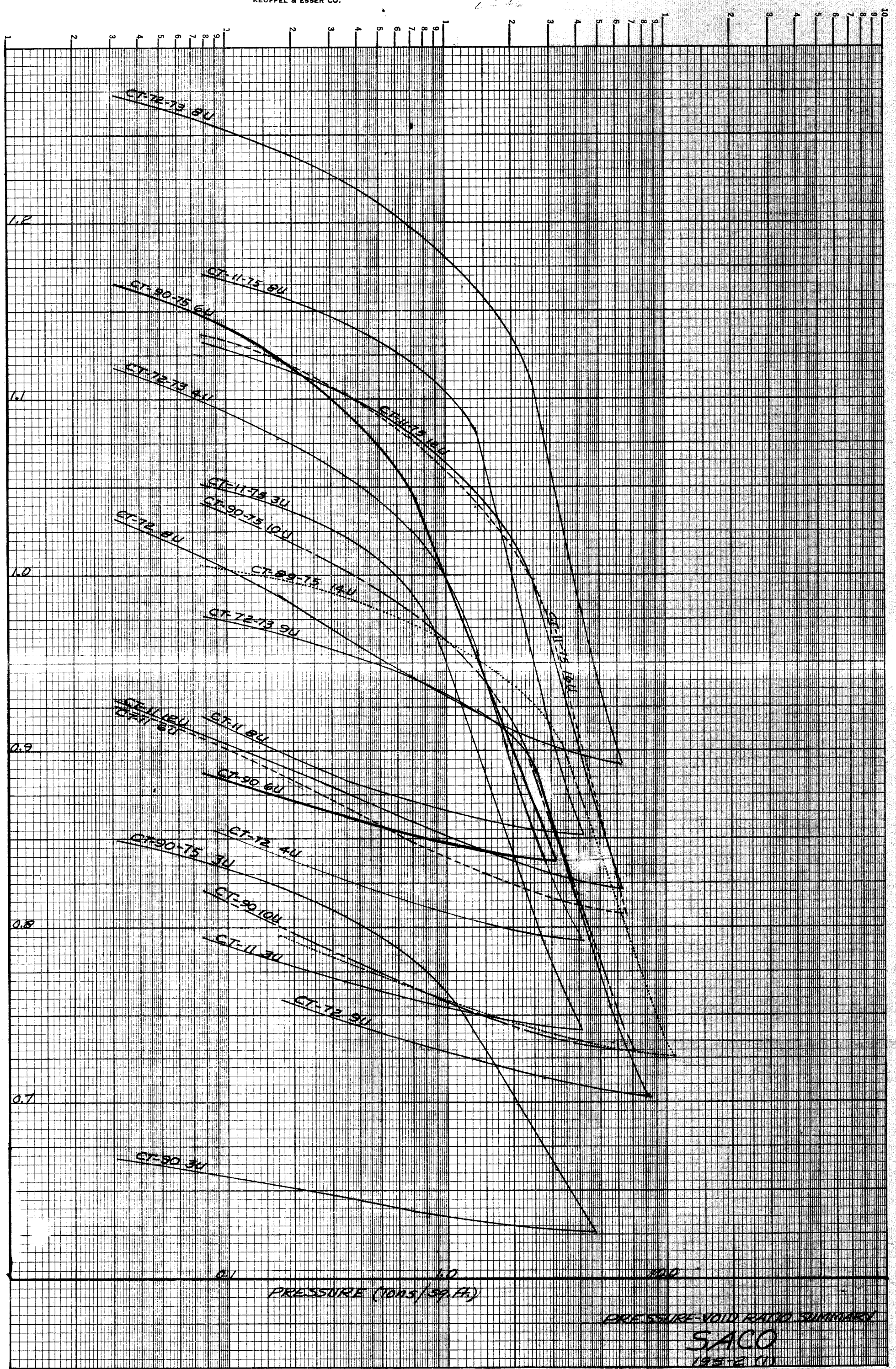
195-2(1)

DATE: OCTOBER 1975

SHEET NO. 49


VOID RATIO (e)
PRESSURE (TONS/SQ.FT.)
PRESSURE-VOID RATIO SUMMARY
SACO
1955-2 (1)
SHEET NO. 50
K+E SEMI-LOGARITHMIC
4 CYCLES X 150 DIVISIONS
KEUFFEL & ESSER CO.
47 6012
MADE IN U.S.A.

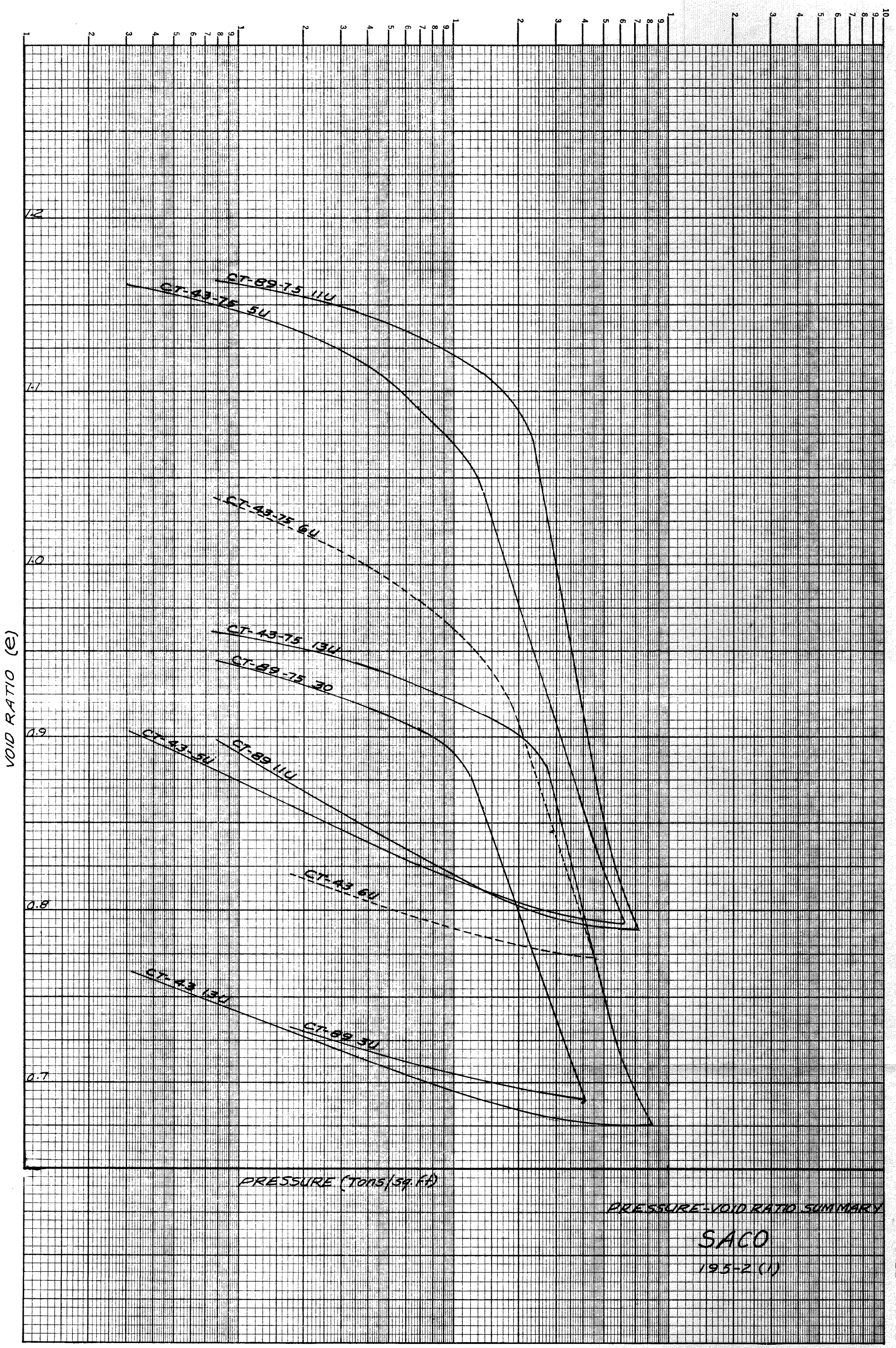
K+E SEMI-LOGARITHMIC 47 6012
4 CYCLES X 150 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.



PRESSURE-VOID RATIO SUMMARY
SACO
1955-2 (1)

SHEET NO. 51

K+E SEMI-LOGARITHMIC 47 6012
4 CYCLES X 150 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.



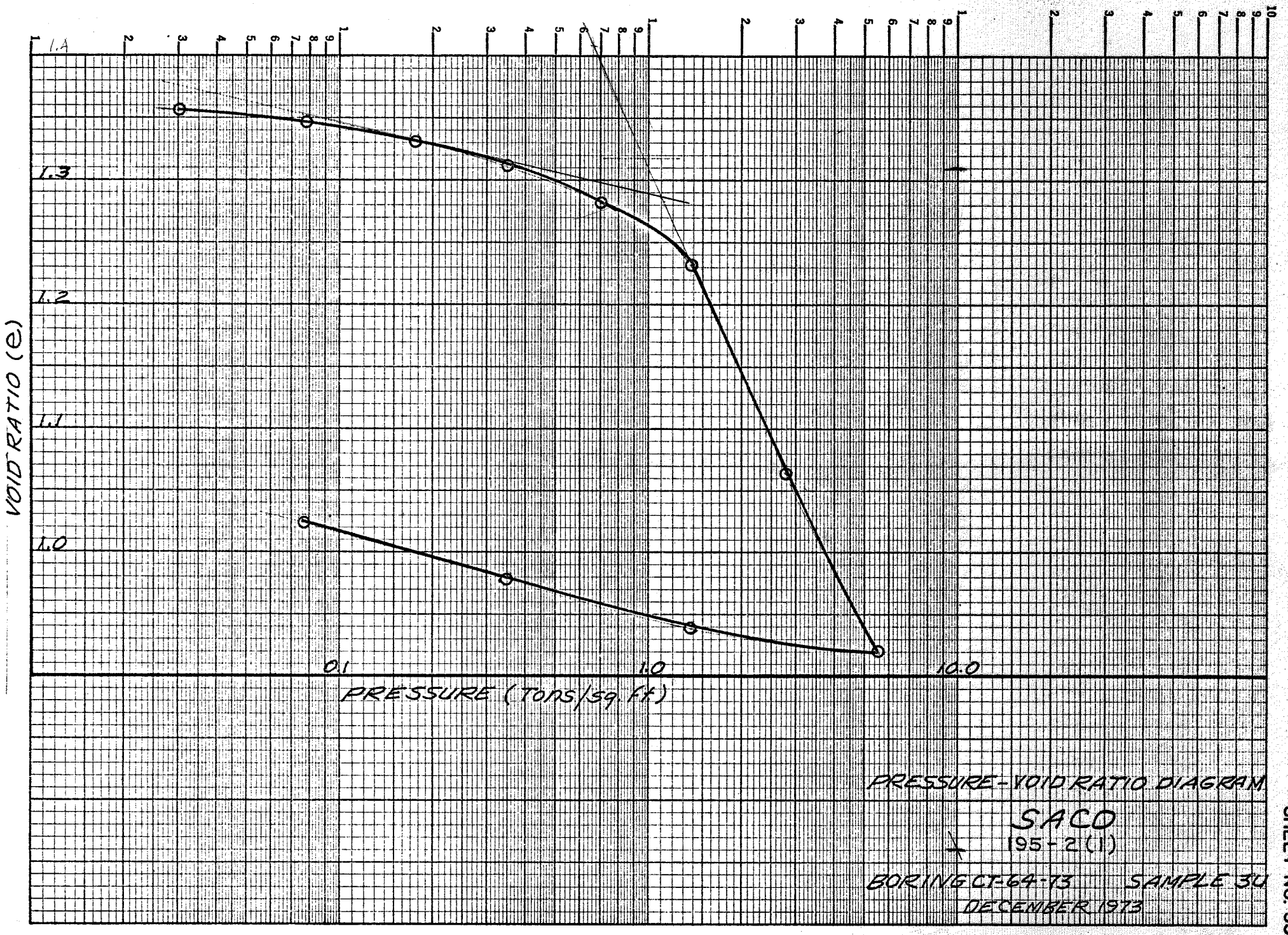
PRESSURE-VOID RATIO SUMMARY

SACO

195-2 (1)

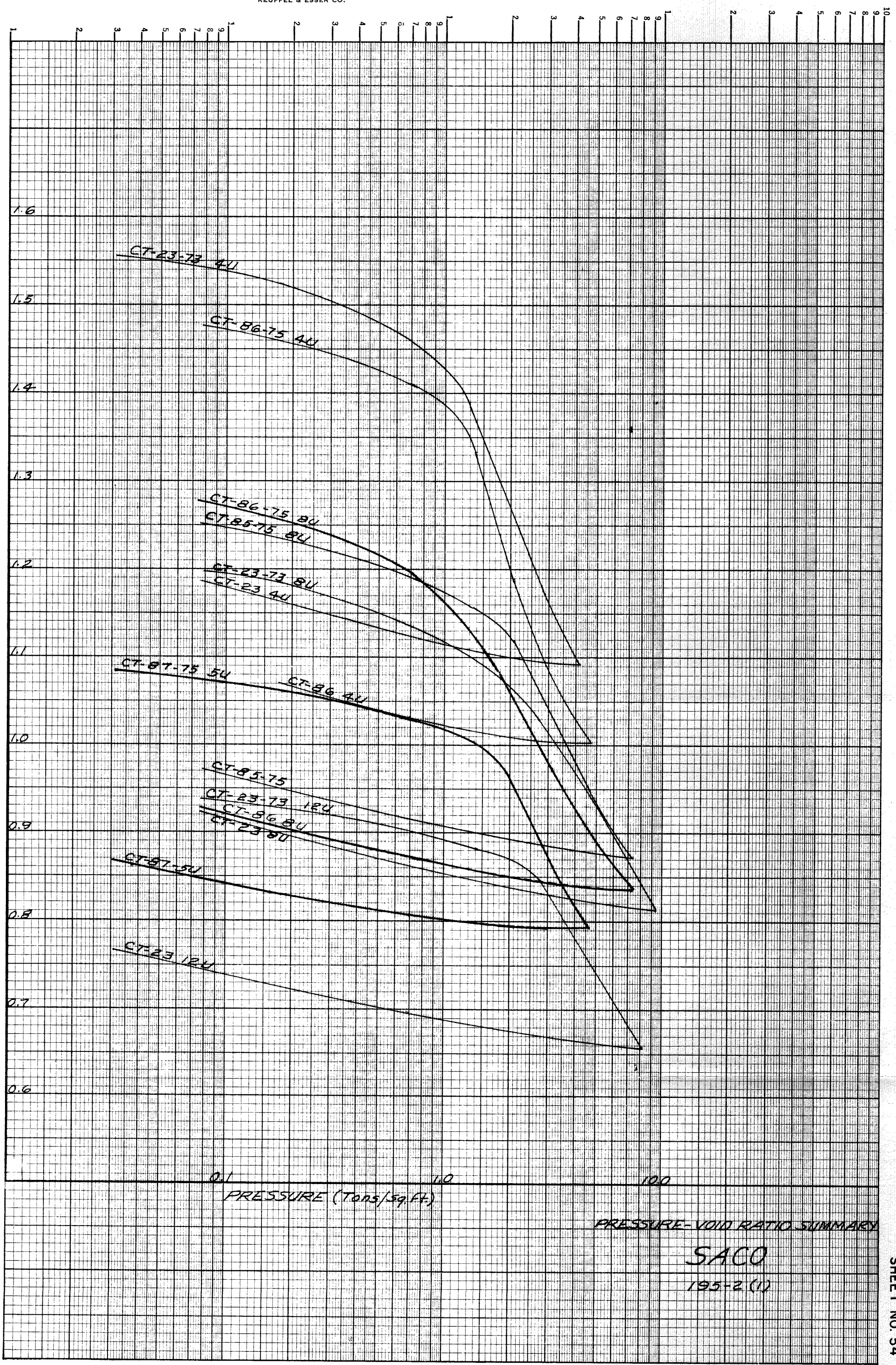
SHEET NO. 52

K+E SEMI-LOGARITHMIC 46 6012
4 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO. LC-100-73



SHEET NO. 53

K+E SEMI-LOGARITHMIC 4 CYCLES X 150 DIVISIONS 47 6012 MADE IN U.S.A.
KEUFFEL & ESSER CO.

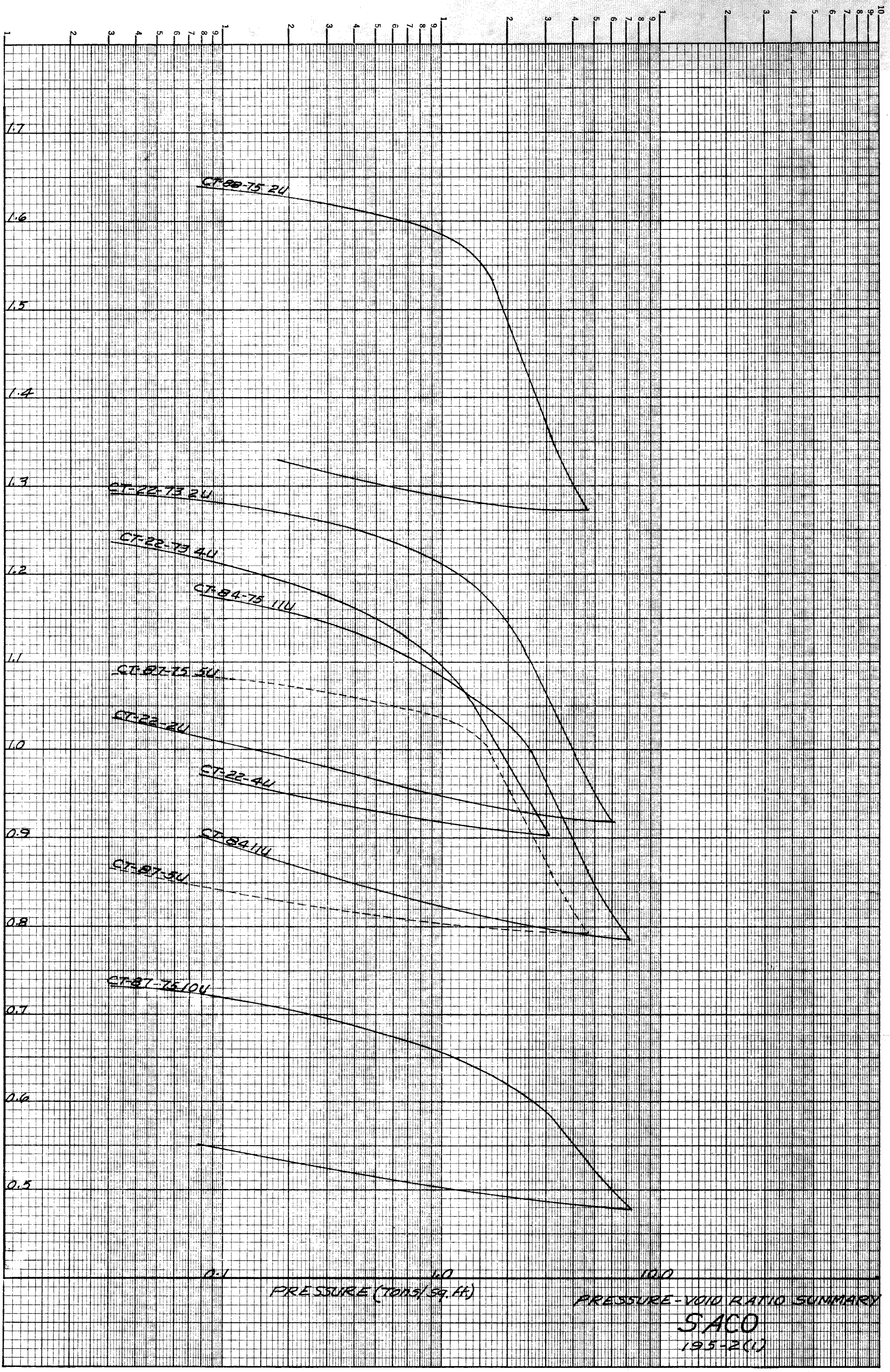


PRESSURE-VOID RATIO SUMMARY

SACO

195-2 (1)

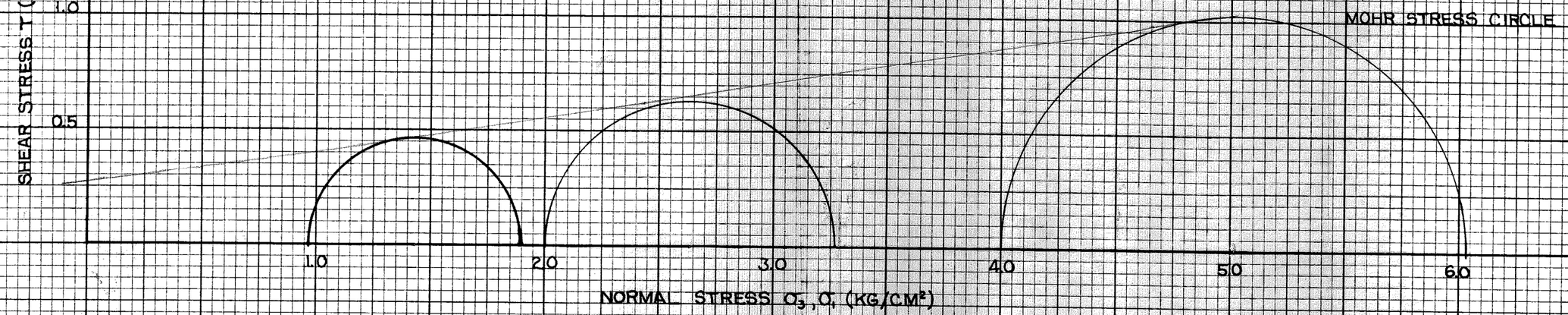
SHEET NO. 54

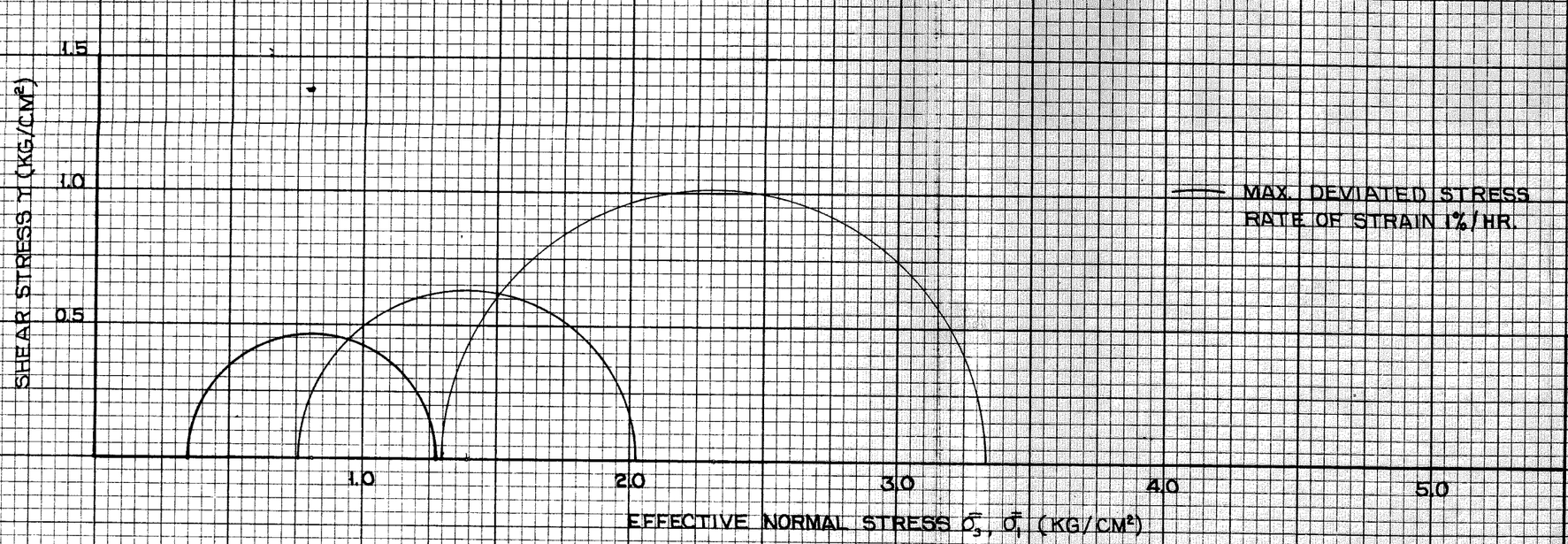

K+E SEMI-LOGARITHMIC 47 6012
4 CYCLES X 150 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.
VOID RATIO (e)
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
CT-88-75 2U
CT-22-73 2U
CT-22-73 4U
CT-84-75 11U
CT-87-75 5U
CT-22-2U
CT-22-4U
CT-84 11U
CT-87-5U
CT-87-75 10U
0.1
1.0
10.0
PRESSURE (TONS/SQ. FT)
PRESSURE-VOID RATIO SUMMARY
SACO
195-2(1)

SHEET NO. 55

LT-8

CHAMBER PRESSURE σ_3	WATER CONTENT % BEFORE CONSOLIDATION	WATER CONTENT % AFTER SHEAR
1.0	42.5	39.7
2.0	43.18	37.42
4.0	43.99	33.6





MAINE DEPARTMENT OF TRANSPORTATION

CONSOLIDATED UNDRAINED TRIAXIAL TESTS

SACO

195-2(1)

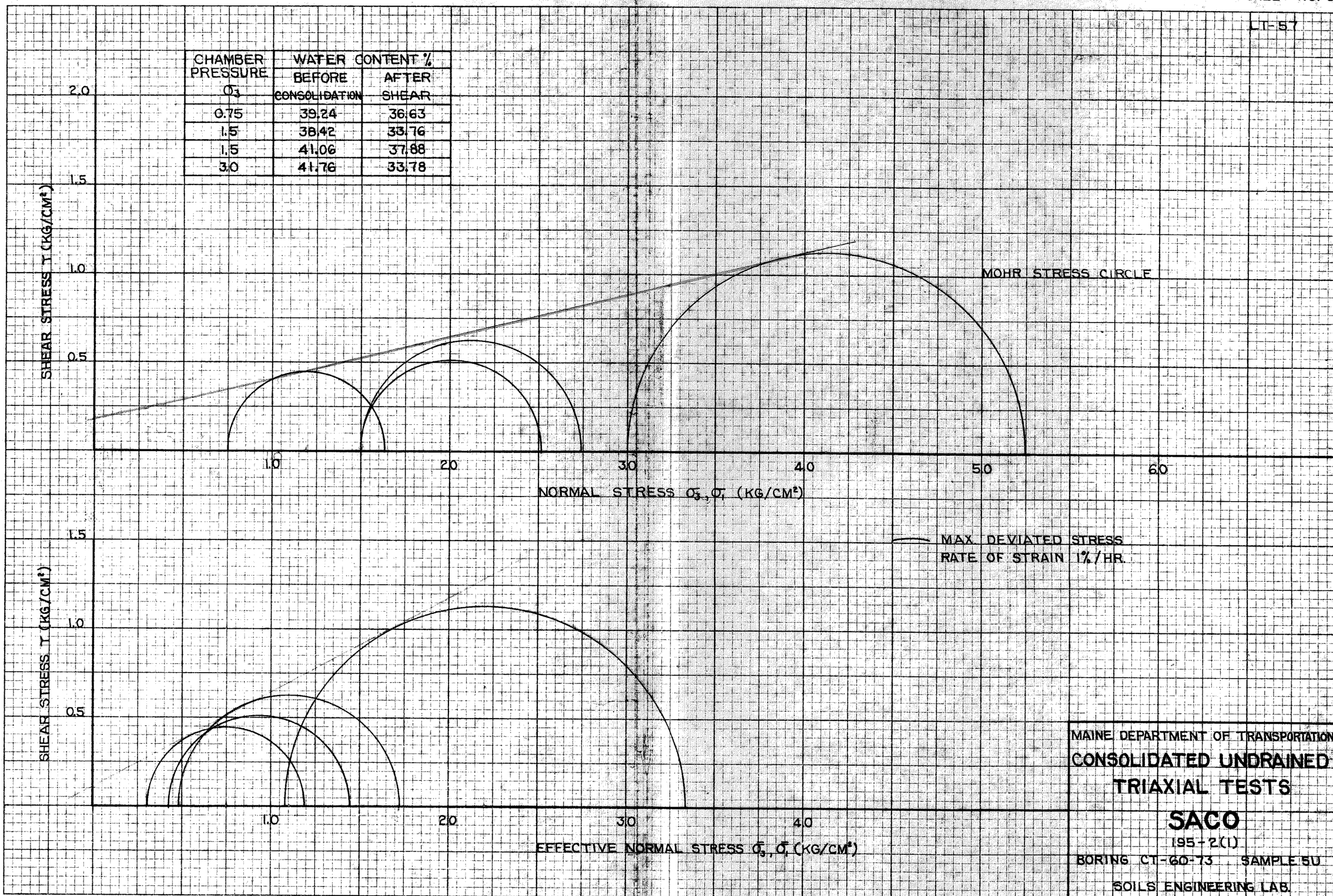
BORING CT-9-75 SAMPLE 9U

SOILS ENGINEERING LAB.

K+E 10 X 10 TO THE INCH 47 0782
10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

LT-57

CHAMBER PRESSURE σ_3	WATER CONTENT % BEFORE CONSOLIDATION	WATER CONTENT % AFTER SHEAR
0.75	39.24	36.63
1.5	38.42	33.76
1.5	41.06	37.88
3.0	41.76	33.78



MAINE DEPARTMENT OF TRANSPORTATION

CONSOLIDATED UNDRAINED TRIAXIAL TESTS

SACO

195-2(1)

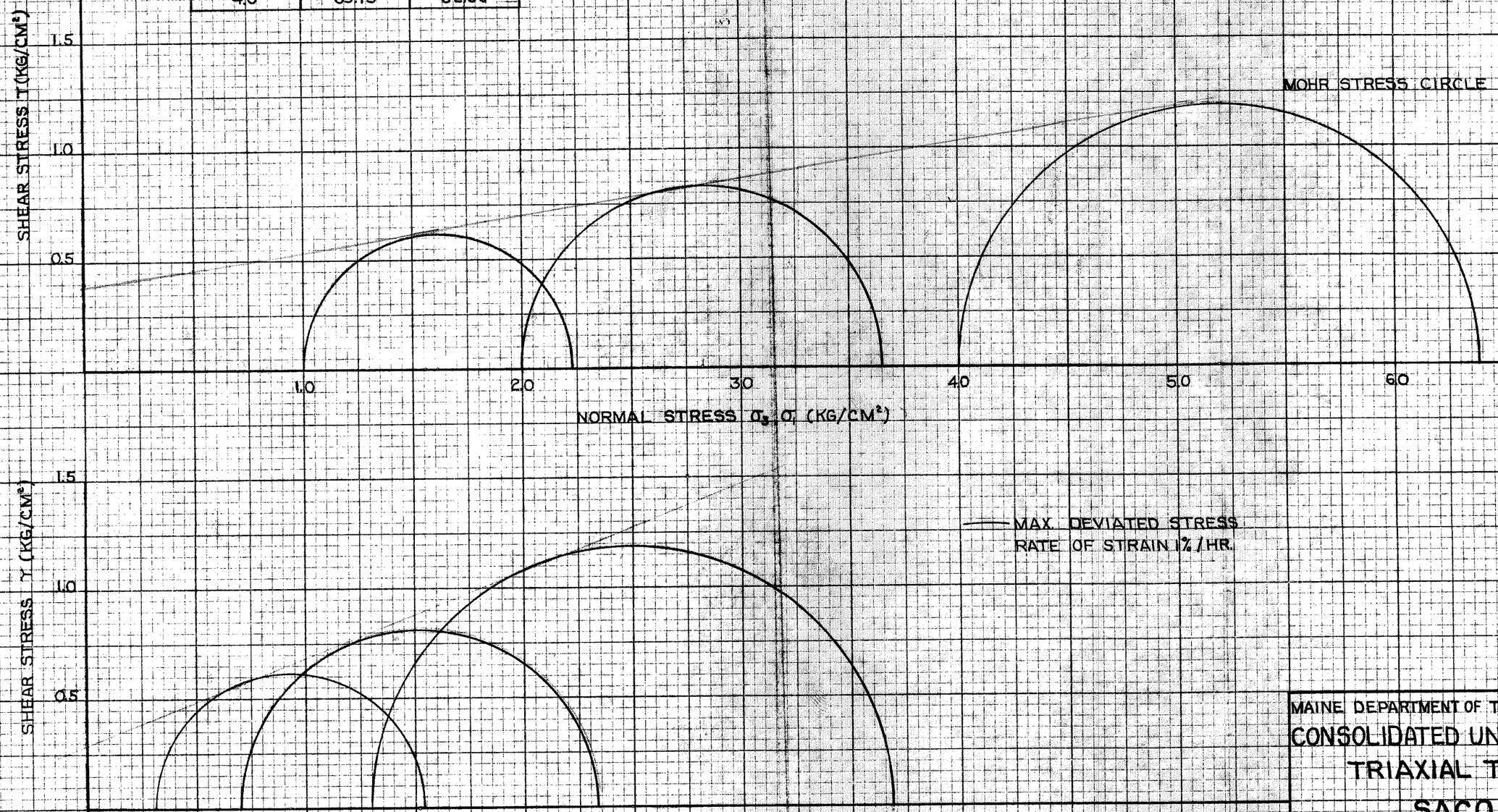
BORING CT-60-73 SAMPLE 5U

SOILS ENGINEERING LAB.

K+E 10 X 10 TO THE INCH 47 0782
10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

LT-58

CHAMBER PRESSURE σ_3	WATER CONTENT % BEFORE CONSOLIDATION	WATER CONTENT % AFTER SHEAR
1.0	39.6	37.88
2.0	39.72	37.25
4.0	39.15	32.55



MAINE DEPARTMENT OF TRANSPORTATION

CONSOLIDATED UNDRAINED TRIAXIAL TESTS

SACO

195-2(1)

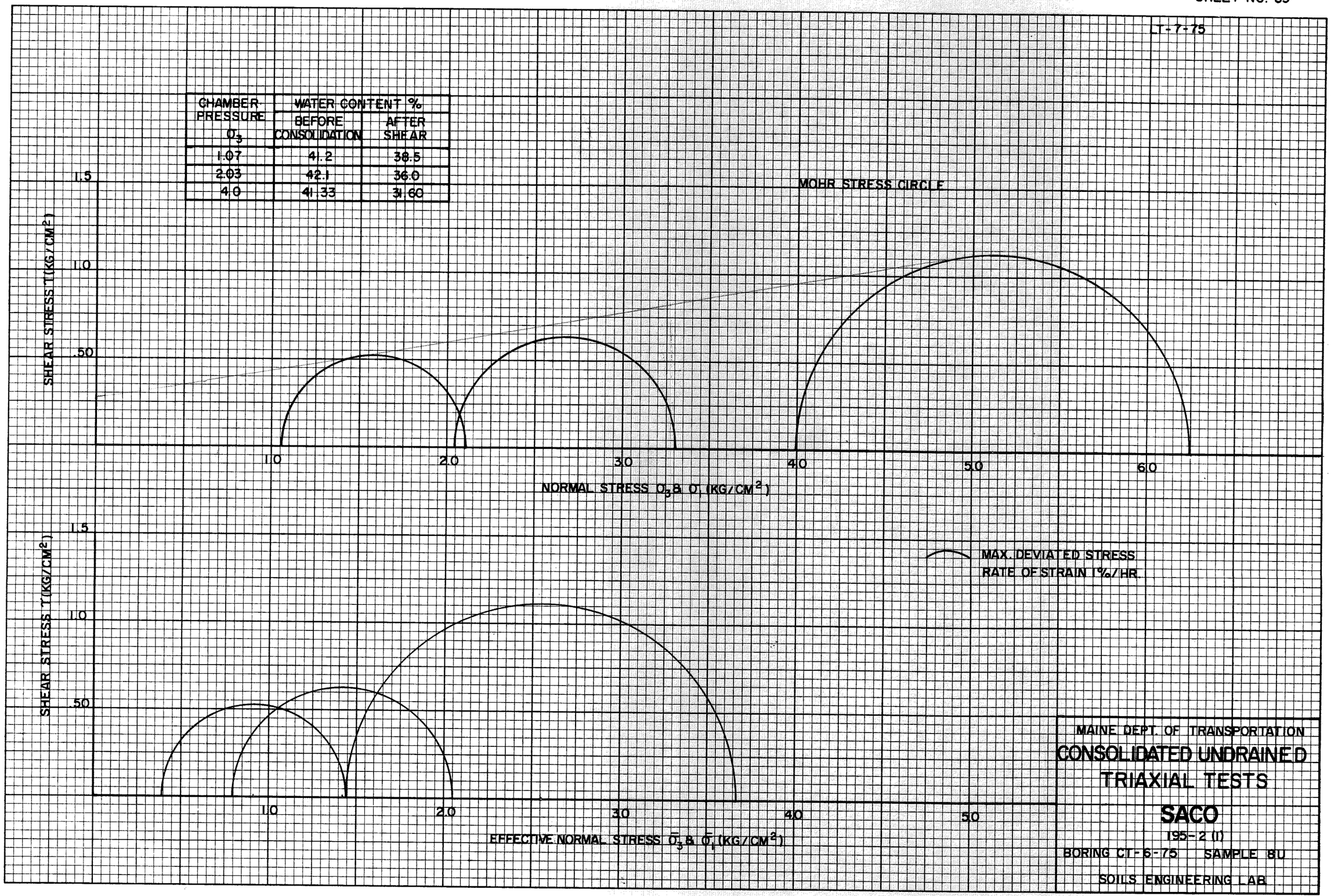
BORING CT-60-73 SAMPLE 12U

SOILS ENGINEERING LAB

K+E 10 X 10 TO THE INCH 47 0782
10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

LT-7-75

CHAMBER PRESSURE σ_3	WATER CONTENT %	
	BEFORE CONSOLIDATION	AFTER SHEAR
1.07	41.2	38.5
2.03	42.1	36.0
4.0	41.33	34.60



MAINE DEPT. OF TRANSPORTATION

CONSOLIDATED UNDRAINED TRIAXIAL TESTS

SACO

195-2 (1)

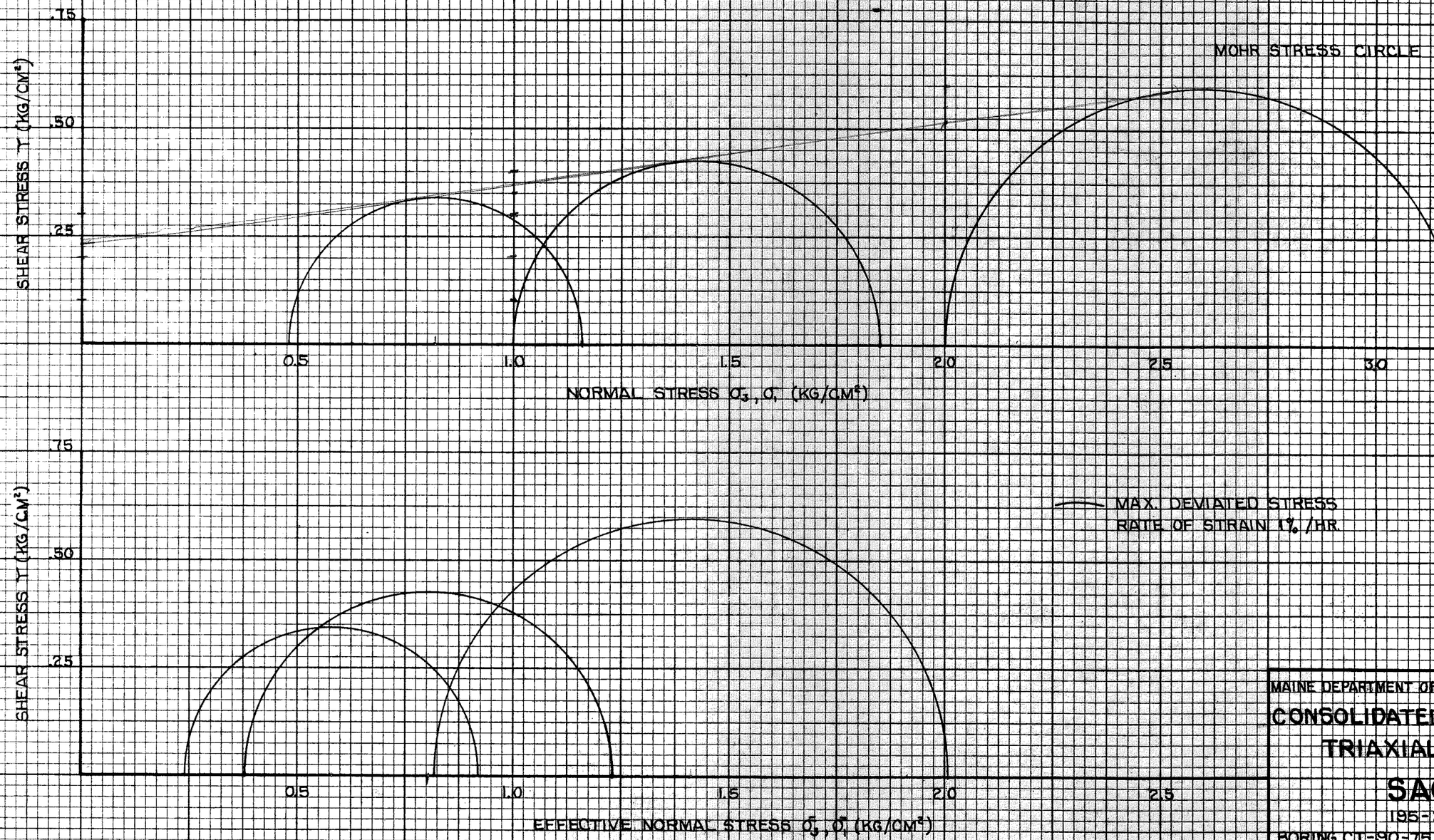
BORING CT-6-75 SAMPLE 8U

SOILS ENGINEERING LAB.

K+E 10 X 10 TO THE INCH 47 0782
10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

LT-2.7

CHAMBER PRESSURE σ_3	WATER CONTENT % BEFORE CONSOLIDATION	WATER CONTENT % AFTER SHEAR
0.5	41.9	39.4
1.0	43.0	39.3
2.0	42.7	33.9



MAINE DEPARTMENT OF TRANSPORTATION

CONSOLIDATED UNDRAINED TRIAXIAL TESTS

SACO

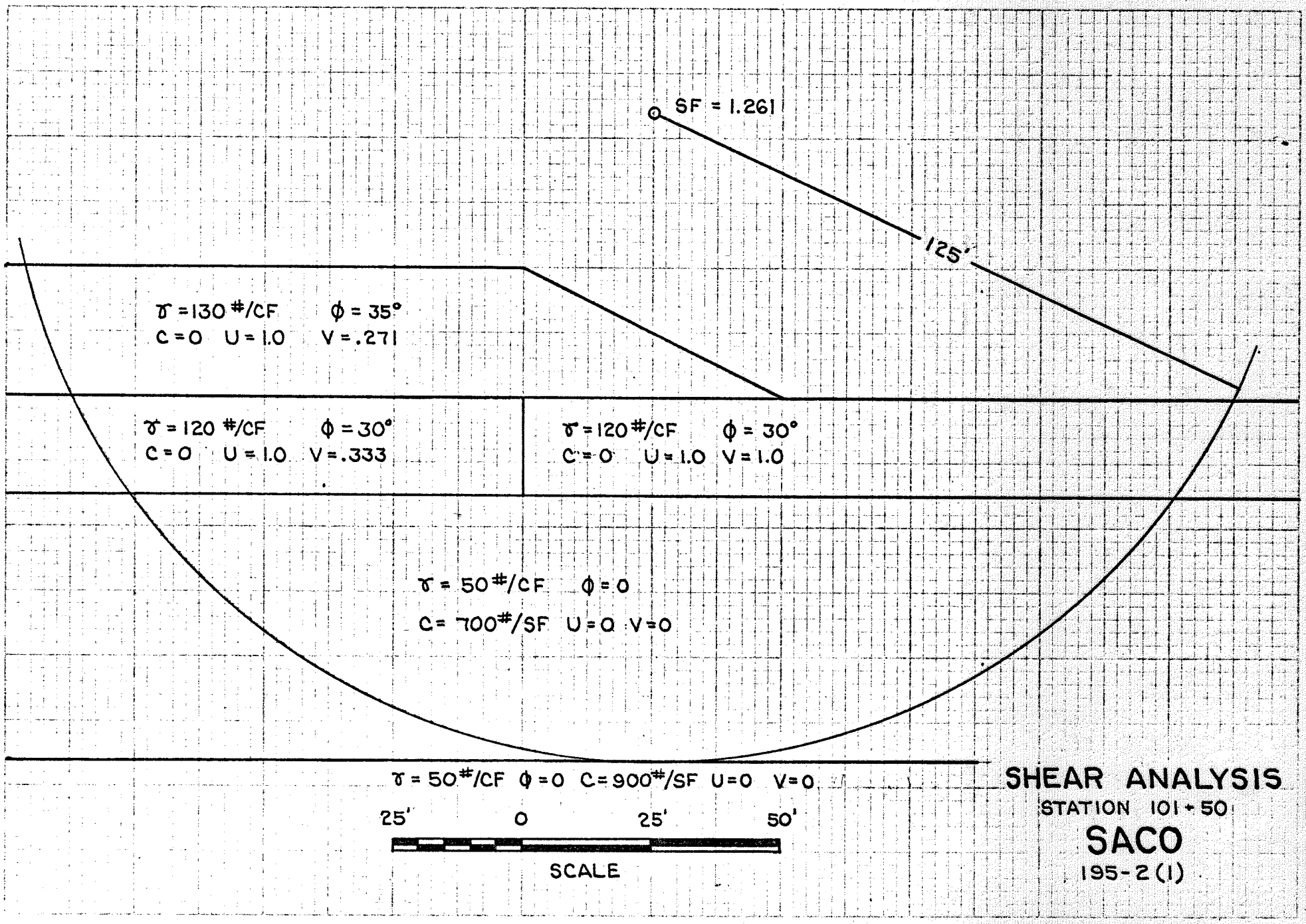
195-2 (1)

BORING CT-90-75 SAMPLE 7U

SOILS ENGINEERING LAB

47 0782

K+E 10 X 10 TO THE INCH • 10 X 15 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.



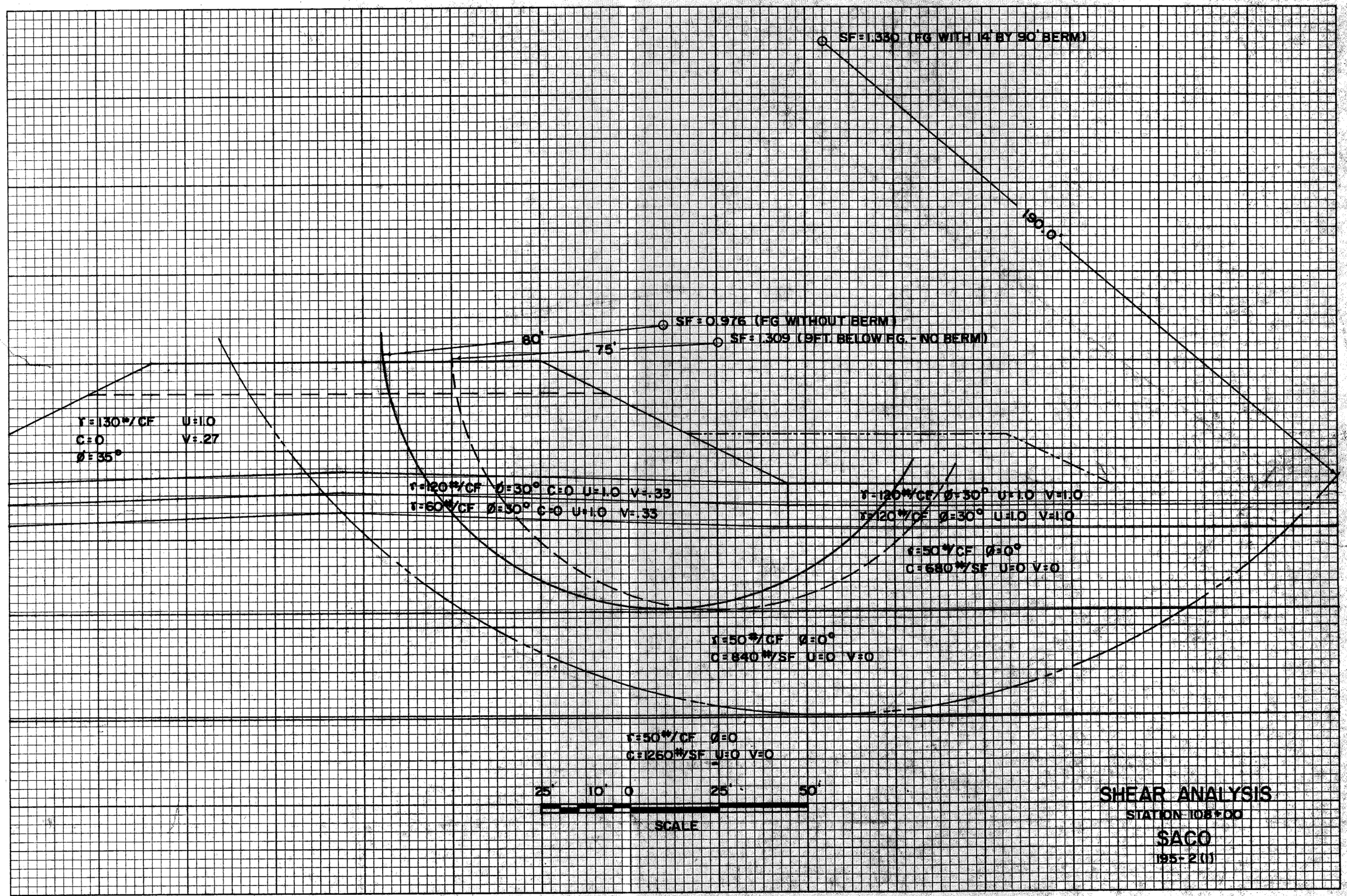
SHEAR ANALYSIS

STATION 101 + 50

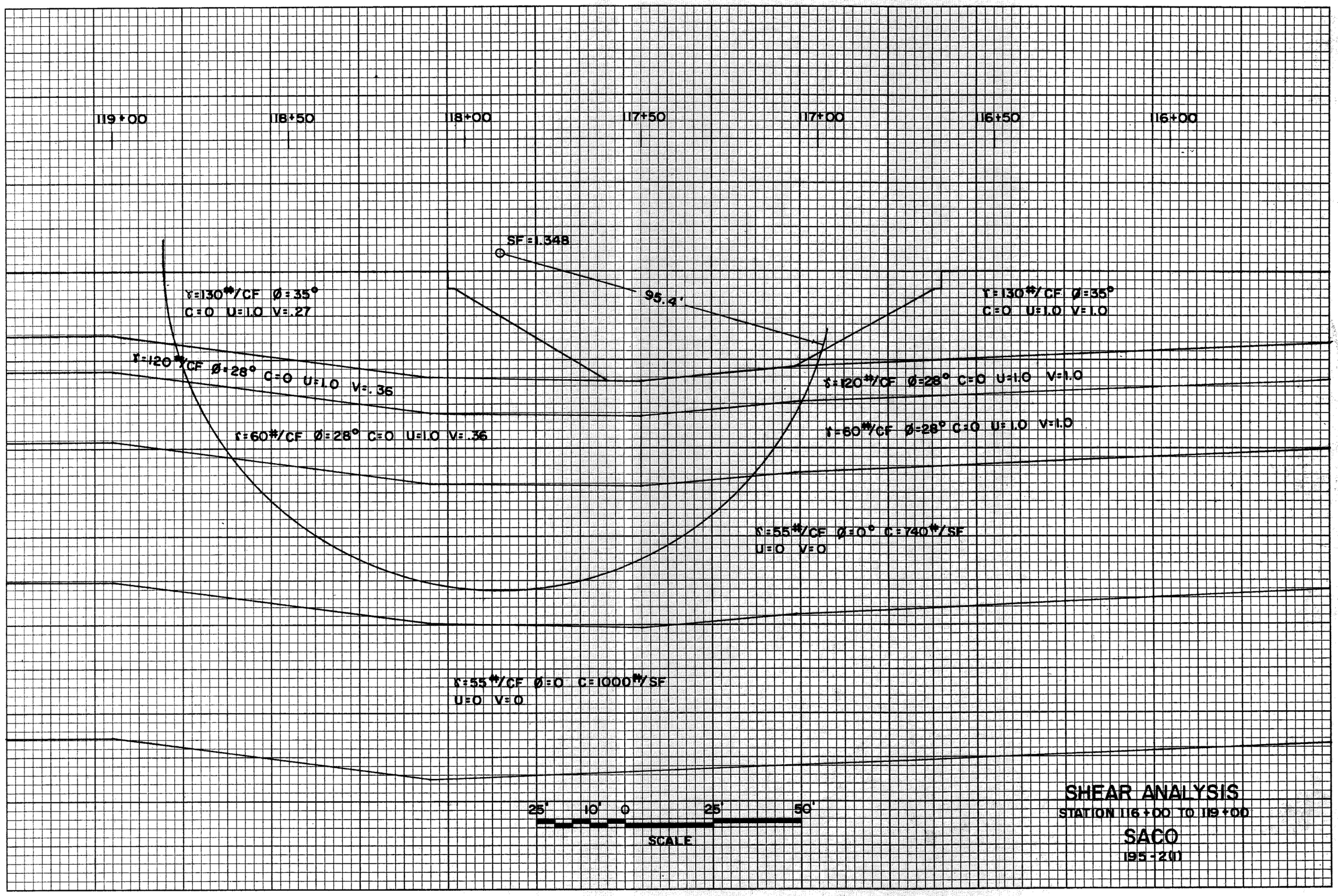
SACO

195-2 (1)

SHEET NO. 61

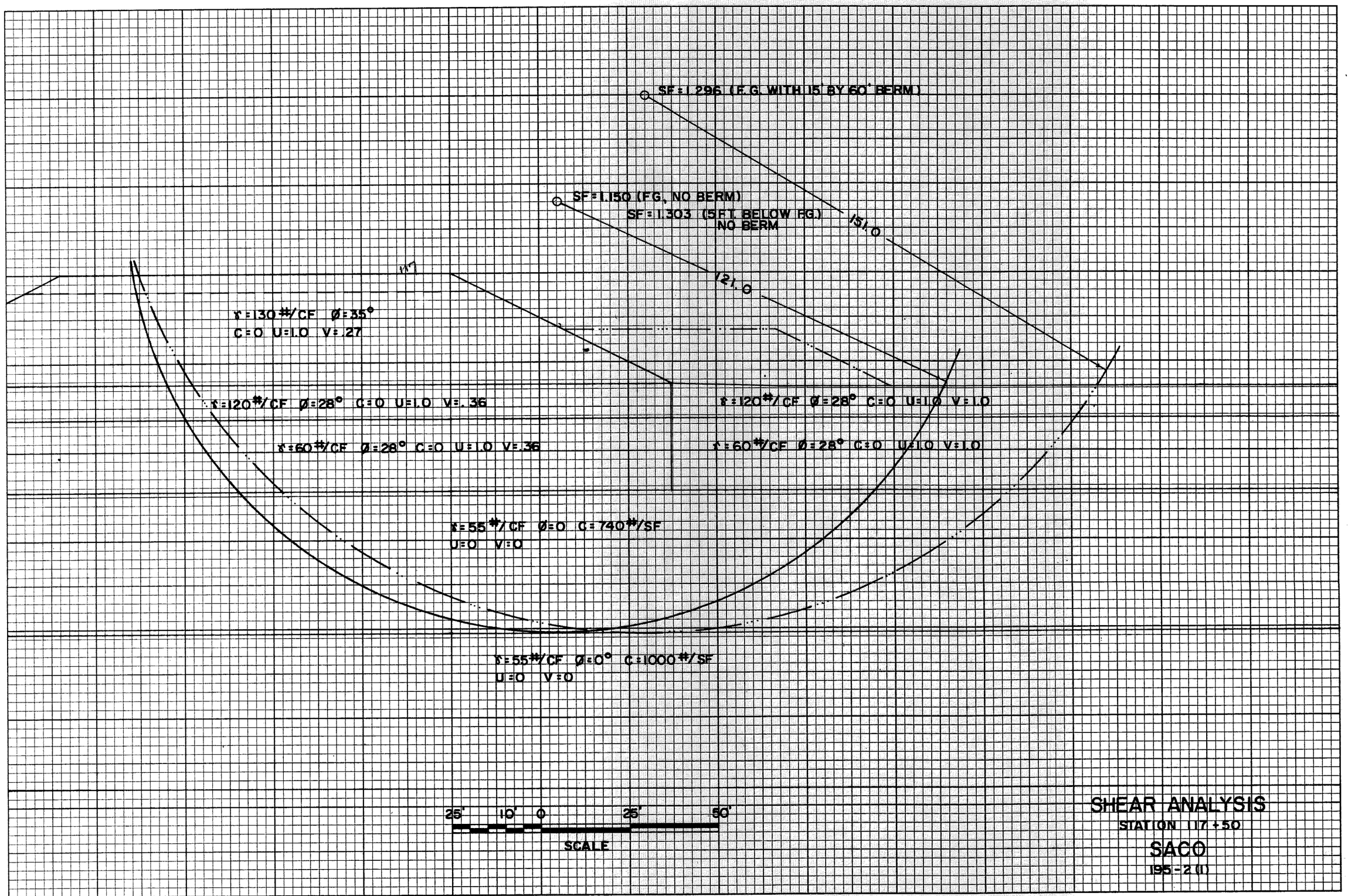


K&E KEUFFEL & ESSER CO. MADE IN U.S.A. 10 X 10 TO THE INCH • 10 X 10 INCHES
47 0782



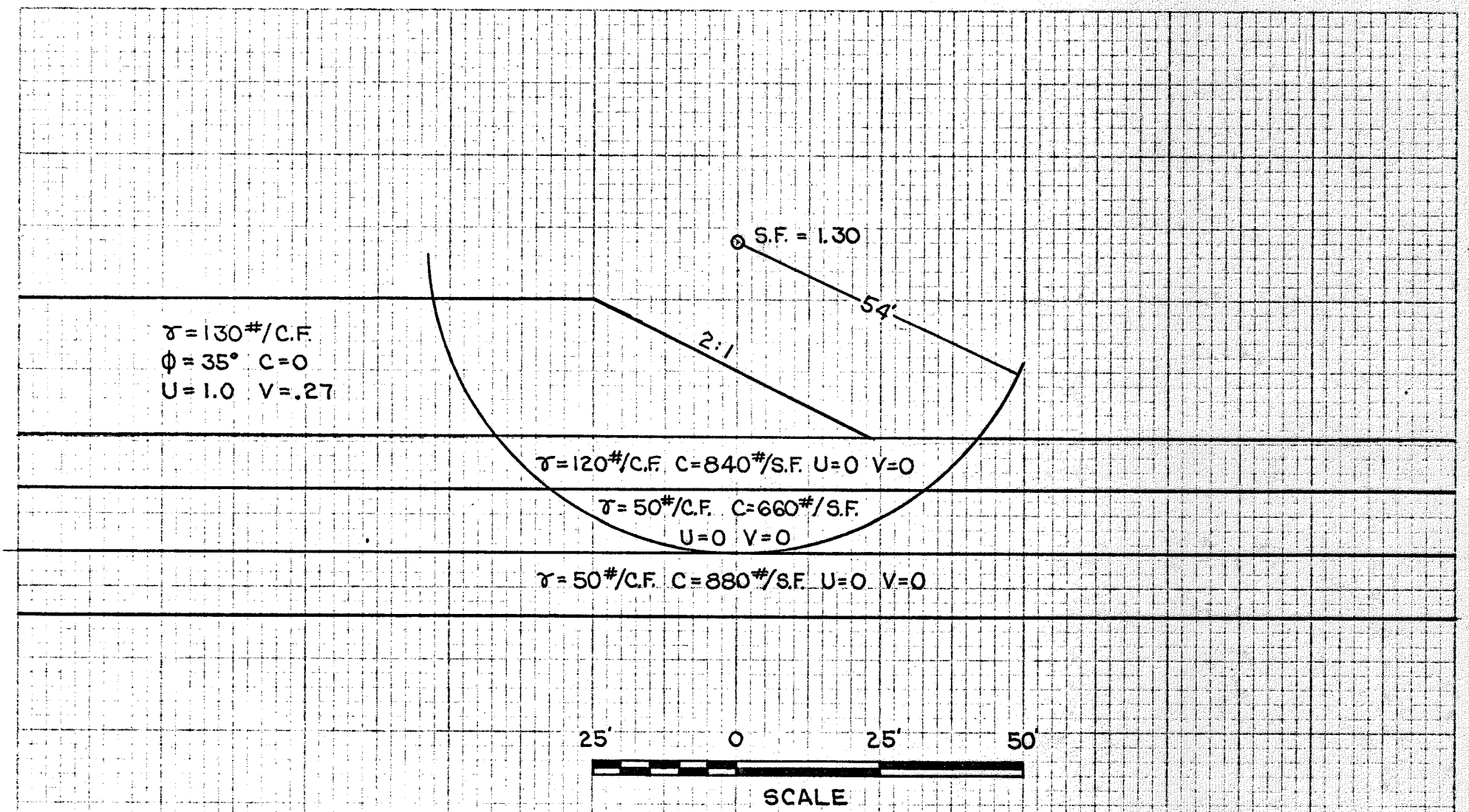
K&E KEUFFEL & ESSER CO. MADE IN U.S.A. 10 X 10 TO THE INCH • 10 X 10 TO THE HALF INCH

47 0782



117 of 56

KEUFFEL & ESSER CO. MADE IN U.S.A. 10 X 10 TO THE INCH • 10 X 12 INCHES
47 0782



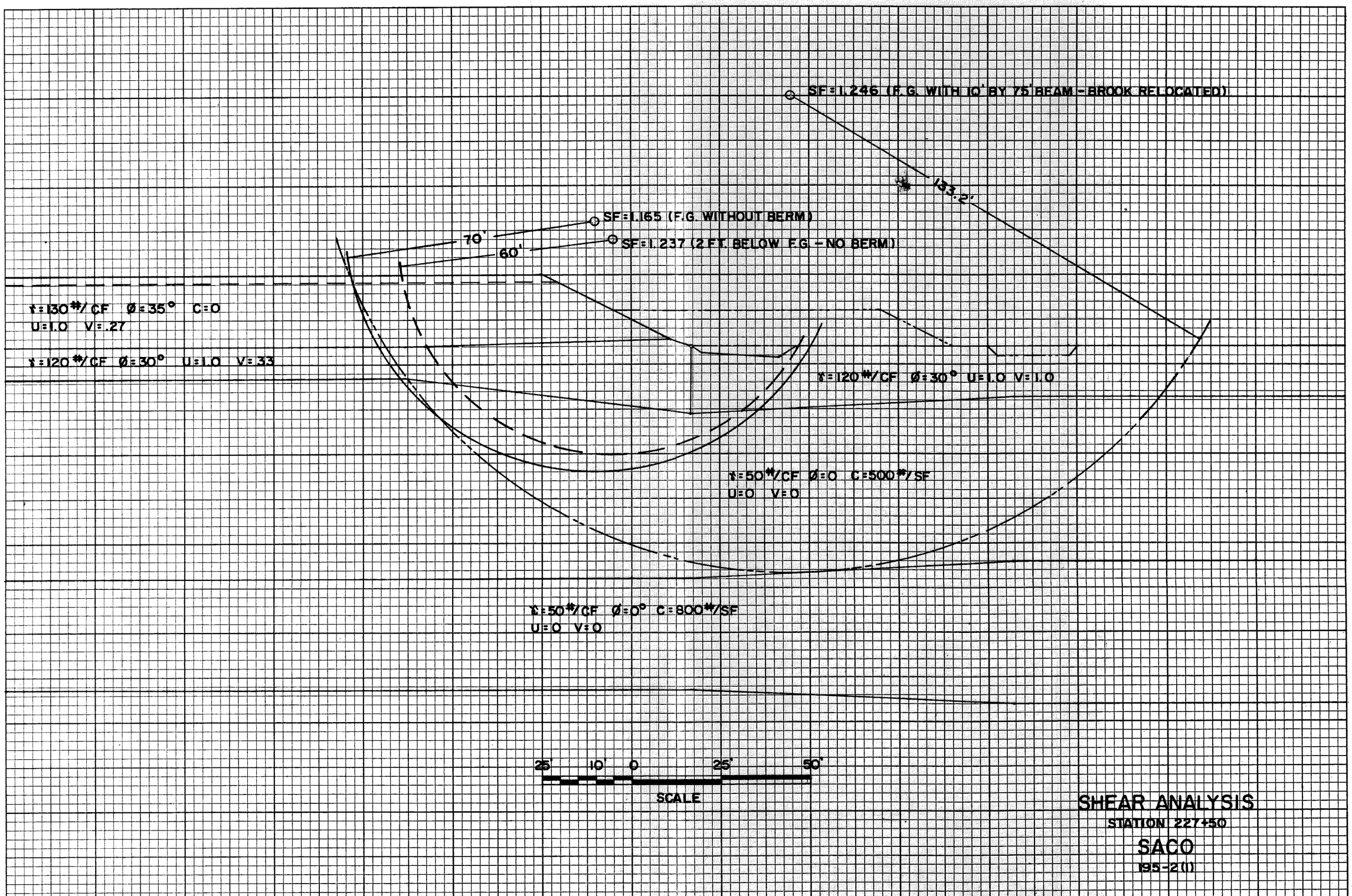
SHEAR ANALYSIS

STATION 124+00

SACO

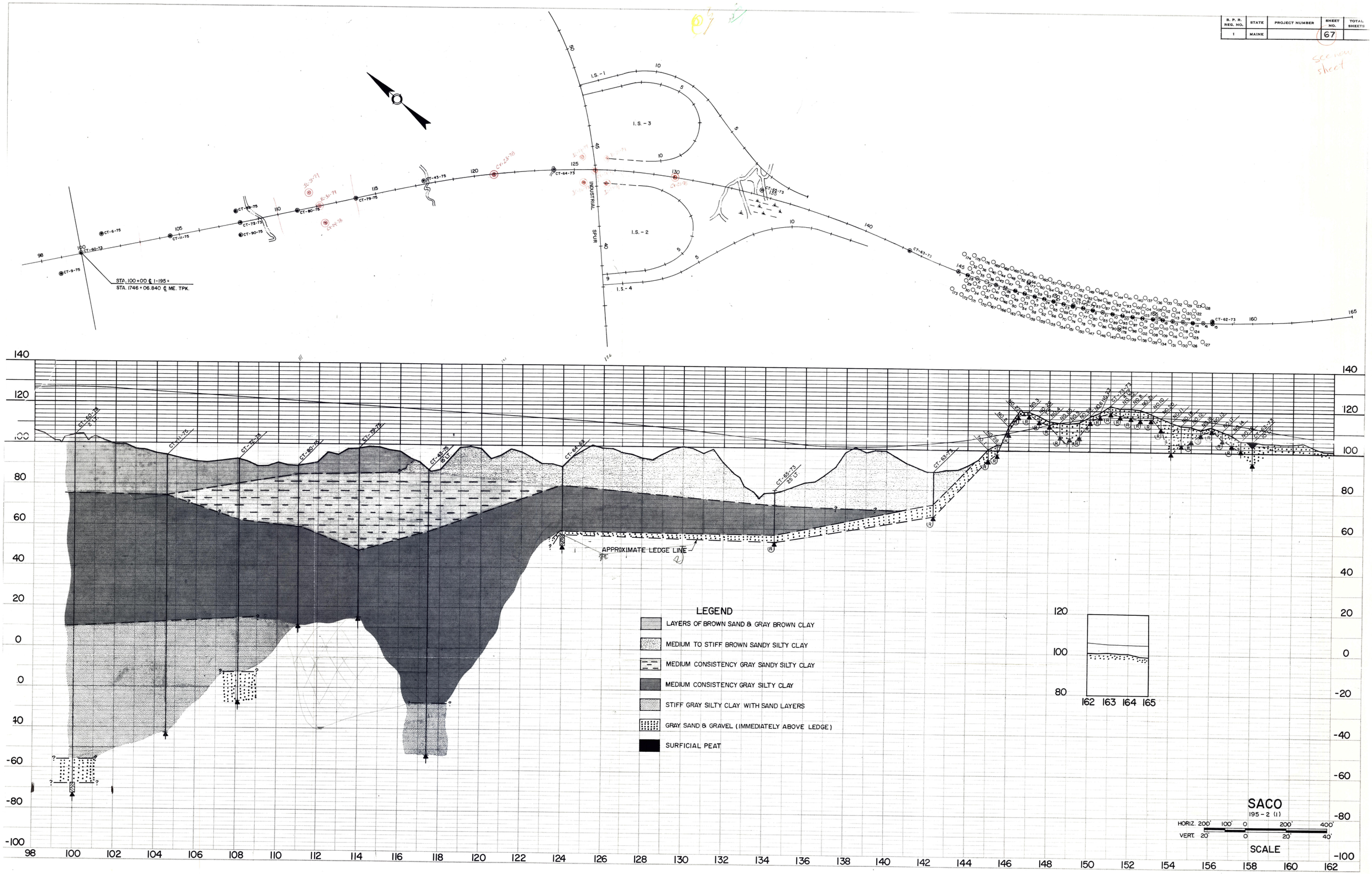
1-195-2(1)

SHEET NO. 65



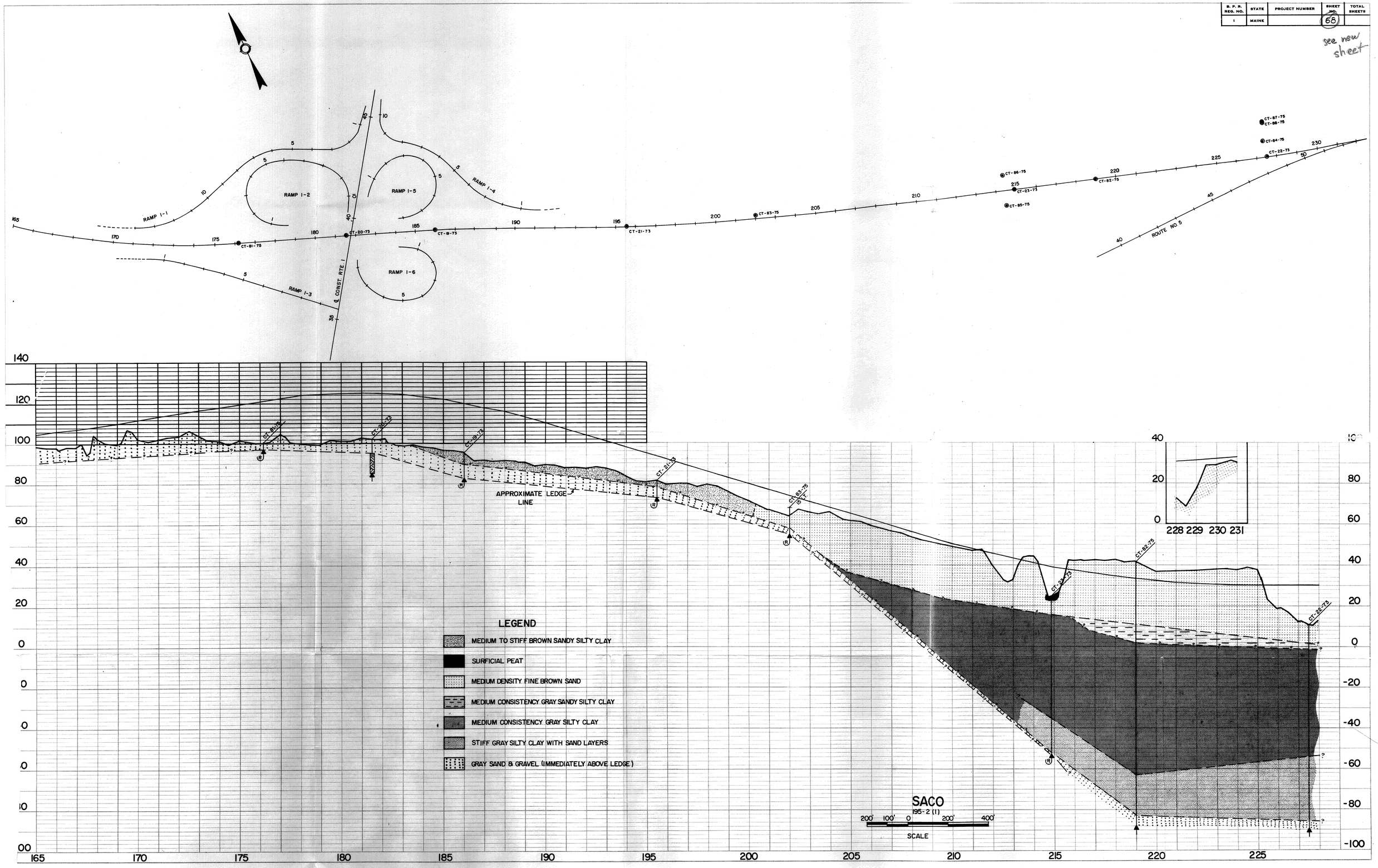
KEUFFEL & ESSER CO. MADE IN U.S.A.
K+E 10 X 10 TO THE INCH • 10 X 12 INCHES
47 0782

B. P. R. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE		67	



B. P. R. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE		68	

see new sheet



Appendix A

Preliminary Materials Inventory

Saco

Proj. 195-2(1)

June 1974

A preliminary ground survey was begun in October, 1973, to determine the availability of materials needed for construction of Project 195-2(1). The general area in the vicinity of the project is divided into two separate entities by the cities of Saco and Biddeford and also by the Saco River. The large area just south of Biddeford has been used as a source of material for many years and is, for practical purposes, worked out. Those who own any remaining materials do no wish to sell in any volume as the location close to the city inflates the value of any type of material. The areas just west of the turnpike and north of Route 111 are worked out. The larger area is now the town dump and the pits here are quite shallow on ledge and with water. The smaller area near Route 111 is deeper but is down on till with very little material remaining except silty bouldery till.

The larger area west of Biddeford and west of the Saco River has not been investigated and may not need to be. They are not in any way readily accessible from the project location.

The best source of material is apparently in the large outwash which lies west of the turnpike in Saco between Boom Road and Route 5. Much of this area is in farms or new homes but owners of two of the largest pits, now PN 121 and PN 124, say that they will sell material. All of the materials required, with the exceptions of the aggregate subbase gravel should be readily available in either of these pits. Coarser material exists in

quantity in both pits but in general it is deeply buried beneath sand or fine sand with some clay and it is extremely variable in grain size. A great deal of planning, screening, and good fortune would be necessary to extract 105,000 yards of subbase gravel from both pits combined though it might possibly be done.

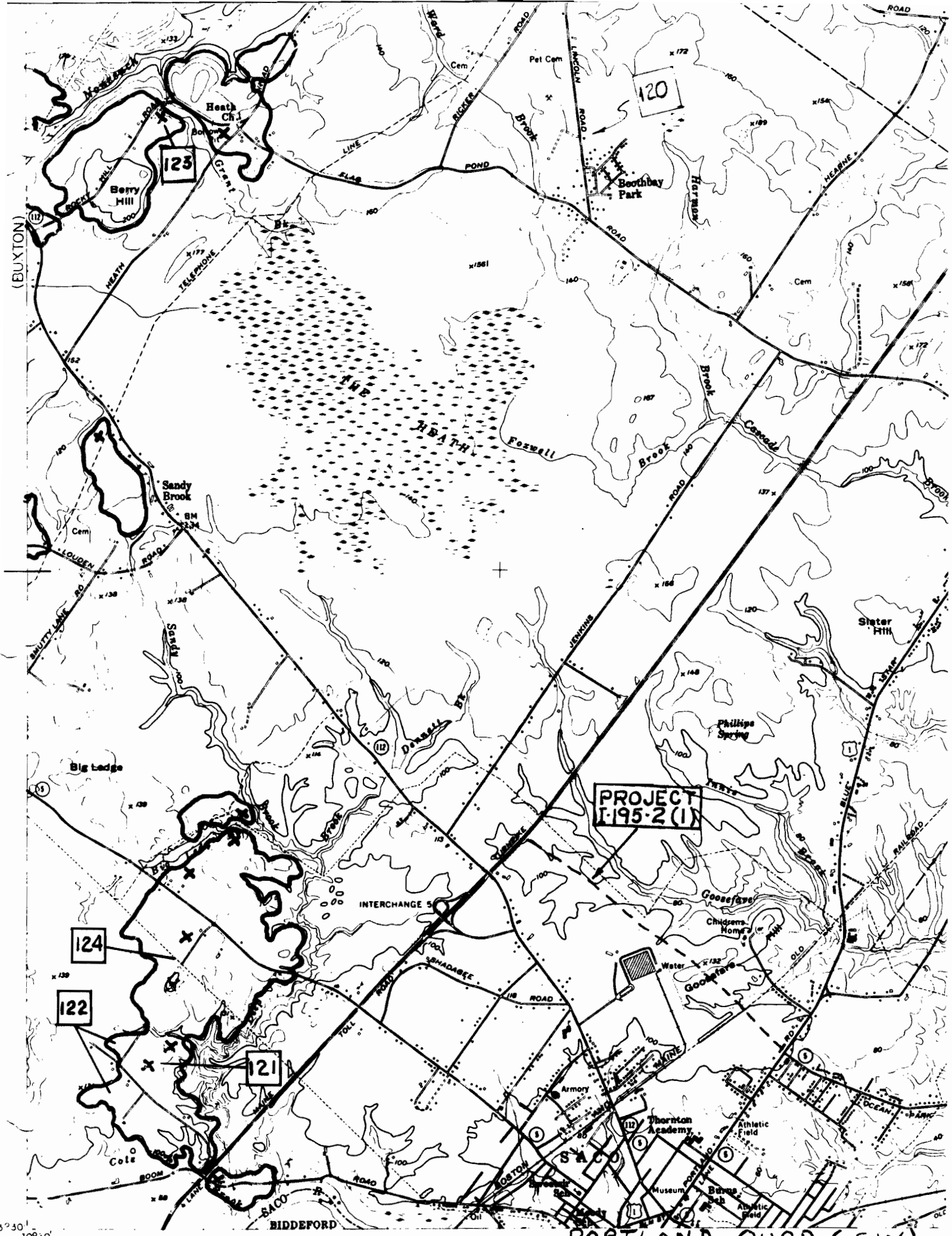
Area PN-122 in the SW corner of the outwash may contain enough material of various kinds to supply most of the materials required including the subbase gravel. A series of borings were completed on this property two years ago. They logged an average of 12 feet of gravel at the surface over 8 feet of sand of various grades on wet clay silt. Recently a few back hoe test pits were completed on the lot by Saco Mobile Homes who is the owner. These indicate that the gravel is clean but possibly somewhat sandy, possibly a very stoney sand with cobbles up to 12 inches. This area should be sampled to better evaluate its potential since gravel other than in the areas mentioned may not be readily available except at considerable distances from the project.

Large amounts of clean sand are available at PN-123 as the owner has indicated that he would sell. The pit has a high face and little overburden. Near the bottom of the face the material becomes cobbly and the State at one time had a crusher at this pit. The cobbly layer dips down and the ground water table is not very far beneath the pit floor. The area just across Rocky Hill road is part of the same deposit and may be an additional source of gravel as well as sand but the owner is difficult to locate on short notice.

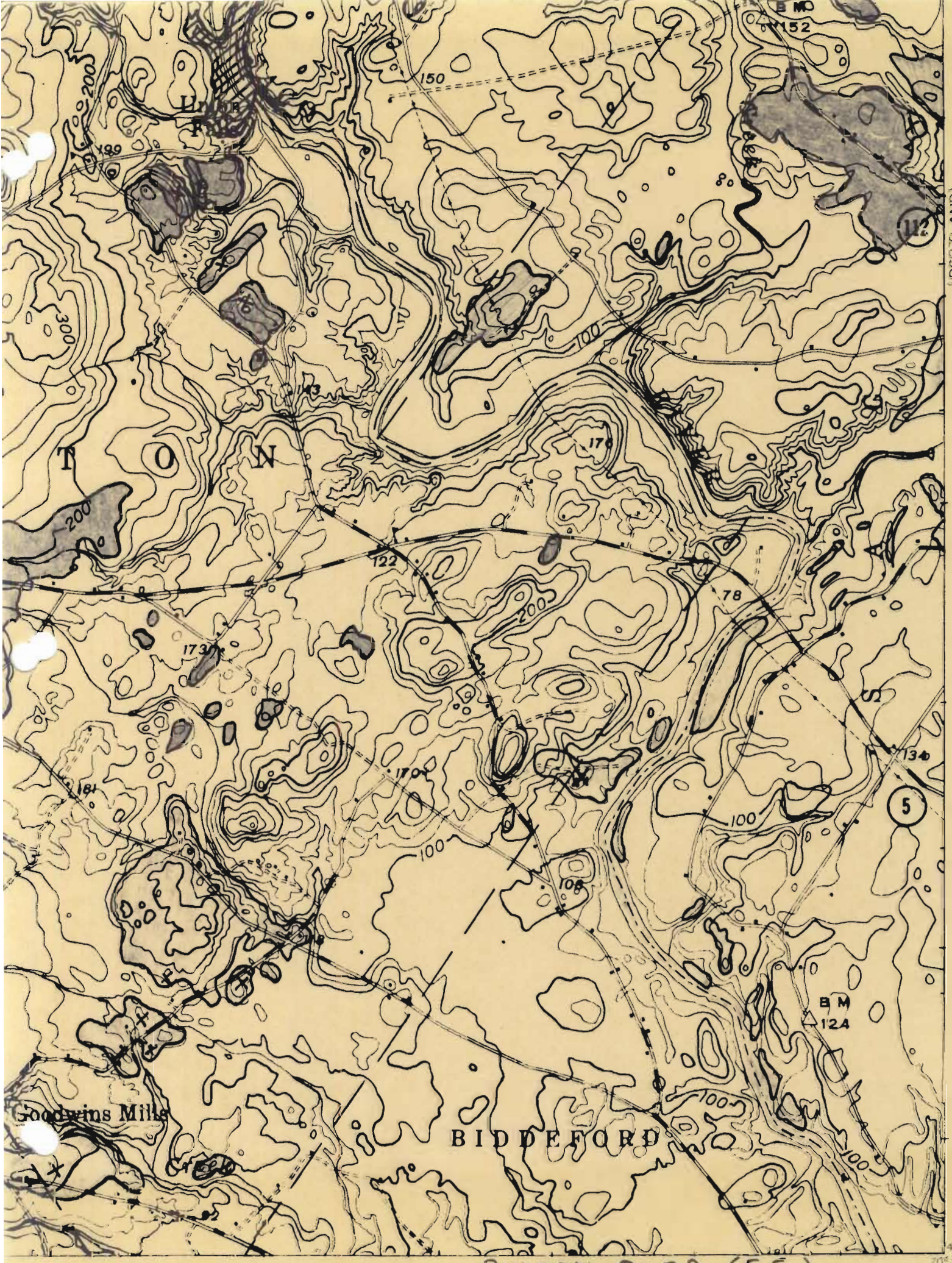
George Eaton
Geologist II

Encl:
Portland Quad - SW Corner
Buxton Quad - SE Corner
Kennebunk Quad - NE Corner
Biddeford Quad - NW Corner

Reviewed by
Charles Denburg Jr.
Geologist II

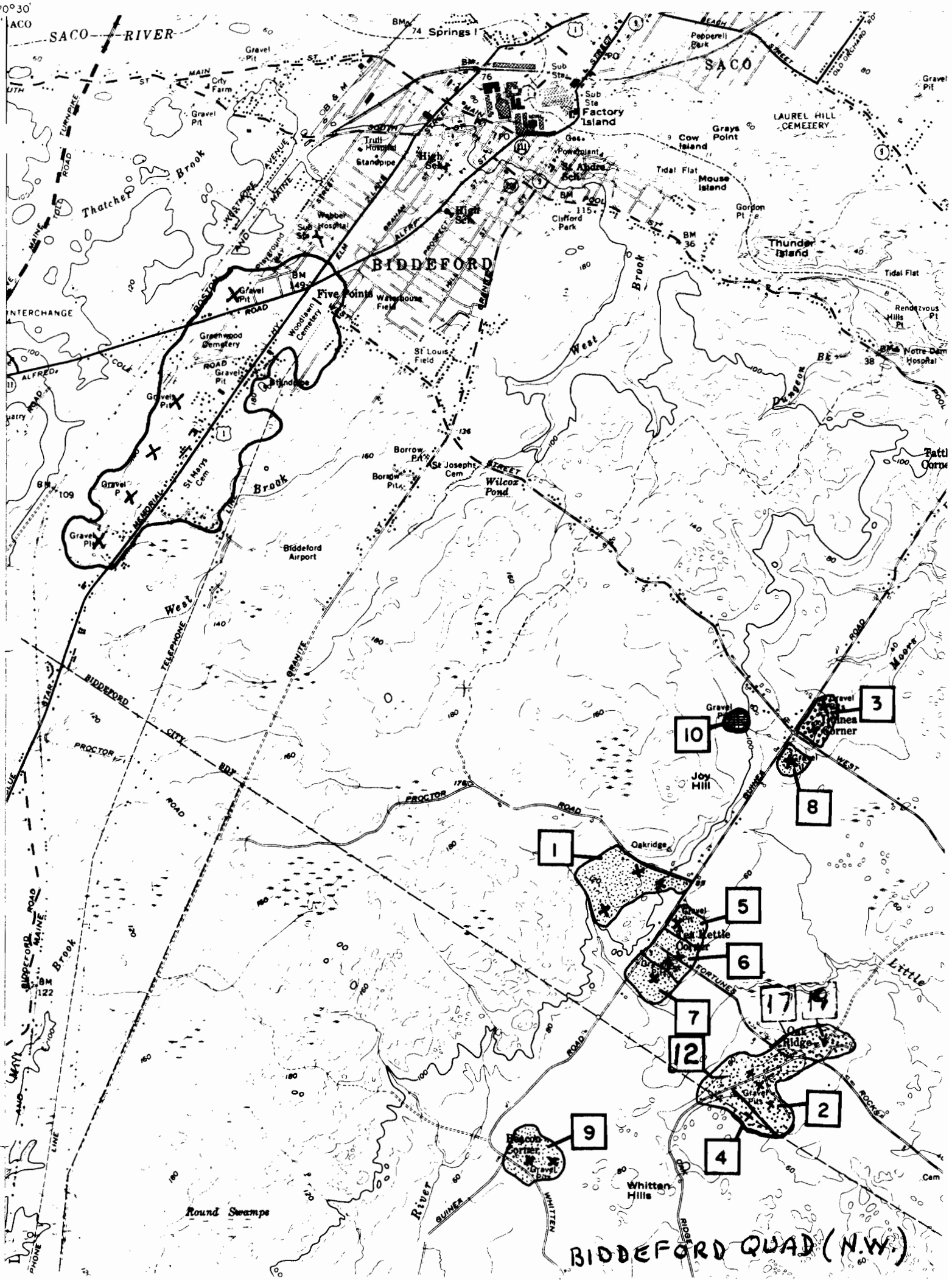


PORTLAND QUAD (S.W.)



BUXTON QUAD. (S.E.)

DAYTON
HILL
CITY BDY
Sudn
Cem
HOLLIS
ROAD
BM
SACO
Brook
SOUTH ST
Pond
BIDDEFORD
CITY
BIDDEFORD
Reservoir
Hopper
BOUNDARY
INTERCHANGE 4
North Chapel Sch
North Chapel
Brimstone Pond
BRIMSTONE
ROAD
NEW RD
4 LANE
ARUNDEL
Davis Pond
LIMERICK
TURNPIKE
MOUNTAIN
RD
Bk
Durell Sch
Duck
KIMBALL LA
Downing
Borrow Pit
CAMPGROUND RD
GRADE
KENNEBUNK QUAD (NE.)
(BIDDEFORD)


70°30'
43°30'
SACO RIVER
SACO
Springs I
Factory Island
LAUREL HILL CEMETERY
Grays Point
Cow Island
Mouse Island
Thunder Island
Tidal Flat
Thatcher Brook
BIDDEFORD
Five Points
Trull Hospital
Standpipe
High Sch
Webber Hospital
Clifford Park
Gordon Pt
Rendezvous Hills Pt
Notre Dame Hospital
Dungeon Bk
West Brook
Greenwood Cemetery
Woodlawn Cemetery
Warehouse Field
St Louis Field
Borrow Pit
St Josephs Cem
Wilcox Pond
St Marys Cem
Biddeford Airport
Joy Hill
Oakridge
Little River
Round Swamps
Whitten Hills
Gravel Pit
3
10
8
1
5
6
7
12
17
19
2
4
9
BIDDEFORD QUAD (N.W.)

(KENNEBUNK)

APPENDIX B

DRAINAGE STUDY

SACO

PROJECT 195-2 (1)

SEPTEMBER 1975

Hydrologic data for sixteen watershed areas bordering this project are tabulated on the attached data sheets. Watersheds are shown on two attached drainage maps.

Ridge lines were delineated on very good quality airphotos flown 4/21/65 at the scale of 1" = 500' and 1" = 1000'.

This study was done in September of 1973, at which time spot field checks were made.

R. G. Woodman
Soils Research Scientist

Att: Two Date Pages
Two Drainage Maps

APPENDIX B

DRAINAGE STUDY

SACO

Project 195-2 (1) October, 1973

Area No.	Station	AREA Acres	AREA SqMi.	POTTER Stor. Ind. K. %	1021 LF	BENSON Slope Ft/Mi.	BENSON Stor. Acres	RATIONAL Elev. Drop (Ft.)	RATIONAL Dist. (Ft.)	RATIONAL Runoff Coef. C.	RATIONAL Chan. Type Factor	RATIONAL Approx. % Forest	Remarks
1							MAIN LINE						
1	111+00	508	.79	24.0	0.15	29	122	53	10000	N/A	1	90	
2	117+50	57	.09	8.7	0.2	39	5	30	2600	0.15	1	100	
3	133+70±	1055	1.65	13.5	N/A	29	142	67	12200	N/A	1	50	Includes Areas 1, 2, 10, 11 and 15
4	142+00±	32	.05	——	0.6	70	——	28	1600	0.5	1	30	
5	166+00	42	.07	7.1	0.4	21	3	16	2300	0.3	1	95	
5A	174+00±	15	.02	27.0	0.3	35	4	11	1150	0.25	1	95	Small swampy area
6	192+00±	30	.05	10.0	0.55	31	3	19	2100	0.5	1	30	Includes area 14
7	203+00	12	.02	——	0.4	115	——	45±	1350	0.4	1	75	Could possibly be carried ahead in left ditch, omitting need for culvert.
8	215+00	36	.06	——	0.45	140	——	81±	2600	0.45	1	40	Includes area 7.
9	228+00	3172	4.96	8.5	N/A	31	270	134	20700	N/A	1	N/A	Goosefare Brook. (Includes all area.)
							ROUTE 112 CONNECTOR						
10	18+00	84	.13	7.1	0.35	9	6	8	2750	0.3	1	25	
11	39+50	982	1.53	14.3	0.35	31	140	65	11500	N/A	1	N/A	Includes areas 1, 2, 10, 15

Area No.	Station	AREA Acres	AREA SqMi.	POTTER Stor. Ind. K. %	1021 LF	BENSON Slope Ft/Mi.	BENSON Stor. Acres	RATIONAL Elev. Drop (Ft.)	RATIONAL Dist. (Ft.)	RATIONAL Runoff Coef. C.	RATIONAL Chan. Type Factor	RATIONAL Approx. % Forest	Remarks
							U. S. ROUTE 2						
12	——	2110	3.3	9.6	N/A	39	203	115	15800	N/A	1	N/A	
13	——	31	.05	16.0	0.5	26	5	16±	2300	0.45	1	65	Includes area 5A proposed just north of interchange.
14	——	20	.03	15.0	0.5	10	3	6±	1300	0.5	1	50	At proposed interchange.
15	Beneath southerly ramp at Turnpike Interchange	49	.08	——	0.35	78	——	30	2350	0.3	1	65	

APPENDIX B

DRAINAGE AREAS

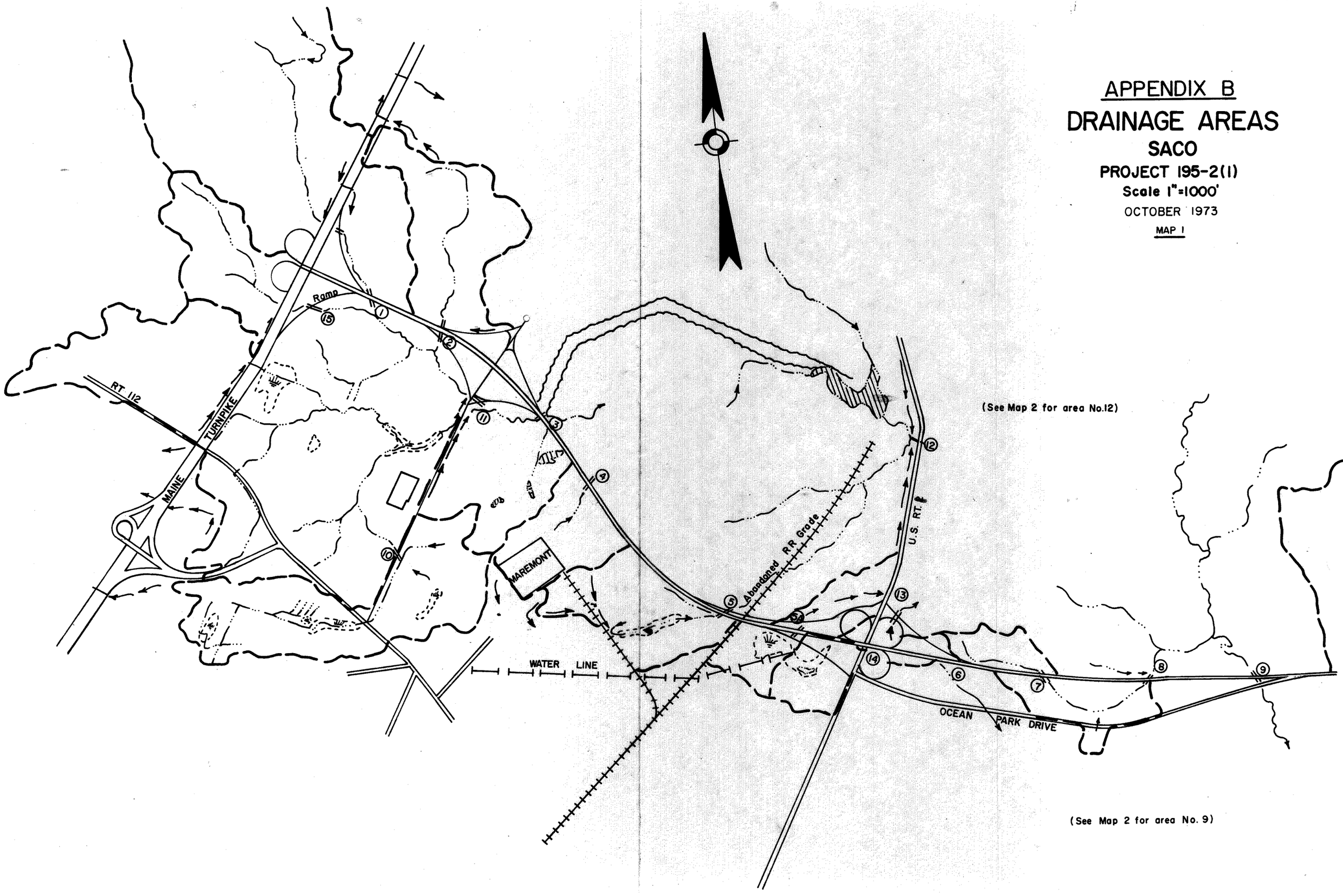
SACO

PROJECT 195-2(1)

Scale 1"=1000'

OCTOBER 1973

MAP 1

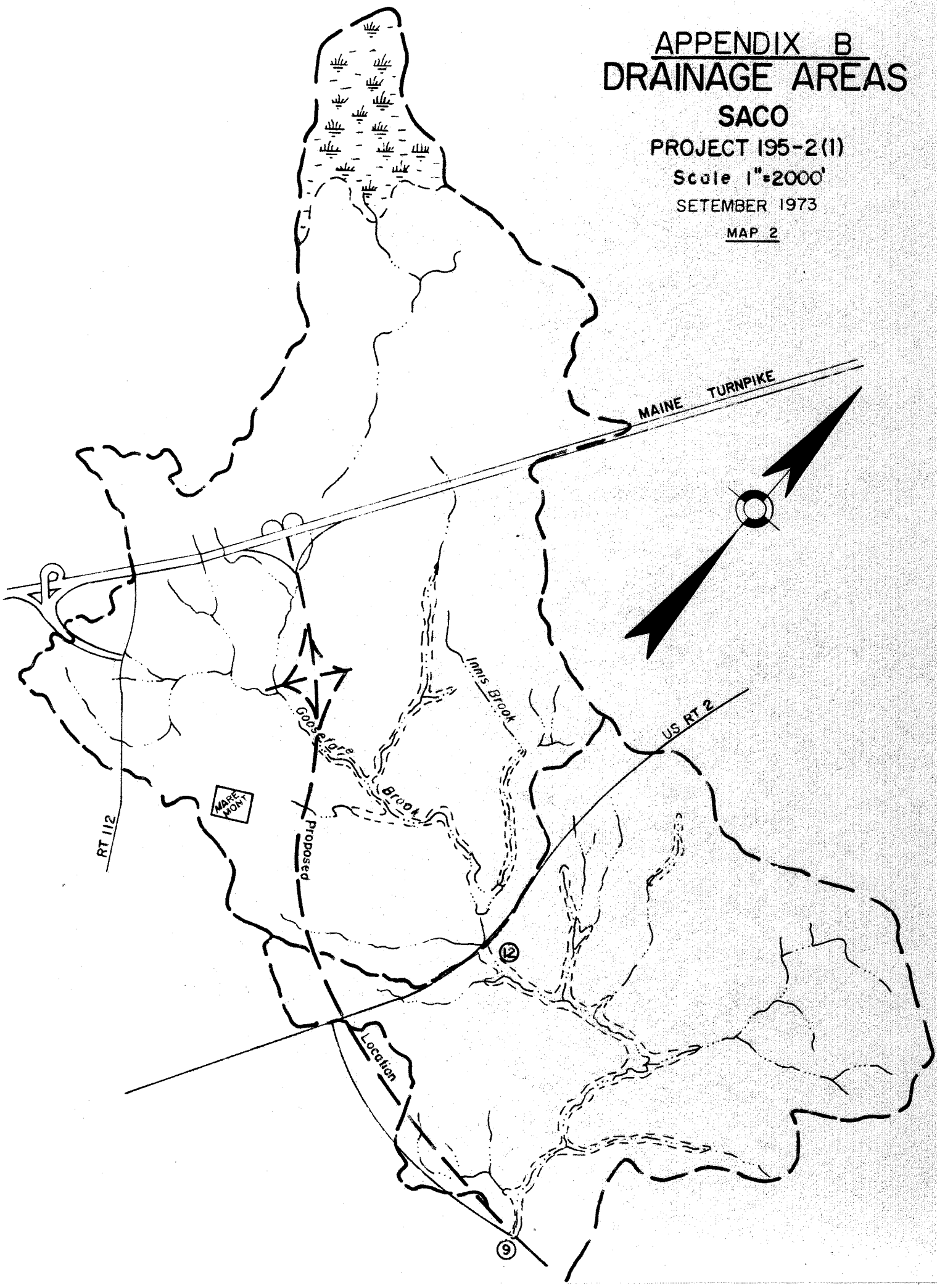


APPENDIX B
DRAINAGE AREAS
SACO
PROJECT 195-2(1)

Scale 1"=2000'

SETEMBER 1973

MAP 2

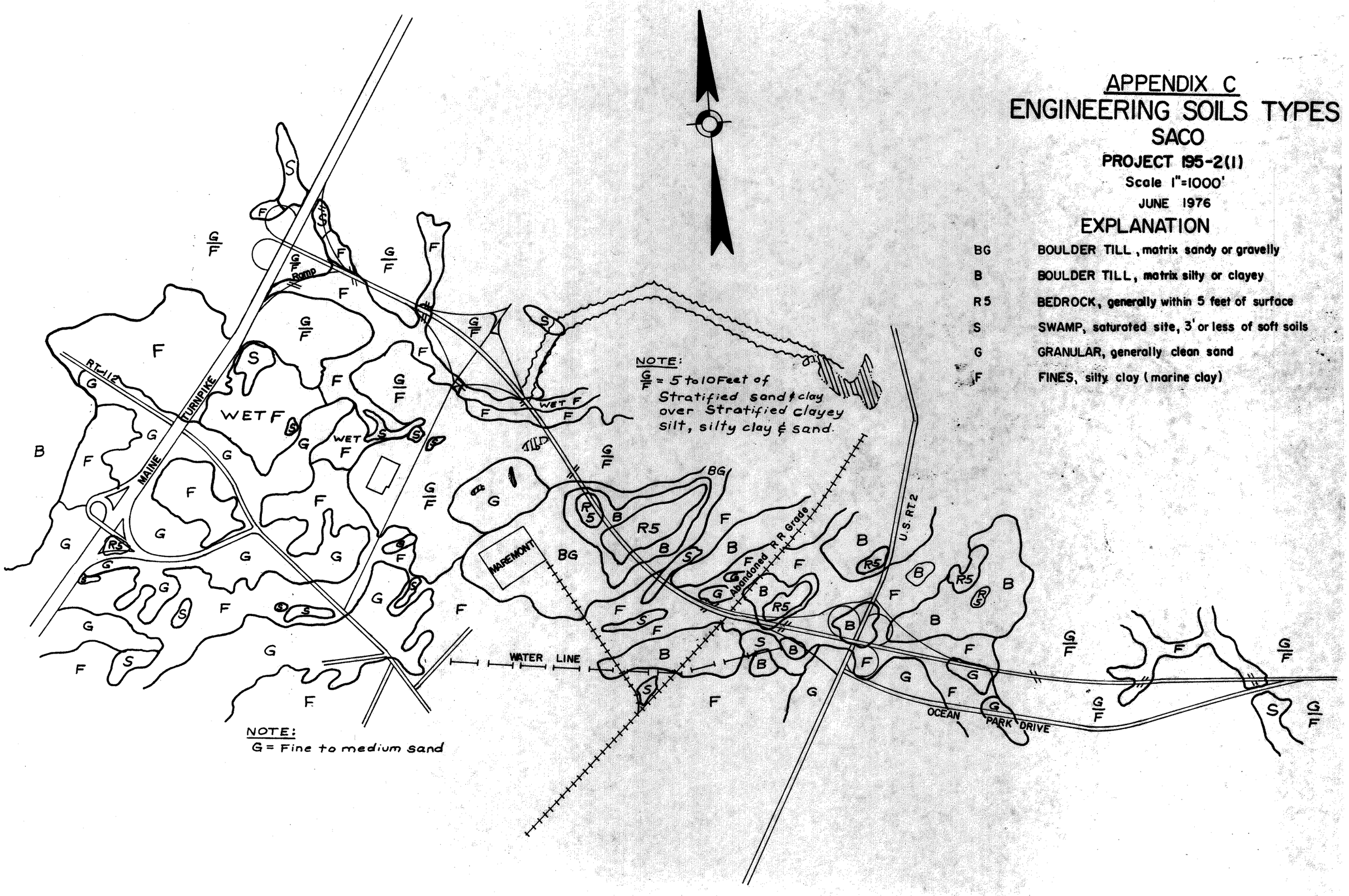


APPENDIX C
ENGINEERING SOILS TYPES
SACO

PROJECT 195-2(1)

Scale 1"=1000'

JUNE 1976

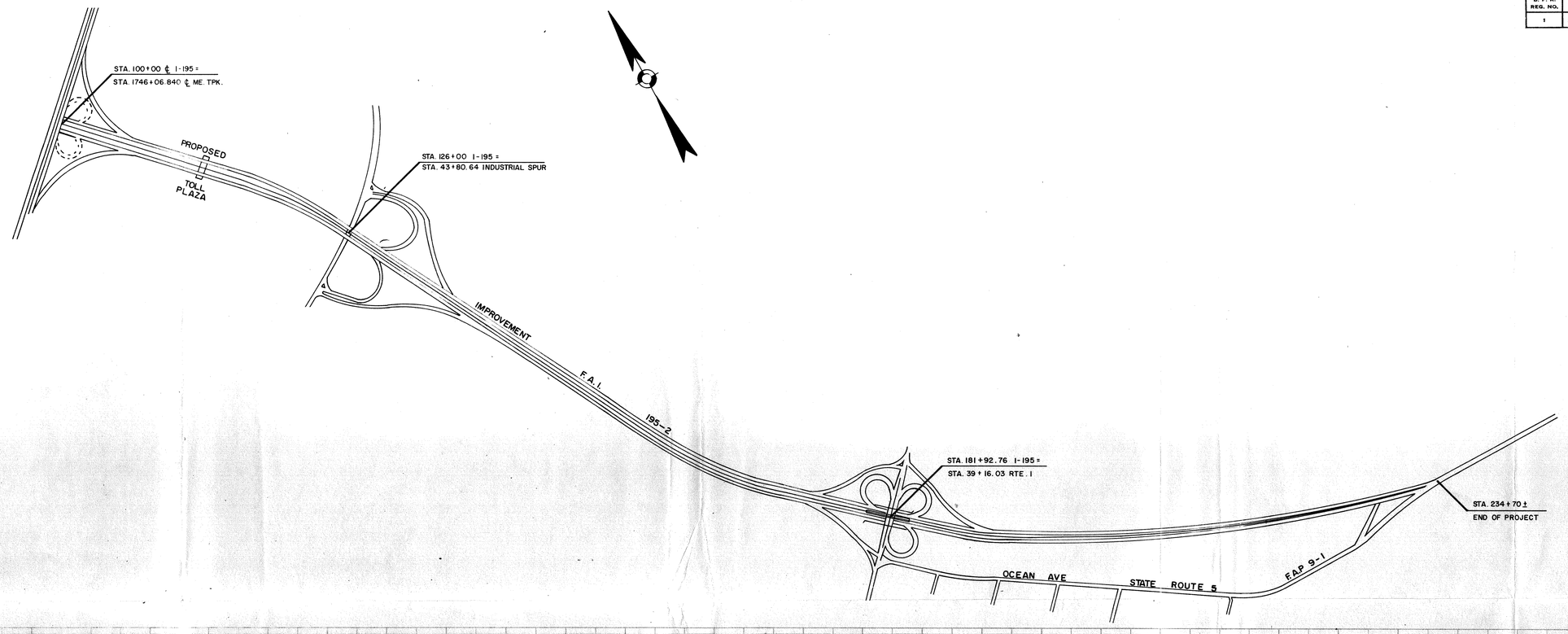
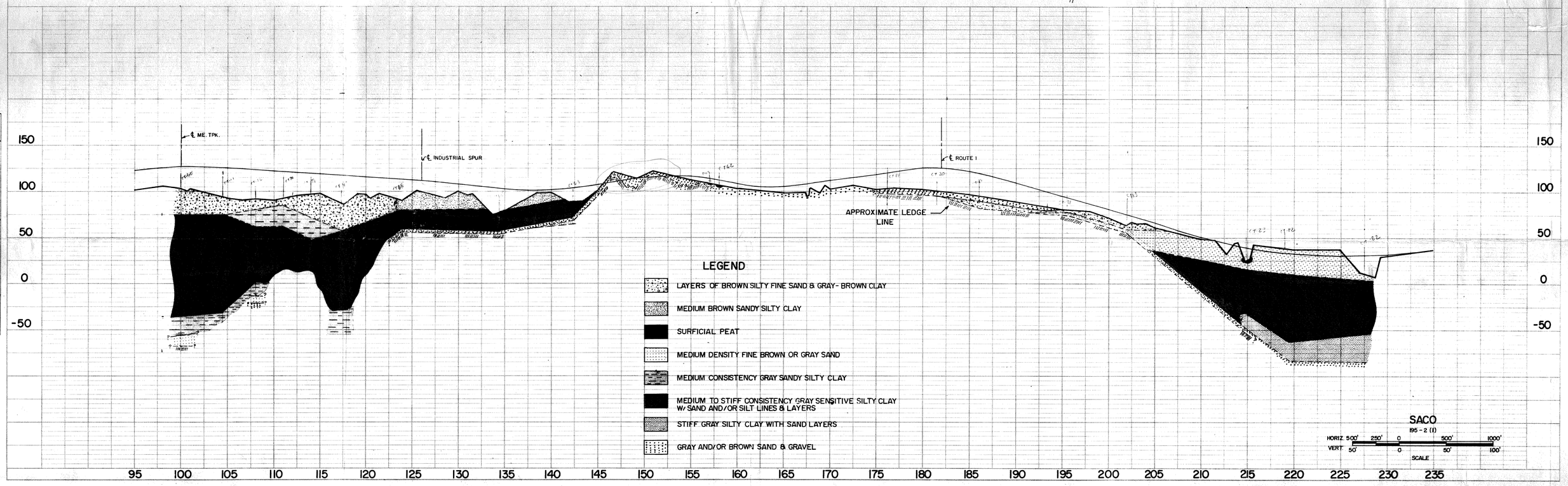


EXPLANATION

BG	BOULDER TILL, matrix sandy or gravelly
B	BOULDER TILL, matrix silty or clayey
R5	BEDROCK, generally within 5 feet of surface
S	SWAMP, saturated site, 3' or less of soft soils
G	GRANULAR, generally clean sand
F	FINES, silty clay (marine clay)

B. P. R. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE		4	

PLAN		BY	DATE
NOTE BOOK	SURVEYED		
	PLOTTED		
	ALIGNMENT CHECKED		
	RT. OF WAY CHECKED		
NO.			



PROFILE		BY	DATE
NOTE BOOK	SURVEYED		
	PLOTTED		
	GRADES CHECKED		
	B. Ms. NOTED		
NO.	STRUCTURE NOTATIONS CH'KD.