HAMPDEN INTERSTATE
PENOBSCOT COUNTY
SOILS REPORT
SOUADABSCOOK RIVER
I-95-7(14) 61-28
CENTER BRIDGE

SUBSURFACE INVESTIGATION FOR

CENTER BRIDGE, SOUADABSCOOK STREAM

PENOBSCOT COUNTY

HAMPDEN, MAINE

**Maine State Highway Commission**

**Soils Division**

61-28

**AUGUST 1961**

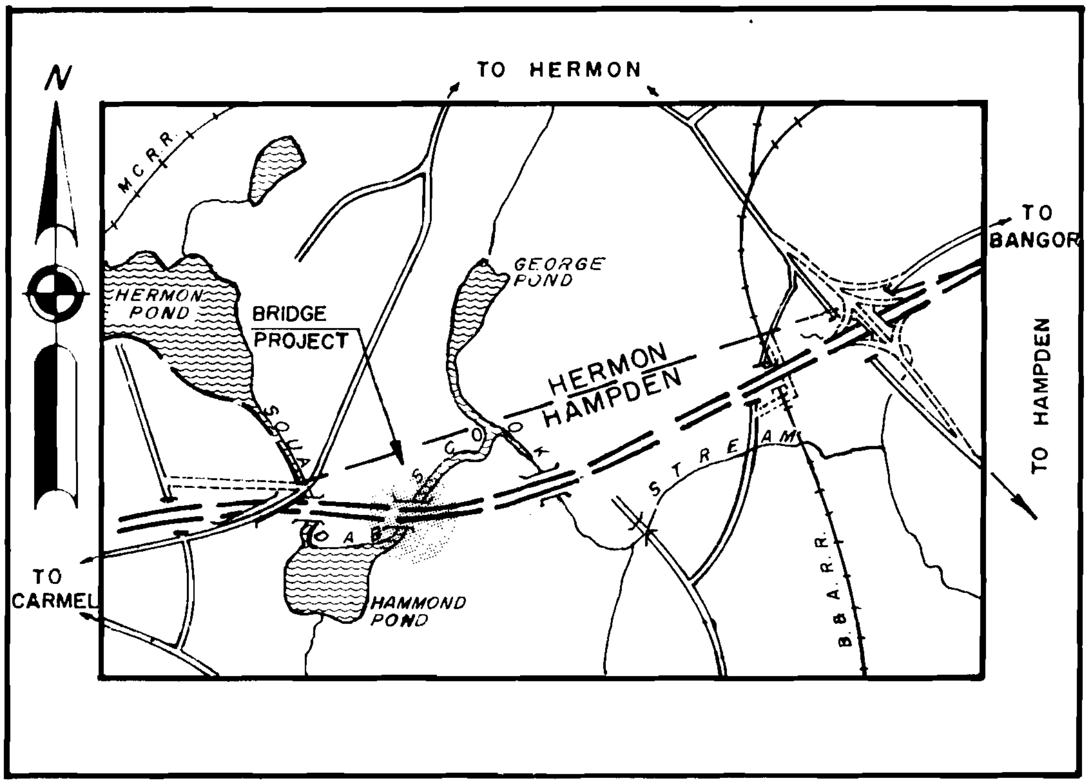
# HAMPDEN

## PENOBSCOT COUNTY

## PROJECT NO. I-95-7(14)

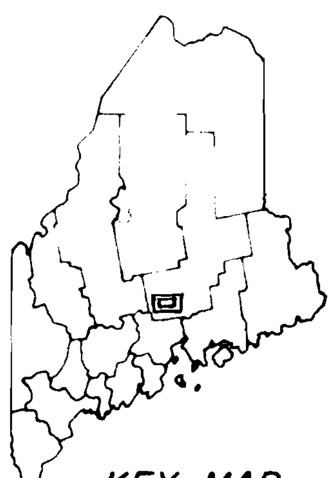
## CENTER BRIDGE, SOUADABSCOOK STREAM

## 1961




LOCATION MAP

Scale: 1" = 1 Mile



KEY MAP

## CONTENTS

CONTENTS (CONT.)

# INTRODUCTION

A subsurface investigation has been completed for the proposed substructure units for the two bridges required to carry the Interstate across the center crossing of the Souadabscook Stream for both northbound and southbound lanes. The subsurface investigation for the approach fills to these structures is also included in this report. This proposed bridge location is part of the Interstate Project I-95-7 (14) in the Town of Hampden, Maine, and is the second of three crossings of the stream required because of poor soils conditions further to the north as mentioned previously in the reports on the West and East Bridge locations. This crossing is the most difficult of the three due to the depths of very sensitive clay and detailed investigations were required on two of the abutments to eliminate the possibility of shear failures.

Preliminary soundings within the bog area were made in the winters of 1959 and 1960 and upon receipt of the plan for the bridge location wash borings were made in March, April and May of this year by the drilling crews under the supervision of Mr. Brown and Mr. Badershall.

Included with the illistrations within this report are the boring notes on Sheets 1 and 2. The boring details for the proposed structures are shown on Sheets 3 through 17. The pressure void ratio diagram summary for the consolidation tests and the direct shear diagram are shown on Sheets 18 and 19 respectively. Stress diagrams for the settlement analysis are shown on Sheet 20. The shear analysis summaries are shown on Sheets 21 through 23. The transverse sections at the substructure locations are shown on Sheet 24 and the foundation survey including the plan and soils profiles along center line for both northbound and southbound roadways are shown on Sheet 25.

## GENERAL CONDITIONS

Due to the presence of the extensive Hermon Bog to the north, it was found that better, although not good, soil conditions were present on the southerly location of the alignment for the Interstate Highway between Newport and Bangor. This southerly alignment requires three crossings of the Souadabscook Stream which flows in an oxbow in this area. This structure is for the center crossing of the stream.

No heavy flows should be expected within this stream. Therefore, scour is not one of the critical factors for the substructure units at this bridge location. However, the drainage area serviced by the stream is extensive and it was noted that the high water elevation of 130.5 was reached in the flood of 1936 and also 1955, therefore, requiring the high finished grade in this area of slightly less than 136 elevation.

At the location of this crossing, extensive areas of peat and organic silty clays up to ten feet in depth are found and must be removed before the embankments and substructures can be constructed. Ledge or dense sand and gravel directly overlying ledge is found at all locations of the substructures and therefore they can be supported with piles driven to the ledge or into this overlying dense sand and gravel. The ledge in general is a phyllite with a high angle foliation which is sometimes very badly broken and eroded near the surface.

Due to the erosion of the stream during the past ages a variety of soils are found in the river channel and below the peat. The general pattern is peat underlain by a layer of stiff gray silty clay which in turn is underlain by a medium consistency gray silty clay with black spots. Below this is found a soft sensitive gray varved silty clay which lies directly upon the sand and gravel layer over the ledge. The gray silty clays with black spots and soft gray varved silty clays are very sensitive due to their high water contents in relation to their liquid limits and therefore, care must be taken not to disturb these soils since liquification could result in complete loss of shear strength. Similarly, care should be taken not to weaken the layer of stiff gray silty clay which serves to bridge and distribute the load over the soft materials below with its high shear strength. At various points within the existing stream bed the flow has cut down through the stiff gray silty clay layer and the various layers below it all the way down to the sand and gravel overlying the ledge.

Since the stream is to be relocated to the east, fills of approximately 26 feet will be required on the approaches to the structures from the west side of the stream. In the areas where the stream has eroded the upper layer of stiff gray silty clay and also where the depths of the soft gray silty clay (varying from 10 to 20 feet) are relatively deep, shear problems requiring a stage-type construction and long-term settlement should be anticipated. These areas are located on the west abutment of the northbound land and east abutment of the southbound lane. Since high fills are required on the abutments and soft compressible soils are found throughout the site, it is recommended that piles be driven to support the substructures. The sand and gravel layer found in most areas below the soft clays will aid in the consolidation by reducing the time and providing shorter drainage paths for the water in the voids of the soft clay.

## SUBSTRUCTURE DETAILS

### Northbound Lane

Abutment No. 1. Due to the relocation of the river channel to the east, a high approach fill will be required across the existing river channel. Borings AB 30 and AB 29 (shown on Sheets 3 and 4 respectively) are located at the left and right ends of Abutment No. 1. The existing river channel is at elevation 110 with a finished grade at elevation 136 proposed at the abutment. Therefore, a fill of 26 feet will be required behind Abutment No. 1.

A layer of stiff gray silty clay was noted between elevations 115 and 105 on the right side of Abutment No. 1. However, at the left end of the abutment this layer was not found. Beneath this stiff layer on the right, and immediately at the surface on the left, was found a medium consistency sensitive gray silty clay with black spots extending downward to elevation 96. This layer in turn is underlain by a medium to soft sensitive gray varved silty clay with sand and silt layers in the lower portions extending downward to elevation 90. Ledge was cored at elevation 90.6 on the left and elevation 87.5 on the right. This ledge was found to be a phyllite with a high angle of foliation with the surface broken and eroded on the right end of the abutment. On the right a thin layer of silty sand and rocks was found between the ledge surface and the gray sensitive varved clay above. The transverse section of this abutment is shown on Sheet 24, while the plan and center line soils profile are shown on Sheet 25.

Since a layer of approximately 20 feet of soft compressible materials exists below this fill, it should be expected that appreciable settlement will occur. A stress diagram for conditions below this fill is shown on Sheet 20. The pressure void ratio diagrams for this material are shown on Sheet 18. The pressure void ratio diagrams indicate that this material has been preconsolidated and therefore, the settlement will not be extremely large. Approximately 1.1 feet of settlement should be expected on the left and slightly less on the right due to the presence of the layer of stiff clay. A settlement of 0.8 of a foot should occur in the 14-foot layer of gray silty clay with black spots and .3 of a foot in the lower six-foot layer of gray varved silty clay. In the upper 14-foot layer of material the consolidation will be relatively slow with 50 per cent occuring in the first 16 months and 90 per cent occuring within five and three-quarters years. In the lower six feet of varved material, settlement will be quite rapid due to the thinness of the layer and the presence of sand lines. Fifty per cent of the settlement should occur within three months and 90 per cent should occur within one year.

Due to the 26-foot height of fill required in this approach and the presence of approximately 20 feet of sensitive clay beneath, a shear problem exists in this location. A shear analysis of this approach fill, a summary of which is shown on Sheet 21, indicates that if the embankment were constructed to its full height, finished grade 136, the factor of safety against shearing would be 1.032, and a shear failure would be likely to occur. It is therefore imperative that a stage-type construction be used. The shear analysis indicates that if the height of embankment were reduced by four feet to elevation 132 for a distance of 100 feet behind the abutment a safety factor against shearing of 1.23 would result. Since this is a bridge abutment toe fills cannot be used. The difficulty arises from the excavation of the channel which reduces the resisting movement in the shear analysis.

If the embankment were built up to within four feet of finished grade, elevation 132 and allowed to stand and consolidate for approximately one year, the shear strength should increase sufficiently to support the additional four feet of material and the desired finished grade of 136 can be obtained. As indicated in the settlement analysis the lower six foot layer of varved materials will consolidate relatively quickly with 90 per cent consolidation taking place within one year. After 90 per cent consolidation has occurred within this layer, the shear strength should increase sufficiently to provide a safety factor of 1.38 with the full height of fill. Since the upper 14 feet of material, gray silty clay with black spots, will consolidate very slowly and has already been subjected to a preconsolidation load, little increase in the shear strength should be expected within this period of one year and, therefore, no change in strength within this layer was considered in the analysis.

To avoid the possibility of shear failure in this area the embankment should only be brought up to elevation 132 and no higher. This would necessitate leaving off the upper four feet of material which would include the one foot of granular borrow and the lower and upper gravel base courses and surface. The embankment should be kept at elevation 132 for 100 feet behind Abutment No. 1 starting at Station 3515 ≠ 85.

In order to determine if settlement is occuring as anticipated and to provide comparison data for future settlement analysis a settlement platform is to be installed on the inside shoulder to the left of Station 3516 ≠ 60 on the northbound lane. This platform is to be placed on the same surface upon which the fill for the embankment is to be added. If peat or organic soils are excavated above the silty clay soils, the platform should be placed directly upon the surface exposed by the excavation.

Due to the expected settlement and stage-type construction required by the shear problem, it is believed that the substructure for this unit can be best supported by piles driven through the approach fill and the underlying soils to the ledge surface at elevations 90.6 on the left and 87.5 on the right, as indicated in the transverse sections. Steel piles are therefore recommended, although cast-in-place concrete piles could perform satisfactorily. Wooden piles would not be satisfactory because of the cut-off above the ground water table.

Pier No. 1. Borings AB 32 and AB 28 were made on the left and right ends respectively of the proposed location of Pier No. 1 at Station 3517 + 25. The details for these two borings are shown on Sheets 5 and 6. The transverse profile at the substructure unit is shown on Sheet 24 and the plan and center line profiles are shown on Sheet 25. These two borings were made within the stream bed which was found to be at elevation 110 at both locations. A layer of medium consistency sensitive gray silty clay with black spots was found to extend to elevation 97 on the left and elevation 100 on the right. Below this layer was a sensitive gray varved silty clay extending to elevation 91 on the left and 93 on the right. This material varied in consistency from medium to soft. Below this was found a dense silty sand and gravel lying directly upon ledge surface. Ledge was cored on the left at elevation 89.6 and on the right at elevation 85.6. The ledge was a phyllite with high angle foliation with calcite strengers and was eroded on the surface.

Since these soils are compressible and within the stream area, piles are recommended to support the substructure for this unit. It is believed that piles can be driven to the ledge surface on the left with little difficulty since the granular layer is thin. However, on the right high casing blow counts and spoon counts indicate that very dense soils are encountered at approximately elevation 88 and it is likely that piles cannot be driven beyond this depth. However, this material should adequately support this structure. Steel piles would be recommended because of the underlying soils. However, cast-in-place or wooden piles would perform satisfactorily provided the latter are cut off below the minimum stream level.

<u>Pier No. 2</u>. Borings CB 23 and AB 31 were made on the left and right ends respectively for the proposed location of Pier No. 2 at Station 3517 + 75. The details for these borings are shown on Sheets 7 and 8. The transverse profile is shown on Sheet 24 and the plan center line soils profile is shown on Sheet 25. Boring CB 23 was made on the bank of the stream at elevation 122.0 while Boring AB 31 was made in the old stream bed at elevation 116.1. Above elevation 116 on Boring CB 23 a layer of soft brown silty peat and layered silty clay and peat were noted. Between elevation 116 and elevation 106.5 a layer of stiff gray silty clay was found in both borings. The layer of medium consistency sensitive gray silty clay previously noted on Pier No. 1 is also found at this location and extends to elevation 103 on the left and elevation 97 on the right. This layer is underlain again by the soft to medium sensitive gray varved silty clay extending to elevation 95 on the left and 90 on the right. A ledge surface was encountered at elevation 87 on the left and elevation 82.1 on the right. This ledge surface was overlain by a layer of gray sand, rocks

and gravel varying in density from medium to dense.

It is recommended that the substructure for this pier be supported by piles driven through the underlying soils into the layer of sand gravel or the ledge although it is doubtful if piles can reach the bedrock surface due to the denseness of this granular material. However, piles should be able to penetrate to the vicinity of elevation 90 on the left and 83 on the right. Steel piles would be recommended; however, cast-in-place concrete or wooden piles could be used provided the latter are cut off below the ground water table.

Abutment No. 2. Borings CB 22 and CB 21 were made on the left and right ends of the proposed abutment at Station 3518 ≁ 15. The boring details are shown on Sheets 10 and 9. The transverse section for the abutment is shown on Sheet 24 and the plan and soils profile along center line is shown on Sheet 25. At Boring CB 22 on the left between elevation 122, which is the surface, and elevation 114 a layer of mixed loose brown sand and peat and a lower layer of very loose gray silty sand were found. At Boring CB 21 on the right, the surface elevation is 112.6 and layers of loose brown sand and mixed silt and peat were found to an elevation of 114. Due to the compressibility of these materials they should be removed before the embankment for the approach fill is constructed. This would entail excavation from elevation 122 to elevation 114, to the top of the gray stiff clay layer which underlies these materials to elevation 107. Care must be taken not to disturb this stiff underlying clay layer, since its full strength is necessary to prevent a shear failure. This stiff gray silty clay layer is underlain by a layer of stiff to medium gray silty clay with black spots to elevation 104 on the left and 102 on the right. This material in turn is underlain by the previously noted medium consistency gray varved silty clay with sand lines being noted in the lower portion to elevation 98 on the left and 96.6 on the right. In this location on the right at Boring CB 21 the varved material lies directly upon the ledge at elevation 96.6. However, on the left this varved material is underlain by dense silty gravel to elevation 85.1, where the ledge surface is encountered. The ledge encountered was a phyllite with a high angle of foliation, somewhat eroded in the upper portion.

A settlement analysis beneath this abutment and approach fill indicates that a maximum of 0.7 of a foot of settlement should be anticipated. However, due to the relative thinness of the clay layers, this settlement should occur rapidly and if approximately two years were allowed between start of construction and placing of the pavement, all appreciable settlement should have occurred. A shear analysis in the area indicates that a factor of safety of 1.28 exists with the full height of fill. Therefore, no shear problem should be anticipated.

Since the embankment should be built up early in the construction to speed the settlement, it is therefore recommended that the substructure be supported on piles driven through the embankment and subsoils to elevation 95 on the left and 96.6 on the right. Steel piles would be recommended; however, cast-in-place concrete piles could be used. Wooden piles would not be satisfactory due to the cutoff above the ground water table.

## Southbound Lane

Abutment No. 1. Boring CB 37 was made at the left end of Abutment No. 1 while Borings CB 36 and CB 38 were made at the right end of the abutment. The additional boring, CB 38, was made when rocks or ledge were noted at a shallow depth on Boring CB 36 and no core was recovered. The details of these three borings are shown on Sheet 11 while the transverse profile is shown on Sheet 24 with the general plan and soils stratification shown on Sheet 25. Due to the relocation of the stream channel to the east, this abutment will fall approximately in the center of the existing stream bed and a high approach fill will be required behind this abutment.

Although no peat or organic soils are noted at the actual abutment location, layers of peat and organic soils will likely be found in some areas beneath the approach fill and toe of the slope. This peat and organic material should be removed before the fill is placed. The elevation of the stream bed was found to be 106.8 on the left rising to elevation 113.5 on the right 15 feet from center line and dropping sharply to elevation 107.3, 17 feet right of center line. On the left a layer of soft gray silt was noted to elevation 104.5 below which, extending to the ledge surface was a dense coarse gray sand and gravel. However, on the right a layer of soft gray varved silty clay extends downward from the surface to elevation 102.5 at Boring CB 36 and elevation 100.5 at Boring CB 38. Ledge was cored at elevation 96.8 on CB 37 and 98.3 on CB 38. Ledge or rocks were cored at elevation 102.5 on CB 36; however, no core was recovered. Although an approach fill approximately 26 feet in height will be required in the area behind this abutment, all settlement should be quite rapid and occur within twelve months due to the thinness of the layer of compressible soils. Since the depth of soft soils is small, no shear difficulties should be encountered at this abutment. The ledge was noted to be a phyllite with a high angle of foliation. It is believed that piles can be driven to the ledge surface with little difficulty; however, it should be noted that rocks or ledge was noted at a high elevation on the right at CB 36 dropping sharply to the right beyond this point. Steel piles would be recommended although cast-in-place concrete piles could be used satisfactorily. Wooden piles would not be satisfactory because of the cutoff above the ground water table. Piles could be driven to the ledge surface at 96.8 on the left and 102.5 or 98.3 on the right.

Pier No. 1. Since at the time the borings were set up the exact station of the piers and abutment was not known, the actual borings on the remaining two piers and abutment on the southbound lanes are not located on the actual structure location. However, an interpolation of the soils profiles for the substructure location is shown on the transverse section on Sheet 24. The interpreted soils stratification on Pier No. 1 was obtained from Borings AB 34 and AB 33, shown on Sheet 12, on the left and Borings AB 35 and CB 24 on the right, shown on Sheets 17 and 13.

The location of this pier is still within the existing stream with the stream bed surface noted at elevation 110 on the left and 114 on the right. A deposit of peat extending downward to elevation 110 was found on the right side in this area. Below the peat and from the surface downward on the left a layer of stiff to medium gray silty clay was noted to elevation 108.5 on the left and 104.5 on the right. This layer is underlain directly by a soft gray varved silty clay to elevation 105.7 on the left and 101 on the right. Below this was sand and gravel becoming dense only directly above the ledge surface, which was noted, on the interpolated transverse section, to be at elevation 98 on the left and 95 on the right. The ledge was noted to be a phyllite with a high angle foliation.

It is recommended that the substructure for this pier be supported by piles driven through the underlying soils to approximately elevation 100 on the left where the sand and gravel becomes dense and elevation 95 on the right to ledge. Steel piles would be recommended; however, cast-in-place or wooden piles could be used provided the latter are cut off below the ground water table.

Pier No. 2. The transverse profile for this pier was determined from Borings AB 33, Sheet 12, and CB 26, Sheet 14, on the left and Borings CB 24, Sheet 13, and CB 25, Sheet 16, on the right. At this location the ground surface was found to be at approximately elevation 120; however, a layer of soft brown peat extends downward to elevation 115 on the left and elevation 113 on the right. A layer of stiff to medium gray silty clay with scattered black spots extends downward on the left to elevation 108 and on the right to elevation 106. This layer is underlain by a soft gray varved silty clay with sand lines in the lower portions extending downward to elevation 103 on the left and 102 on the right. The interpreted ledge surface was found to be at elevation 94.5 on the left and elevation 97 on the right. The ledge was a phyllite similar to that found on Pier No. 1. Between the soft gray varved silty clay layer and the ledge surface, a layer of dense sand and gravel was noted.

It is recommended that the substructure for this pier be supported by piles. Because the sand and gravel overlying the ledge is dense, it is likely that piles can be driven only to elevation 95.5 on the left and elevation 99 on the right. Steel piles would be recommended; however, cast-in-place or wooden piles could be used provided the latter are cut off below the ground water level. Because of the shear problem which exists on Abutment No. 2 care should be taken not to disturb or cut into the layer of medium to stiff clay just below the peat.

Abutment No. 2. Behind this abutment a fill of approximately 20 feet to finished grade will be required and a shear problem exists. The interpreted transverse profile for this abutment is shown on Sheet 24. The interpolation was made between Borings CB 26, Sheet 14, and CB 27, Sheet 15, on the left and CB 25, Sheet 16, and CB 28, Sheet 17, on the right. The plan and center line soils profiles are shown on Sheet 25. Throughout this area behind and ahead of the abutment, a layer of soft brown peat extends downward from elevation 121.5 to 117. This peat layer should be removed before the embankment is constructed. Care should be taken not to disturb or cut into the layer of stiff to medium consistency gray silty clay which lies directly below this peat layer. This stiff to medium clay extends downward to elevation 112 on the left and elevation 107 on the right. This layer is underlain by medium to soft sensitive gray silty clay with black spots to elevation 106 on the left and 102.5 on the right, below which a layer of soft sensitive varved silty clay was noted to extend to elevation 98.5 on the left and elevation 94.5 on the right. The interpreted ledge surface was found to be at elevation 94 on the left and 90.5 on the right. The ledge in this area was found to be phyllite with a high angle of foliation.

A maximum depth of 18 feet of soft compressible materials will be found beneath this fill. A settlement analysis indicates that 0.8 of a foot of total settlement should be anticipated beneath this embankment. Five tenths of a foot should be expected in the upper layer of gray silty clay with black spots. Due to the thickness of the layeb and the overlying layer of stiff clay, settlement in this layer will be slow with 90 per cent occuring within four years and 50 per cent occuring within twelve months. In the lower layer of gray varved silty clay .3 of a foot of settlement should be expected. This will occur rapidly with 90 per cent occuring within twelve months and 50 per cent within three months.

A previously mentioned, a shear problem exists within this embankment. A shear analysis shown on Sheet 23 indicates that if the full height of fill were constructed to elevation 136, the minimum safety factor would be 1.068 and, consequently, a shear failure might result. The analysis also found that if the upper four feet of material consisting of one foot of granular borrow and the upper and lower base courses were left off, resulting in constructing only to elevation 132, the factor of safety against shearing would be 1.28 which is adequate. This upper four feet of material should be left off for a distance of 100 feet beyond the abutment. As previously determined in the settlement analysis, consolidation in the lower layer of gray varved silty clay should be quite rapid with 90 per cent occuring within one year. The resulting increase in the shear strength in this layer with 90 per cent consolidation would increase the safety factor with the full height of fill to 1.30. Therefore, if the fill were built up to a maximum elevation of 132 and left to consolidate for a minimum of one year, the additional four feet of material could be added safely. Since the consolidation in the upper layer of gray silty clay material with black spots is slow no increase in shear strength due to consolidation in this layer was considered in the analysis.

In order to determine if settlement is occuring as anticipated and to provide comparison data for future settlement analysis, a settlement platform is to be installed in the inside shoulder to the right of Station 3518 + 00 on the southbound lane. This platform is to be placed on the same surface upon which the fill for the embankment is to be added. If peat or organic soils are excavated above the silty clay soils, the platform is to be placed directly upon the surface exposed by the excavation.

Due to the expected settlement and a stage-type construction required by the existing shear problem, it is believed that the substructure for this unit can be best supported by piles driven through the approach and underlying soils. The sand and rocks over the ledge beneath this abutment become quite dense just above the ledge surface and therefore it is unlikely if the piles can be driven all the way to ledge. However, they should be able to be driven to elevation 95 on the left and 92.6 on the right. Steel piles are therefore recommended although cast-in-place concrete piles could perform satisfactorily. Wooden piles would not be satisfactory because of the cutoff above the ground water table.

## SUMMARY

Piles are recommended to support the substructure units. It is believed that piles can be driven to the following elevations:

| | Left Side | Right Side |
|---|---|---|
| **Northbound Lane** | | |
| Abutment No. 1 | 90.6 | 87.5 |
| Pier No. 1 | 89.6 | 88 |
| Pier No. 2 | 90 | 83 |
| Abutment No. 2 | 95 | 96.6 |

| | Left Side | Right Side |
|---|---|---|
| Southbound Lane | | |
| Abutment No. 1 | 96.8 | 102.5 - 98.3 |
| Pier No. 1 | 100 | 95 |
| Pier No. 2 | 95.5 | 99 |
| Abutment No. 2 | 95 | 92.6 |

Steel piles would be recommended. However, cast-in-place concrete piles could be used. Wooden piles could be used on the piers if they were cut off below the ground water table.

Soft compressible soils underlie the area under each abutment. Due to the thinness of the layers of the soils on Abutment No. 2, northbound lane, and Abutment No. 1, southbound lane, the anticipated settlement should be quite rapid with the majority of it occuring before the time for paving the roadways in these two locations. However, on Abutment No. 1 on the northbound land and Abutment No. 2 on the southbound lane long-term settlement and shear problems exist. On Abutment No. 1, northbound lane, a maximum of 1.1 feet of settlement should be expected with 50 per cent occuring within the first year and the remainder taking up to five and three-quarters years. Because of the shear problem existing at this abutment, a stage-type construction is required. In the first stage the embankment should be constructed to elevation 132 and allowed to stabilize with no more material being added for a minimum of one year. This upper four feet of material should be left off for a distance of 100 feet behind the abutment. After the fill has stabilized for at least one year the additional four feet of material to bring the roadway to the desired finished grade can be added and with a safety factor of 1.38 which will adequately support the total height of fill, that is, to elevation 136.

A maximum settlement beneath Abutment No. 2 on the southbound lane of 0.8 of a foot should be anticipated. Five tenths (0.5) of a foot of this settlement should occur within the first twelve months and the remaining .3 of a foot will take up to four years. Since the factor of safety against shearing would be low if the full height of embankment were constructed in one lift, a stage-type construction is also required behind this abutment. In the first stage the embankment should be built up to a maximum elevation of 132, that is, four feet short of the desired elevation and allowed to stabilize for one year. After the embankment has consolidated and stabilized for one year, the shear strengths of the underlying soft varved silty clays should have increased sufficiently so that the total height of embankment to elevation 136 may be constructed with a safety factor of 1.30. This stage-type construction should be used for 100 feet beyond the abutment.

In most of the areas at the locations of the abutments and piers a layer of peat and organic materials is found on the surface. This material should be removed before the embankments are constructed. This material must also be removed within the new channel area. Care should be taken not to disturb the layer of stiff clay or underlying clay soils since these materials are quite sensitive and the shear strengths are critical.

Settlement platforms are to be installed behind Abutment No. 1

on the northbound lane at Station 3516 ≠ 60 in the left shoulder and behind Abutment No. 2 on the southbound lane at Station 3513 ≠ 00 in the right shoulder.

Report written by *Kenneth A. Dinsmore*

Kenneth A. Dinsmore

Report Approved by *F. M. Boyce*

Frederick M. Boyce, Jr.
Soils Engineer

cb

Sheet #1

| BORING NOTES | DETAIL SHEETS |
| --- | --- |
| 1. All samples and vanes are taken ahead of casing. | |
| 2. Scales and casing sizes as noted on drawings. | |
| 3. Ground water table indicated thus: | |
| 4. Number of blows of 275# hammer, falling 18", required to drive extra heavy casing one foot thus: | (Graphical) |
| 5. Location and designation of "dry" samples taken in S&H sampler #1290s indicated thus: | 1D |
| 6. Location and designation of "dry" samples taken in 2" O. D. 16 ga. seamless tubing indicated thus: | 4C |
| 7. Location and designation of "dry" samples taken in $3\frac{1}{2}$" O.D. 16 ga. seamless tubing indicated thus: | 2U |
| 8. Location and designation of "wash" samples indicated thus: | 1W |
| 9. Unsuccessful attempts to secure dry samples indicated thus, followed by type of sampler: | $M_D$ |
| 10. Location of field vane test indicated thus: | |
| 11. Number of blows of 275# hammer, falling 15", required to drive spoon or tubing one foot indicated thus: | (Graphical) |
| 12. Sampling spoon or seamless tubing driven by static weight of drill rods and 275# hammer indicated thus: | H |
| 13. $3\frac{1}{2}$" O.D. "dry" samples taken with piston sampler. | P |
| 14. Natural water contents, given as percent of dry weight | Graphical |
| 15. Bottom of boring indicated thus: | |
| 16. Refusal of drill rods or casing indicated thus: | R |
| 17. Percent recovery of rock core by diamond bit thus: | 71% |

Sheet #2

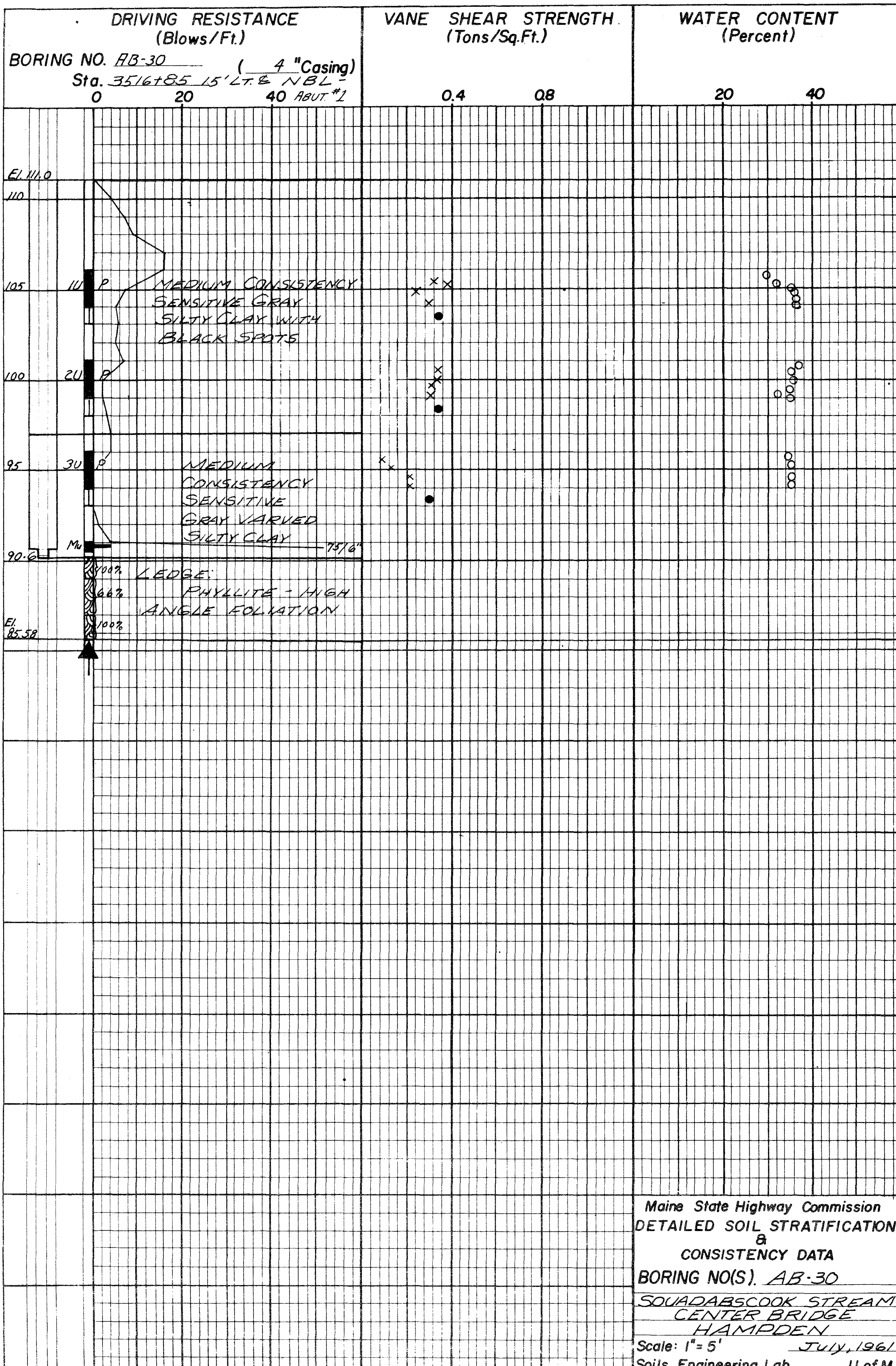
## SHEAR AND WATER CONTENT NOTES

Shear Notes:

1. Field vane shear strengths indicated thus: ●
2. Laboratory vane shear strengths indicated thus: x
3. One half unconfined compressive strengths indicated thus: o
4. Strengths beyond range of plot indicated at right edge of plot by numerical values and symbols thus: 1.62●
5. Field vane shear strengths in excess of capacity of equipment indicated thus: —●→
6. Laboratory vane shear strengths in excess of capacity of equipment (1.0 T/sf) indicated thus: —x→
7. Field vane shear strengths in excess of capacity of equipment and beyond range of plot indicated at right edge of plot thus: 1.50(+)●
8. Laboratory vane shear strength in excess of capacity of equipment (1.0T/sf) and beyond range of plot indicated at right edge of plot thus: 1.00 (+)x

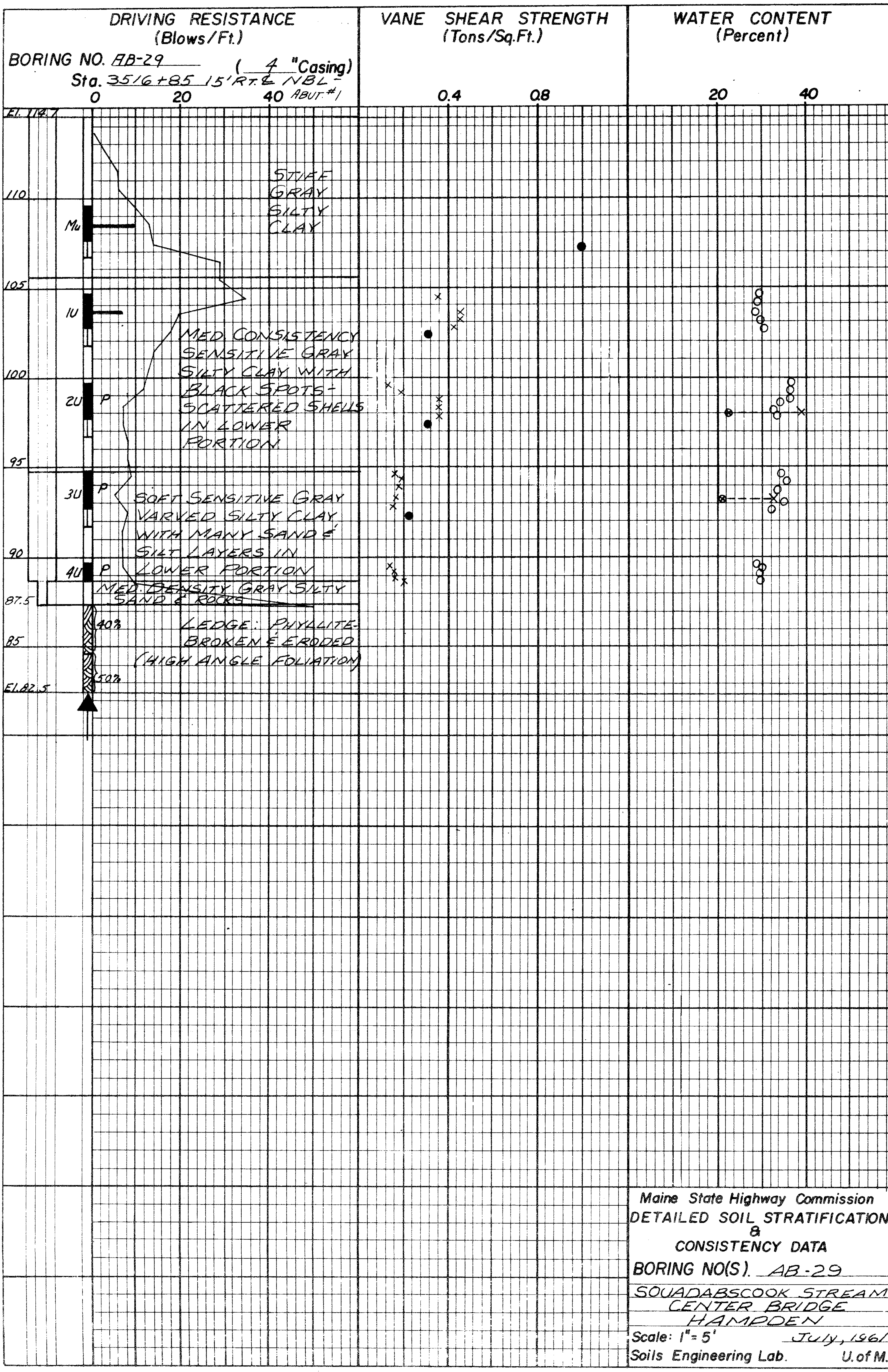
Water Content Notes:

1. Natural water contents, given as percent of dry weight, are indicated thus: o
2. Plastic and liquid limits are indicated thus: ⊗ — — — x
3. Ignition losses are given as percent of dry weight.



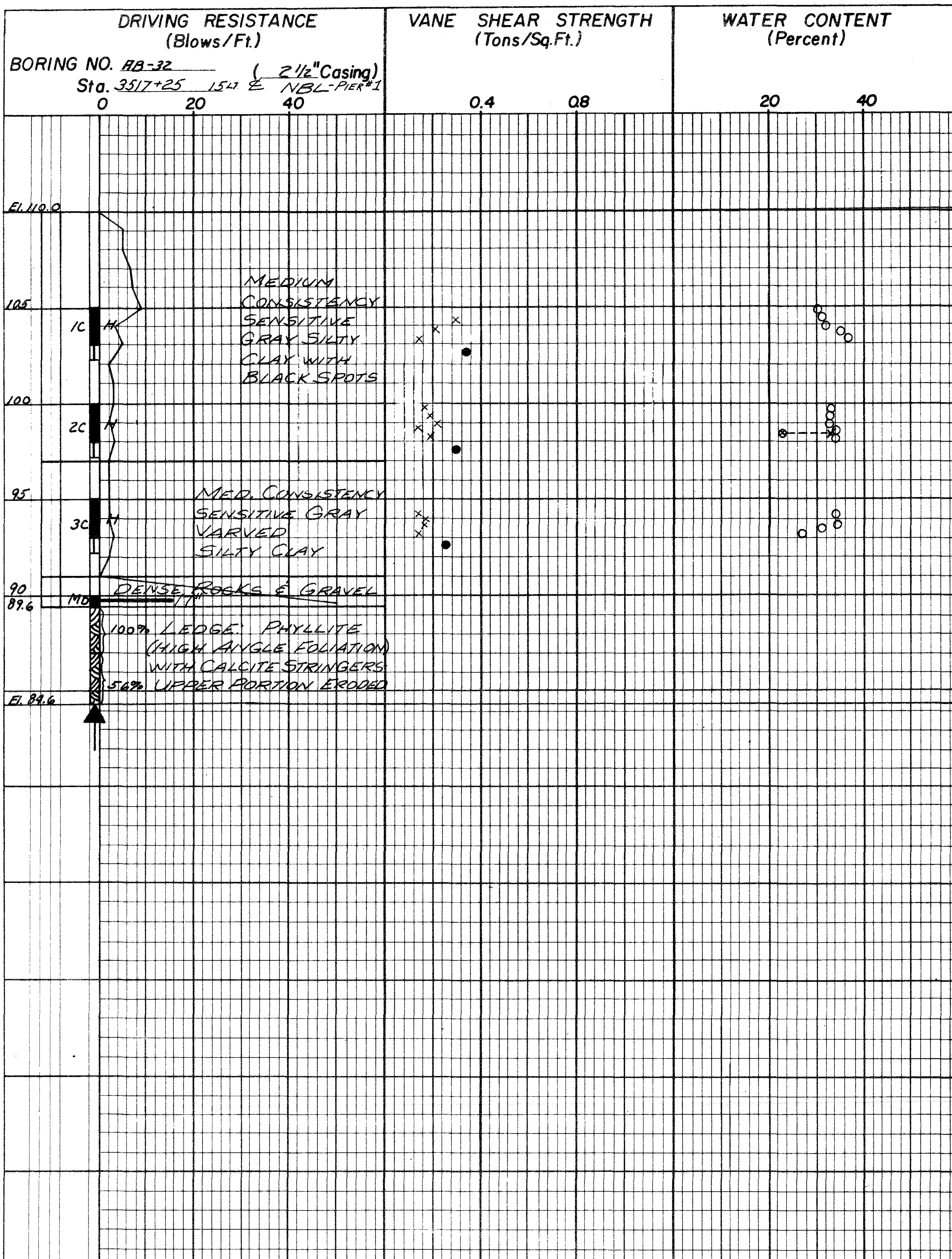
DRIVING RESISTANCE
(Blows/Ft.)
BORING NO. AB-30
( 4 "Casing)
Sta. 3516+85 15' LT. ℄ NBL - ABUT. #1
0
20
40
VANE SHEAR STRENGTH
(Tons/Sq.Ft.)
0.4
0.8
WATER CONTENT
(Percent)
20
40
El. 111.0
110
105
100
95
90.6
El. 85.58
1U
2U
3U
Mu
P
MEDIUM CONSISTENCY SENSITIVE GRAY SILTY CLAY WITH BLACK SPOTS
MEDIUM CONSISTENCY SENSITIVE GRAY VARVED SILTY CLAY
75/6"
100%
66%
100%
LEDGE: PHYLLITE - HIGH ANGLE FOLIATION
Maine State Highway Commission
DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA
BORING NO(S). AB-30
SOUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN
Scale: 1" = 5'
July, 1961
Soils Engineering Lab.
U. of M.


Sheet No. 3




Maine State Highway Commission
DETAILED SOIL STRATIFICATION & CONSISTENCY DATA
BORING NO(S). AB-29
SOUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN
Scale: 1" = 5'  July, 1961
Soils Engineering Lab.  U. of M.

Sheet No. 4




Maine State Highway Commission

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

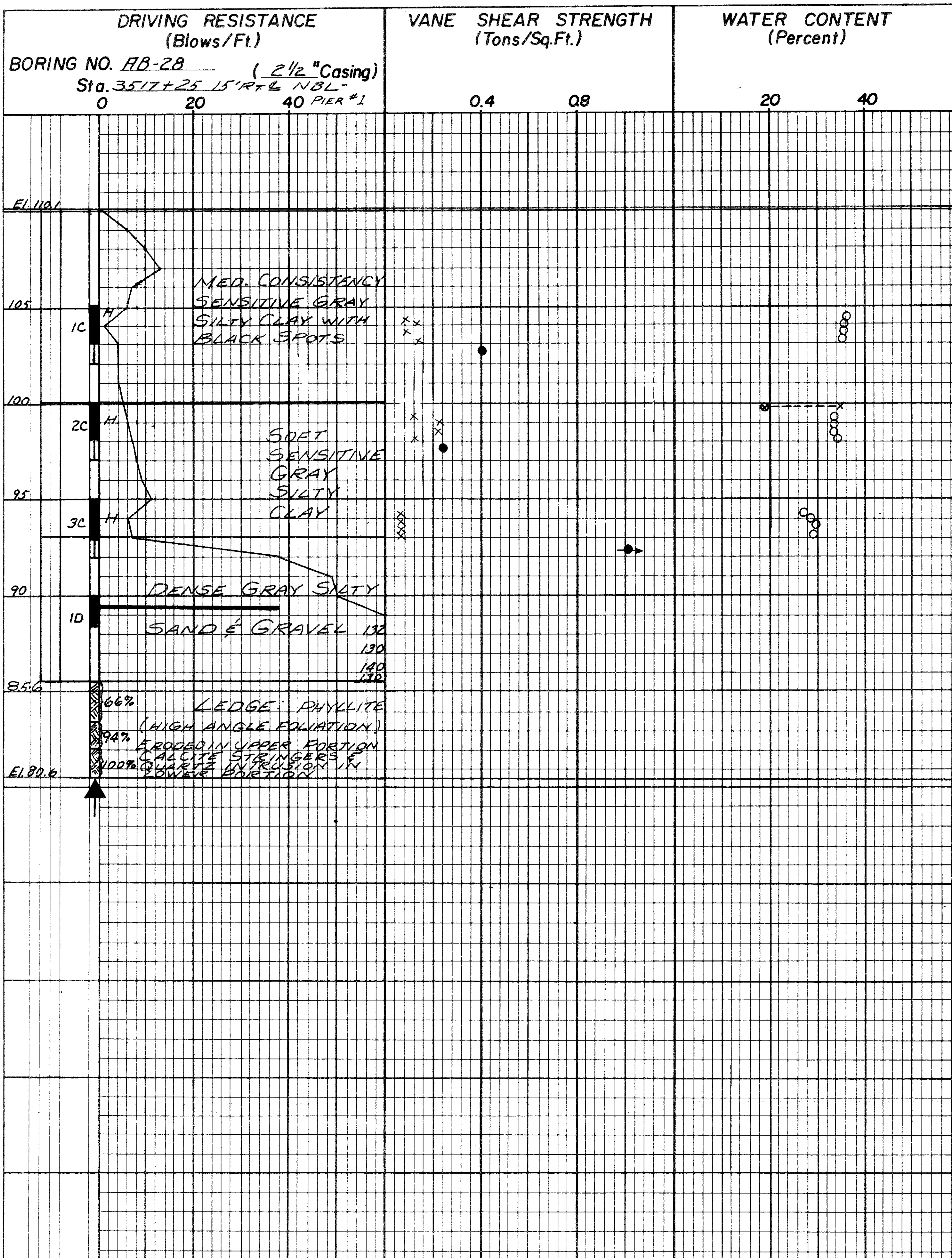
BORING NO(S). AB-32

SQUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN

Scale: 1" = 5'    July, 1961

Soils Engineering Lab.    U. of M.

Sheet No. 5




Maine State Highway Commission
DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA

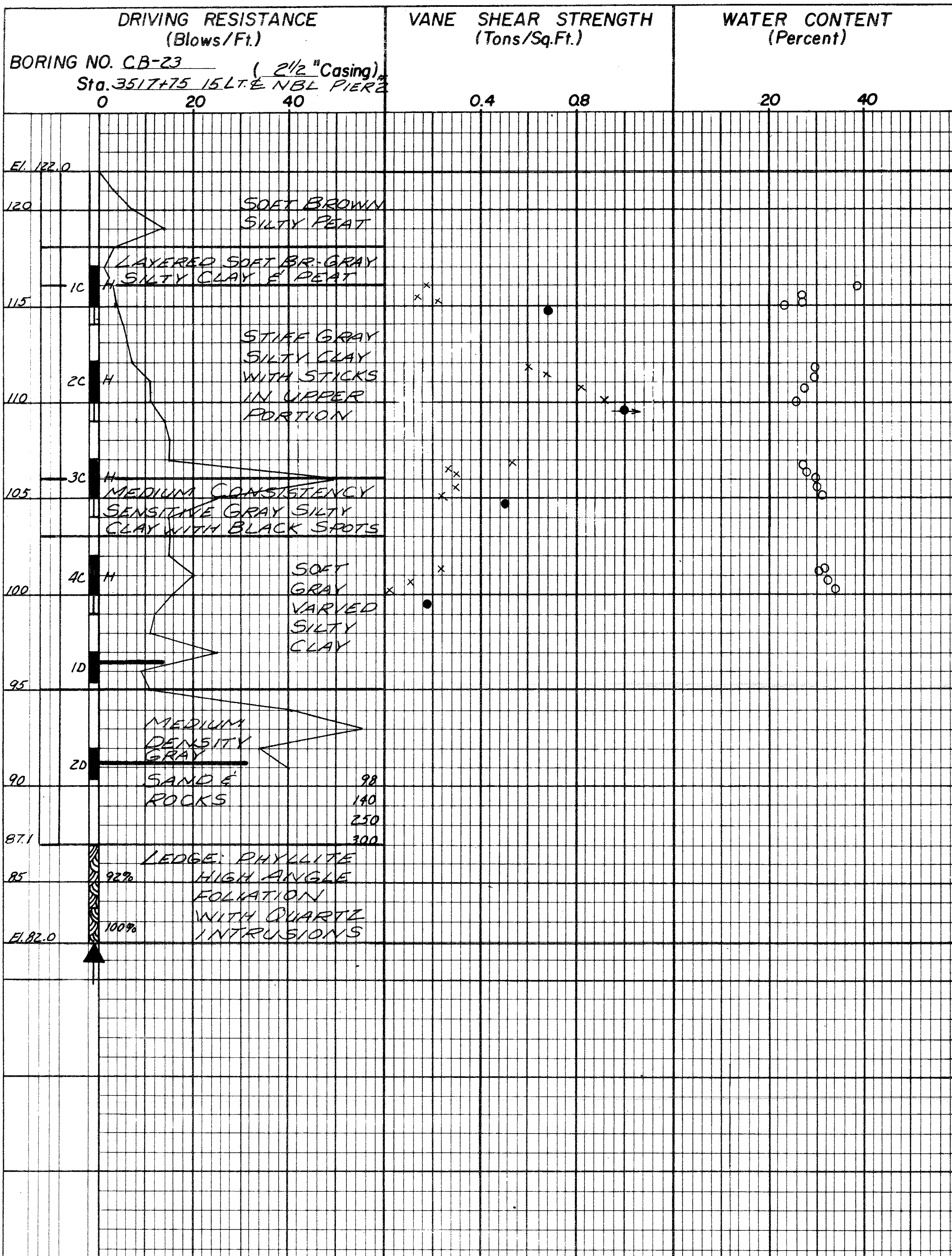
BORING NO(S). AB-28

SOUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN

Scale: 1" = 5' July, 1961

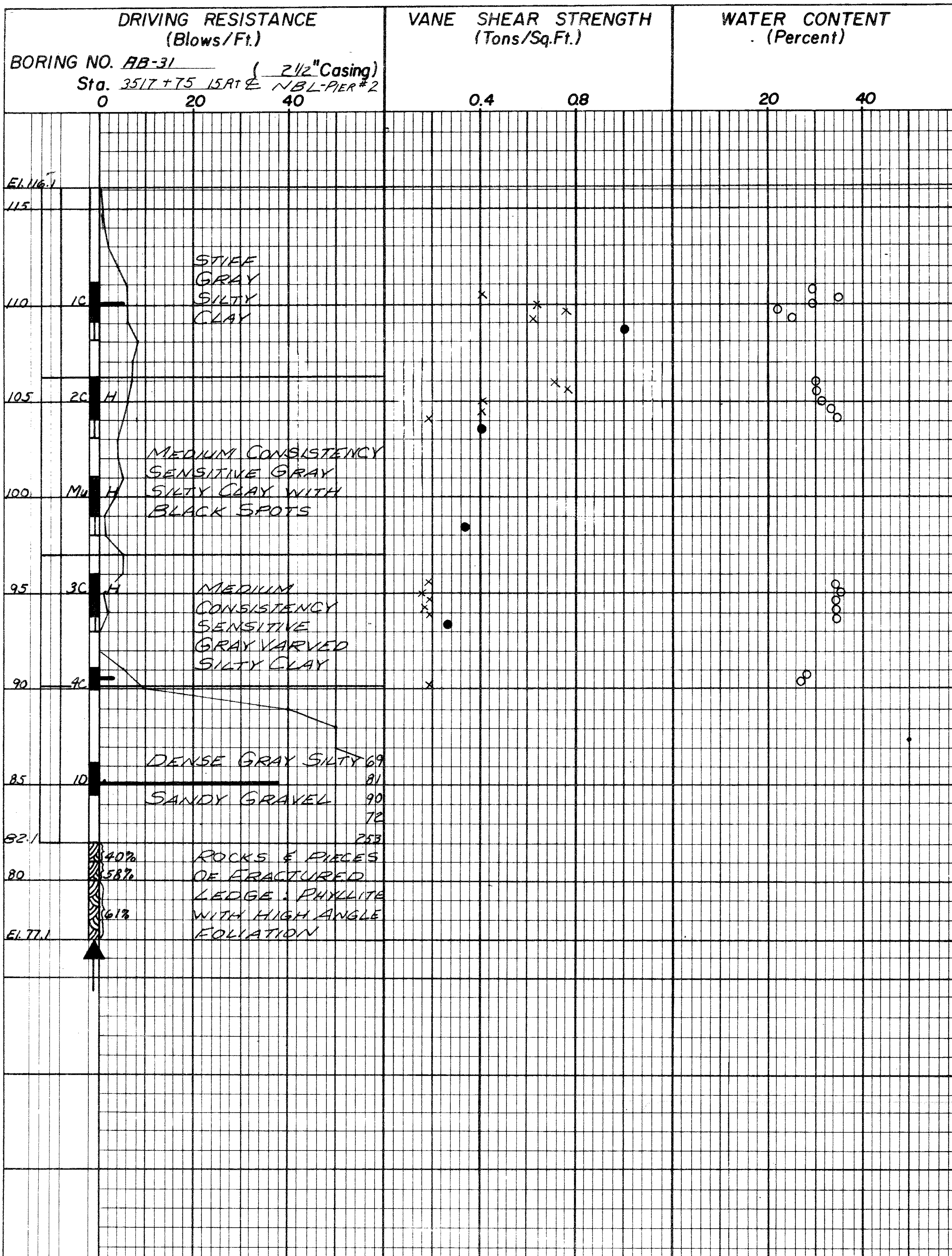
Soils Engineering Lab. U. of M.

Sheet No. 6




Maine State Highway Commission
DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA
BORING NO(S). CB-23
SOUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN
Scale: 1" = 5'  July, 1961
Soils Engineering Lab.  U. of M.

Sheet No. 7




Maine State Highway Commission

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

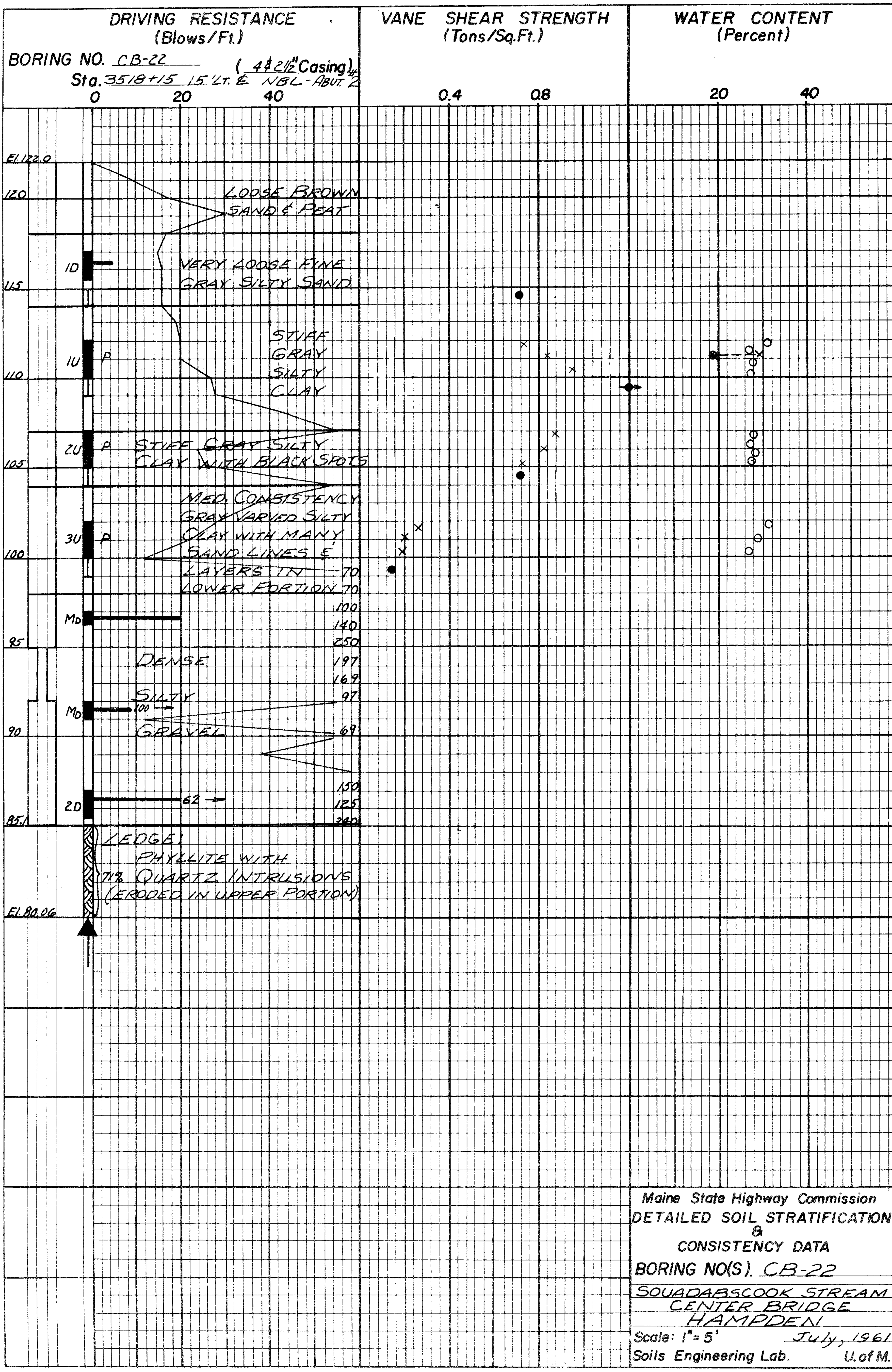
BORING NO(S). AB-31

SOUADABSCOOK STREAM CENTER BRIDGE
HAMPDEN

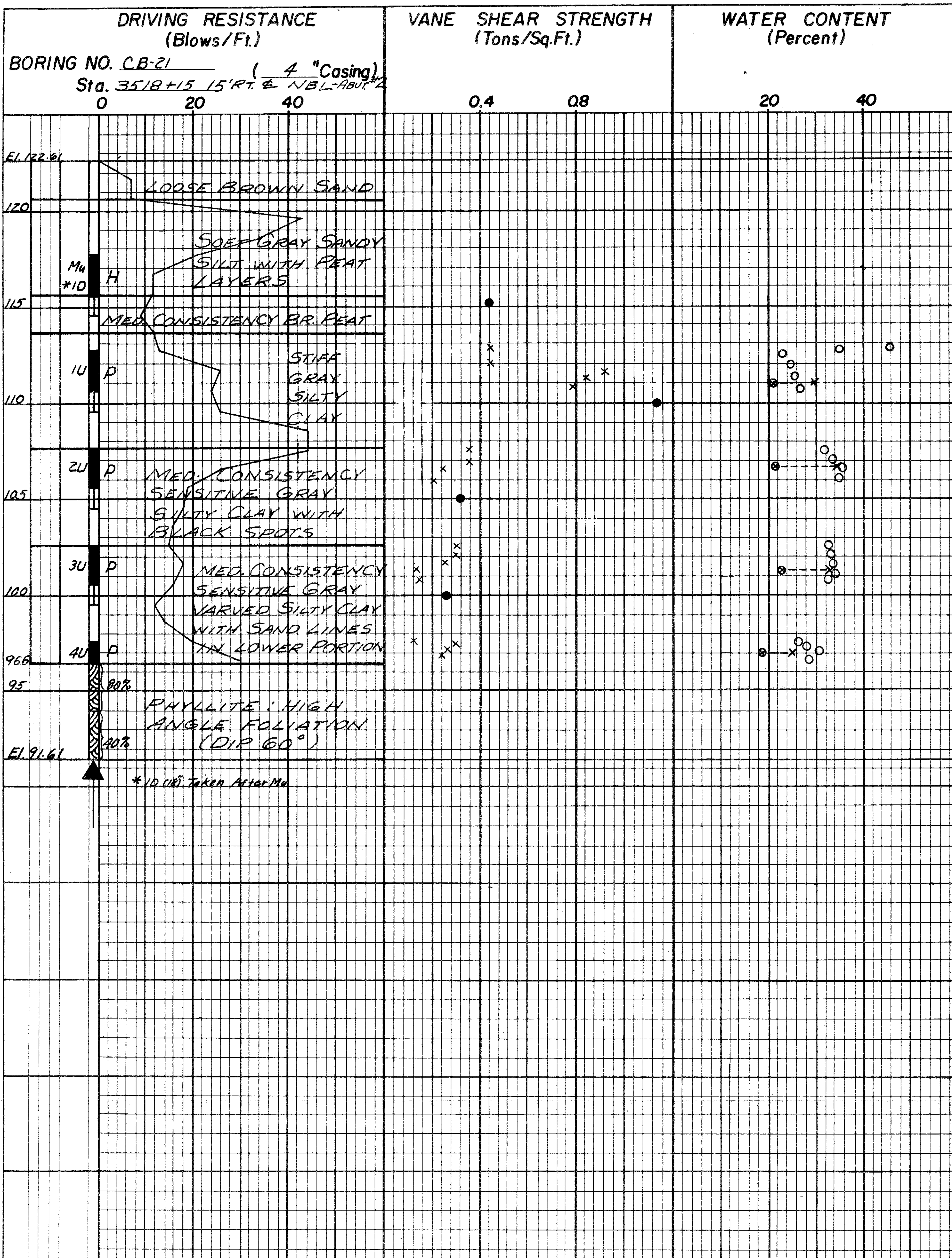
Scale: 1" = 5'    July, 1961

Soils Engineering Lab.    U. of M.

Sheet No. 8


DRIVING RESISTANCE (Blows/Ft.)
BORING NO. CB-22 (4" & 2½" Casing)
Sta. 3518+15 15' Lt. ℄ NBL - Abut. 2
0
20
40
VANE SHEAR STRENGTH (Tons/Sq.Ft.)
0.4
0.8
WATER CONTENT (Percent)
20
40
El. 122.0
120
115
110
105
100
95
90
85.1
El. 80.06
LOOSE BROWN SAND & PEAT
1D
VERY LOOSE FINE GRAY SILTY SAND
1U
P
STIFF GRAY SILTY CLAY
2U
P
STIFF GRAY SILTY CLAY WITH BLACK SPOTS
3U
P
MED. CONSISTENCY GRAY VARVED SILTY CLAY WITH MANY SAND LINES & LAYERS IN LOWER PORTION
70
70
MD
100
140
250
DENSE
197
169
SILTY
97
MD
100 →
GRAVEL
69
150
2D
62 →
125
240
LEDGE:
PHYLLITE WITH 71% QUARTZ INTRUSIONS (ERODED IN UPPER PORTION)
Maine State Highway Commission
DETAILED SOIL STRATIFICATION & CONSISTENCY DATA
BORING NO(S). CB-22
SOUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN
Scale: 1" = 5'
July, 1961
Soils Engineering Lab.
U. of M.

Sheet No. 9




Maine State Highway Commission

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

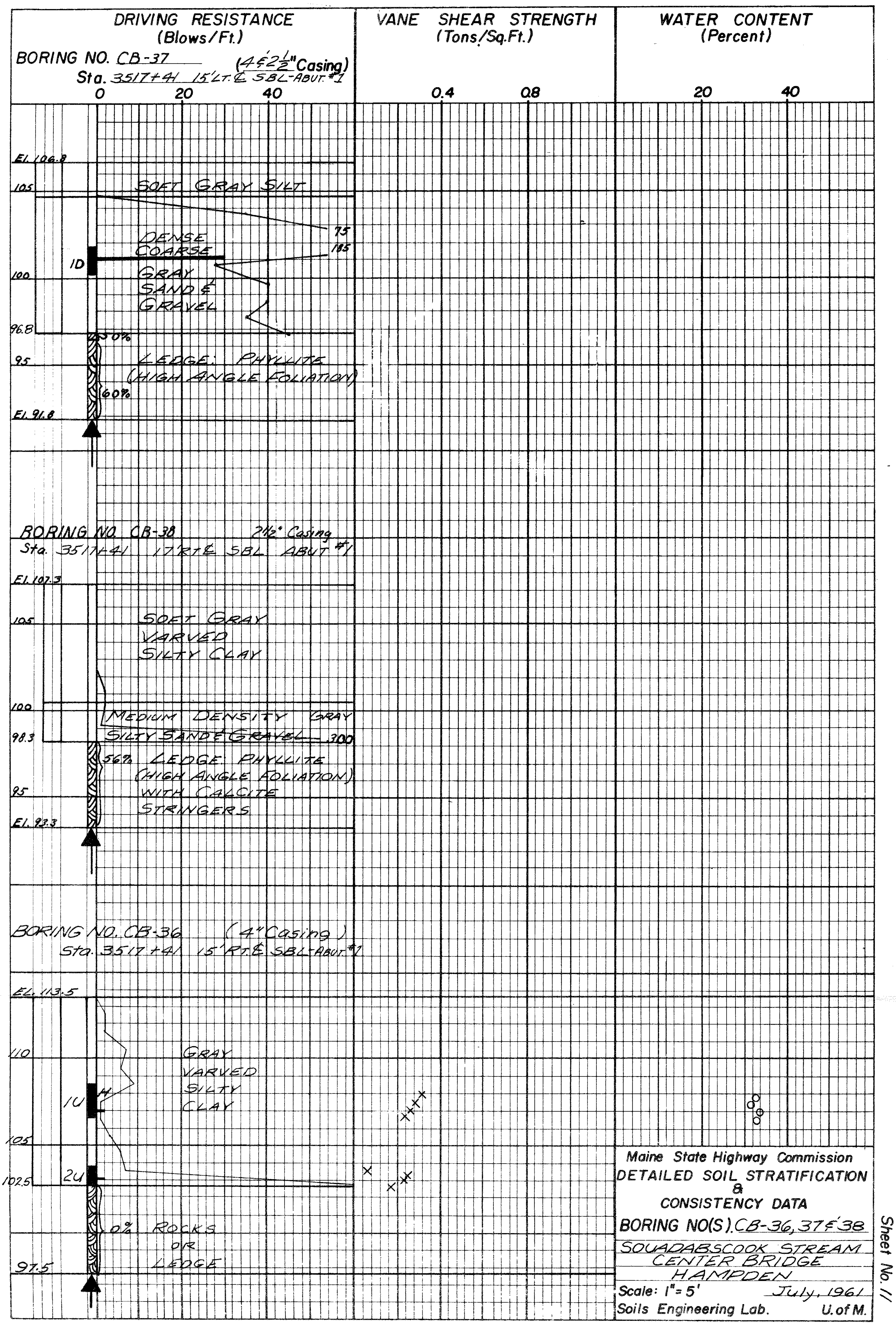
BORING NO(S). CB-21

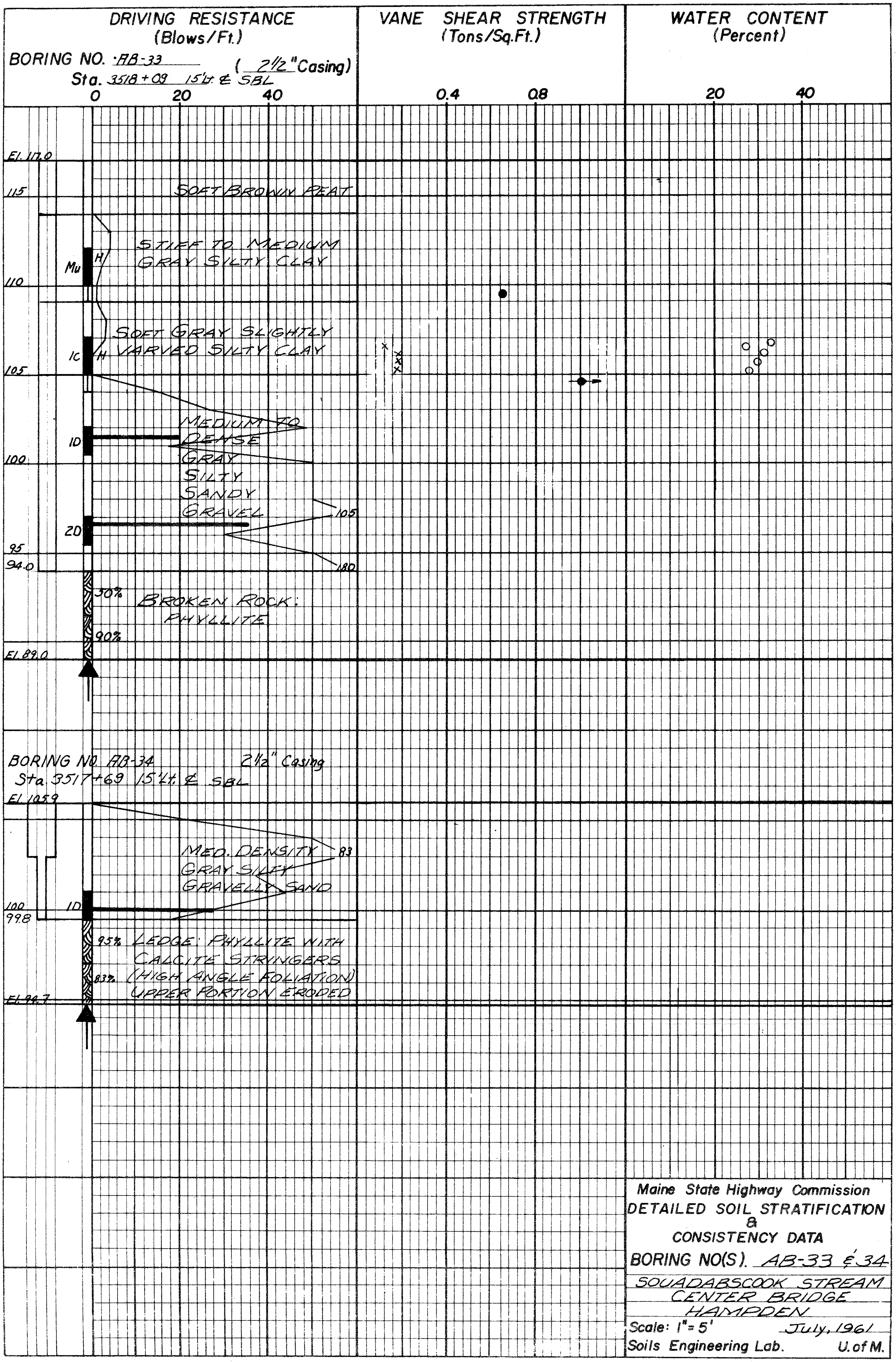
SOUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN

Scale: 1" = 5'    July, 1961

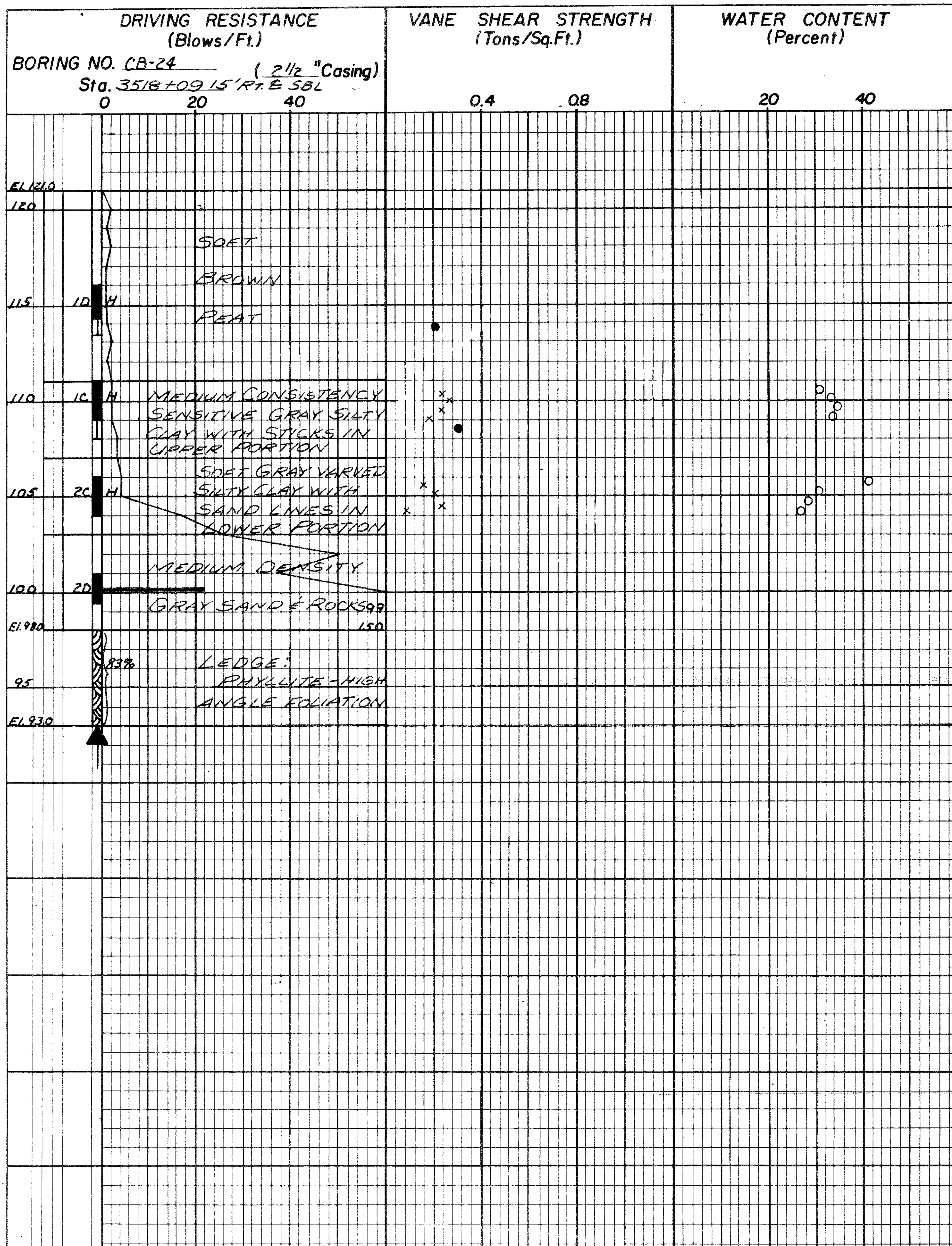
Soils Engineering Lab.    U. of M.

Sheet No. 10


DRIVING RESISTANCE (Blows/Ft.)
VANE SHEAR STRENGTH (Tons/Sq.Ft.)
WATER CONTENT (Percent)
BORING NO. CB-37 (4"&2½" Casing)
Sta. 3517+41 15' LT. ℄ SBL-ABUT. #1
0 20 40
0.4 0.8
20 40
El. 106.8
105
SOFT GRAY SILT
75
185
DENSE COARSE GRAY SAND & GRAVEL
1D
100
96.8
30%
95
LEDGE: PHYLLITE (HIGH ANGLE FOLIATION)
60%
El. 91.8
BORING NO. CB-38 2½" Casing
Sta. 3517+41 17' RT. ℄ SBL ABUT #1
El. 107.3
105
SOFT GRAY VARVED SILTY CLAY
100
MEDIUM DENSITY GRAY SILTY SAND & GRAVEL
98.3
300
56%
LEDGE: PHYLLITE (HIGH ANGLE FOLIATION) WITH CALCITE STRINGERS
95
El. 93.3
BORING NO. CB-36 (4" Casing)
Sta. 3517+41 15' RT. ℄ SBL-ABUT. #1
EL. 113.5
110
GRAY VARVED SILTY CLAY
1U
105
2U
102.5
0%
ROCKS OR LEDGE
97.5
Maine State Highway Commission
DETAILED SOIL STRATIFICATION & CONSISTENCY DATA
BORING NO(S). CB-36, 37 & 38
SOUADABSCOOK STREAM CENTER BRIDGE
HAMPDEN
Scale: 1" = 5'
July, 1961
Soils Engineering Lab.
U. of M.
Sheet No. 11

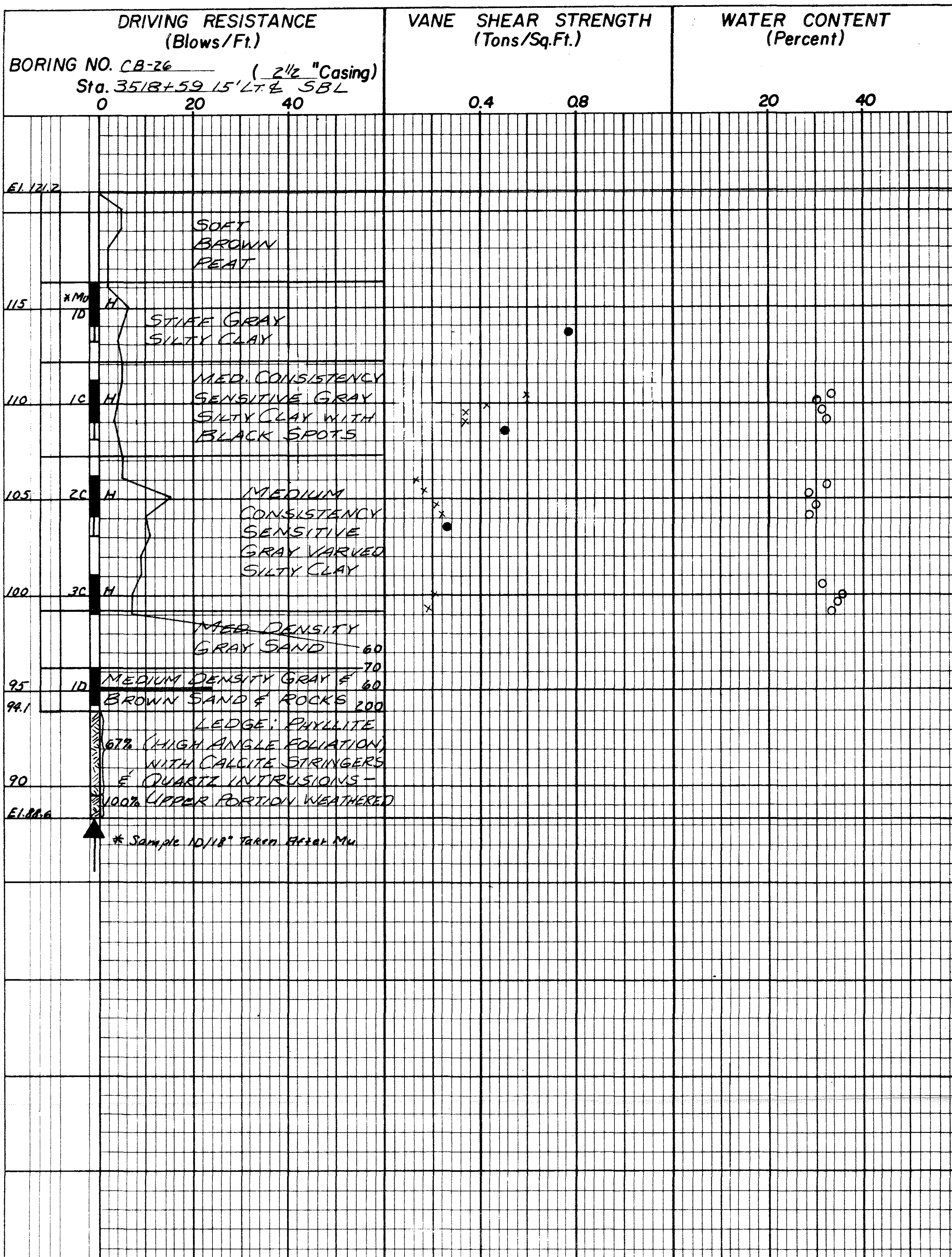

DRIVING RESISTANCE (Blows/Ft.)
VANE SHEAR STRENGTH (Tons/Sq.Ft.)
WATER CONTENT (Percent)
BORING NO. AB-33 (2½" Casing)
Sta. 3518+09 15' Lt. ℄ SBL
0 20 40
0.4 0.8
20 40
El. 117.0
115
SOFT BROWN PEAT
STIFF TO MEDIUM GRAY SILTY CLAY
Mu
H
110
SOFT GRAY SLIGHTLY VARVED SILTY CLAY
1C
H
105
MEDIUM TO DENSE GRAY SILTY SANDY GRAVEL
1D
100
105
2D
95
94.0
180
30%
BROKEN ROCK: PHYLLITE
90%
El. 89.0
BORING NO. AB-34 2½" Casing
Sta. 3517+69 15' Lt. ℄ SBL
El. 105.9
83
MED. DENSITY GRAY SILTY GRAVELLY SAND
100
99.8
1D
95% LEDGE: PHYLLITE WITH CALCITE STRINGERS
83% (HIGH ANGLE FOLIATION) UPPER PORTION ERODED
El. 94.7
Maine State Highway Commission
DETAILED SOIL STRATIFICATION & CONSISTENCY DATA
BORING NO(S). AB-33 & 34
SOUADABSCOOK STREAM CENTER BRIDGE
HAMPDEN
Scale: 1" = 5'
July, 1961
Soils Engineering Lab.
U. of M.

Sheet No. 12




Maine State Highway Commission
DETAILED SOIL STRATIFICATION & CONSISTENCY DATA
BORING NO(S). CB-24
SOUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN
Scale: 1" = 5'    June, 1961
Soils Engineering Lab.    U. of M.

Sheet No. 13




Maine State Highway Commission

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

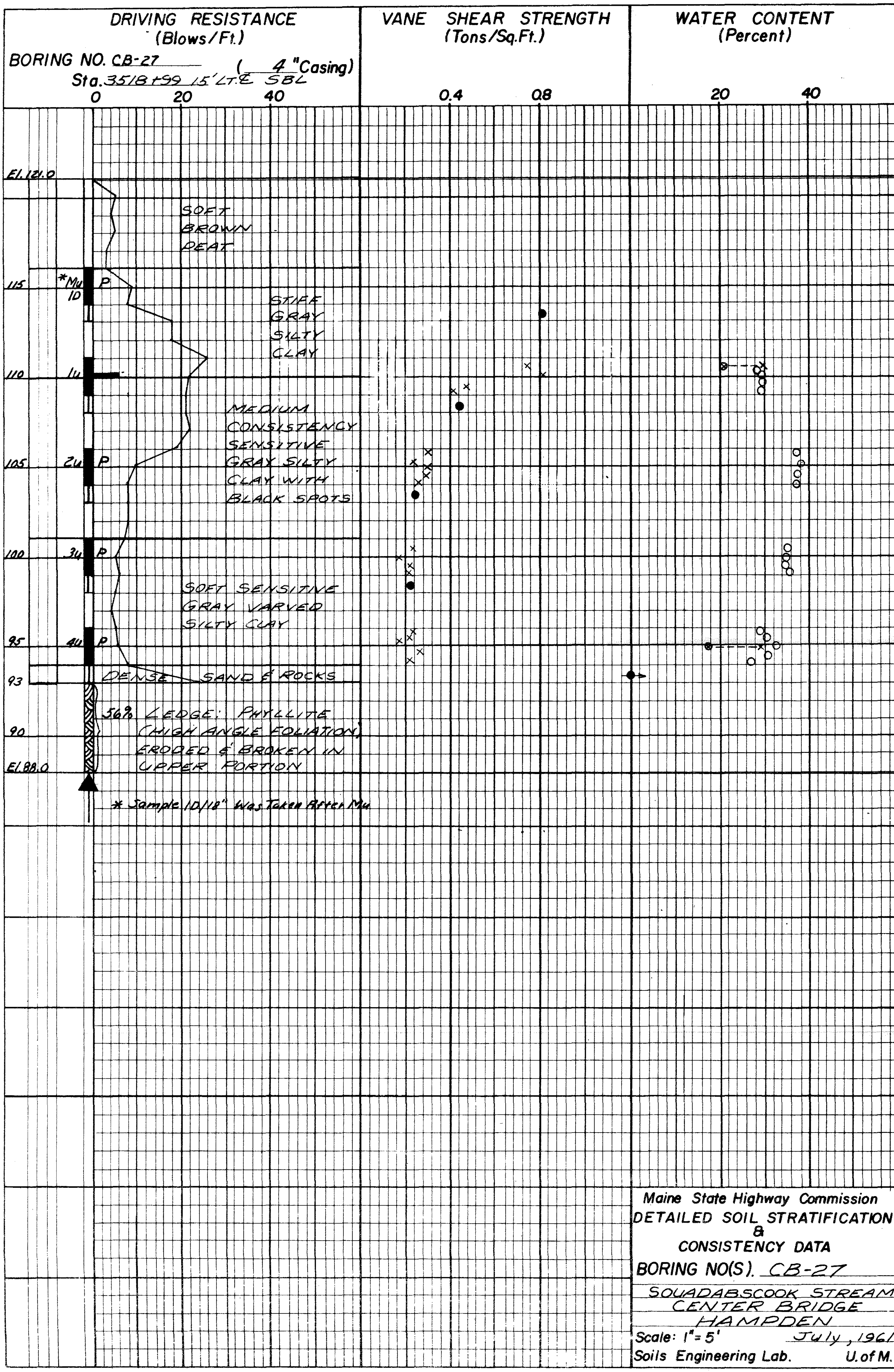
BORING NO(S). CB-26

SOUADABSCOOK STREAM CENTER BRIDGE HAMPDEN

Scale: 1" = 5' June, 1961

Soils Engineering Lab. U. of M.

Sheet No. 14




Maine State Highway Commission

DETAILED SOIL STRATIFICATION & CONSISTENCY DATA

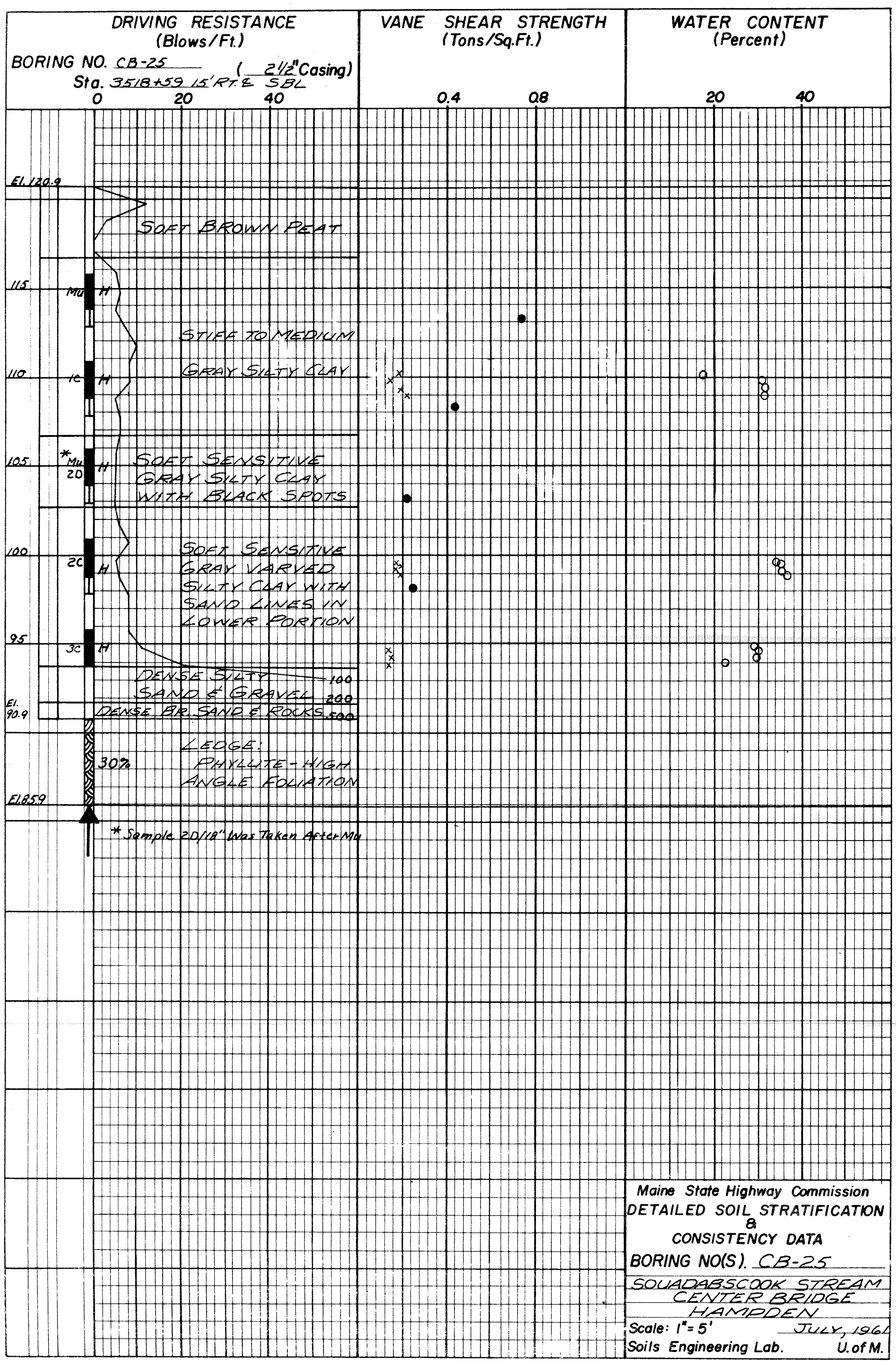
BORING NO(S). CB-27

SQUADABSCOOK STREAM CENTER BRIDGE HAMPDEN

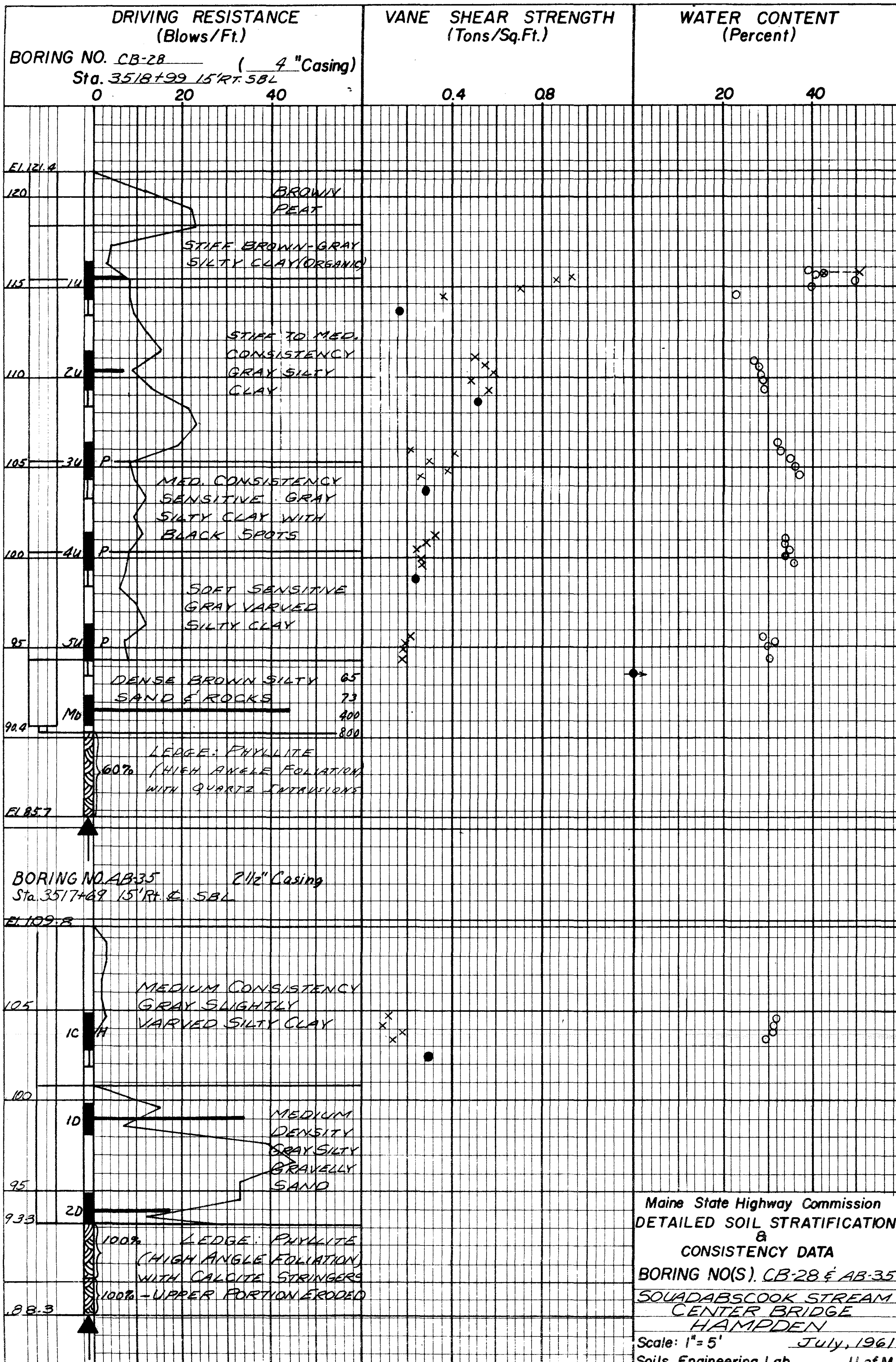
Scale: 1" = 5'  July, 1961

Soils Engineering Lab.  U. of M.

Sheet No. 15

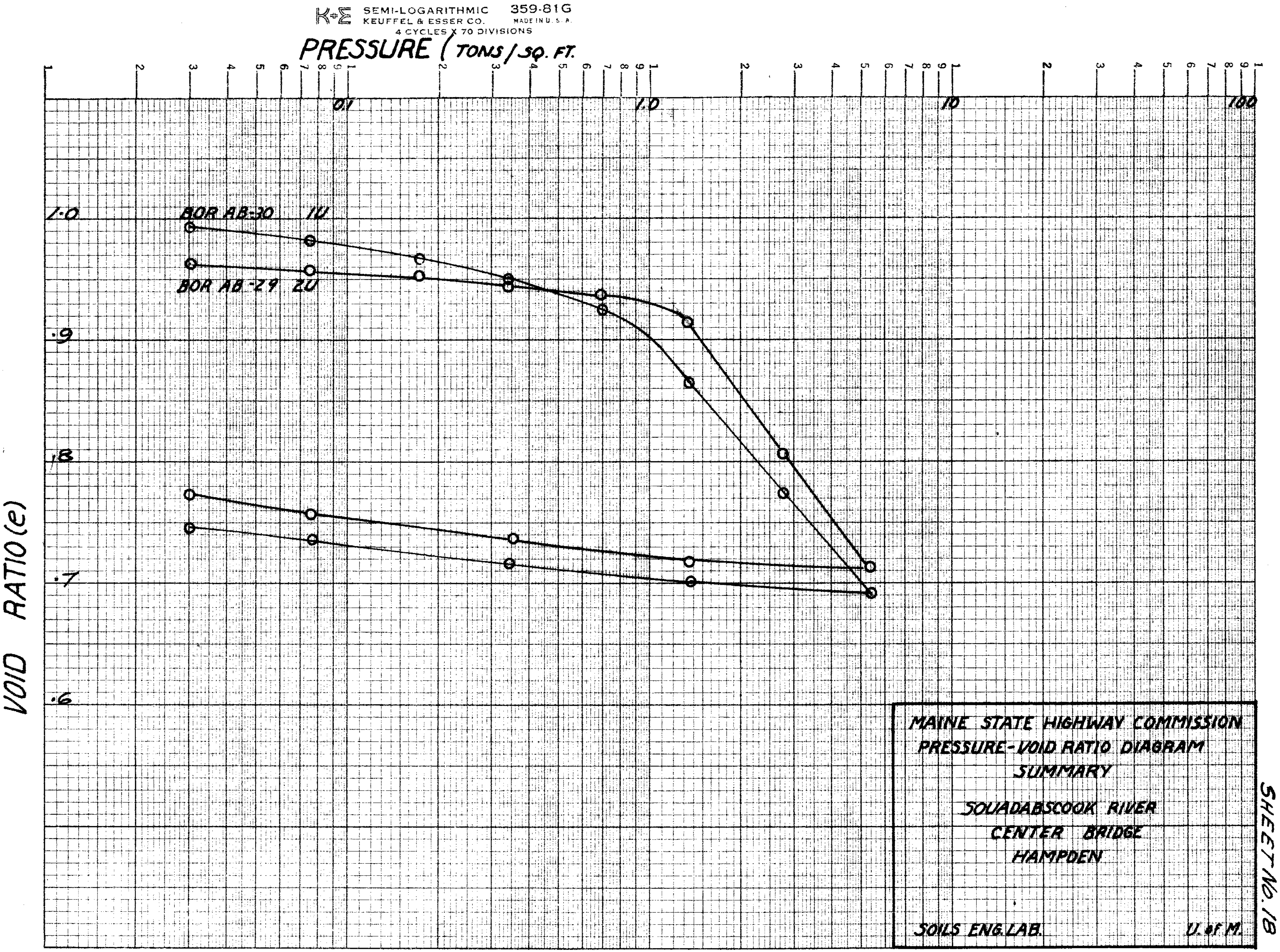

DRIVING RESISTANCE (Blows/Ft.)
BORING NO. CB-25 ( 2 1/2" Casing)
Sta. 3518+59 15' RT. ℄ SBL
0 20 40
VANE SHEAR STRENGTH (Tons/Sq.Ft.)
0.4 0.8
WATER CONTENT (Percent)
20 40
El. 120.9
115
110
105
100
95
El. 90.9
El. 85.9
Mu
1C
*Mu
2D
2C
3C
H
SOFT BROWN PEAT
STIFF TO MEDIUM GRAY SILTY CLAY
SOFT SENSITIVE GRAY SILTY CLAY WITH BLACK SPOTS
SOFT SENSITIVE GRAY VARVED SILTY CLAY WITH SAND LINES IN LOWER PORTION
DENSE SILTY SAND & GRAVEL
100
200
DENSE BR. SAND & ROCKS
500
LEDGE: PHYLLITE - HIGH ANGLE FOLIATION
30%
* Sample 2D/18" Was Taken After Mu
Maine State Highway Commission
DETAILED SOIL STRATIFICATION & CONSISTENCY DATA
BORING NO(S). CB-25
SOUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN
Scale: 1" = 5'
JULY, 1961
Soils Engineering Lab.
U. of M.

Sheet No. 16




Maine State Highway Commission
DETAILED SOIL STRATIFICATION
&
CONSISTENCY DATA
BORING NO(S). CB-28 & AB-35
SOUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN
Scale: 1" = 5'  July, 1961
Soils Engineering Lab.  U. of M.

Sheet No. 17



K+E SEMI-LOGARITHMIC 359-81G
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS
PRESSURE (TONS / SQ. FT.
0.1
1.0
10
100
VOID RATIO (e)
1.0
.9
.8
.7
.6
BOR AB-30 1U
BOR AB-29 2U
MAINE STATE HIGHWAY COMMISSION
PRESSURE-VOID RATIO DIAGRAM
SUMMARY
SOUADABSCOOK RIVER
CENTER BRIDGE
HAMPDEN
SOILS ENG. LAB.
U. of M.
SHEET No. 18

| FRAME & APPLIED WT. | LOAD ON SAMPLE TONS/SQ. FT. | MAX. STRESS TONS/SQ. FT. |
|---|---|---|
| C 40# | .7398 | .250 |
| C 80# | 1.2926 | .396 |
| B 120# | 1.8124 | .479 |

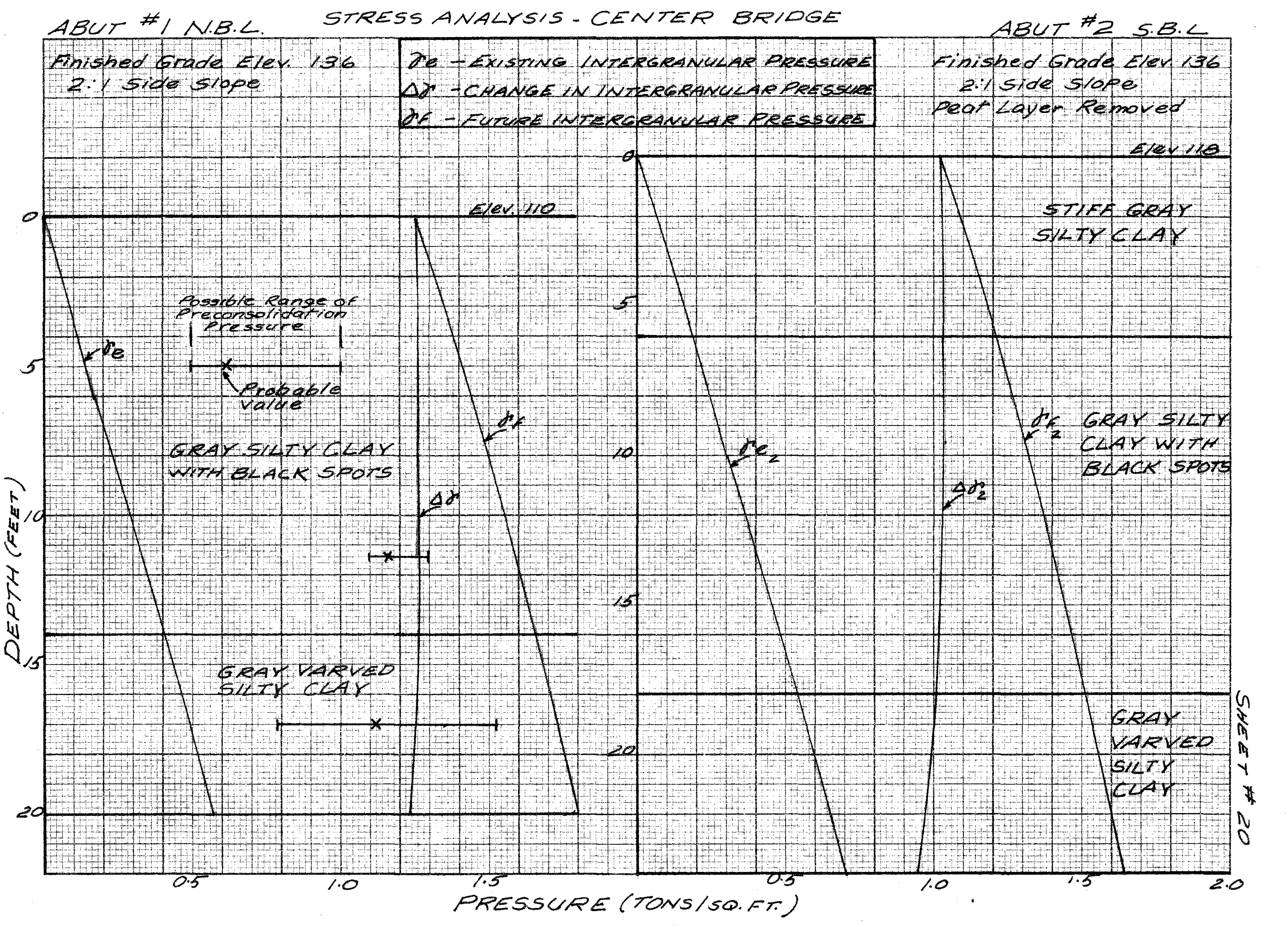

Maine State Highway Commission

DIRECT SHEAR DIAGRAM

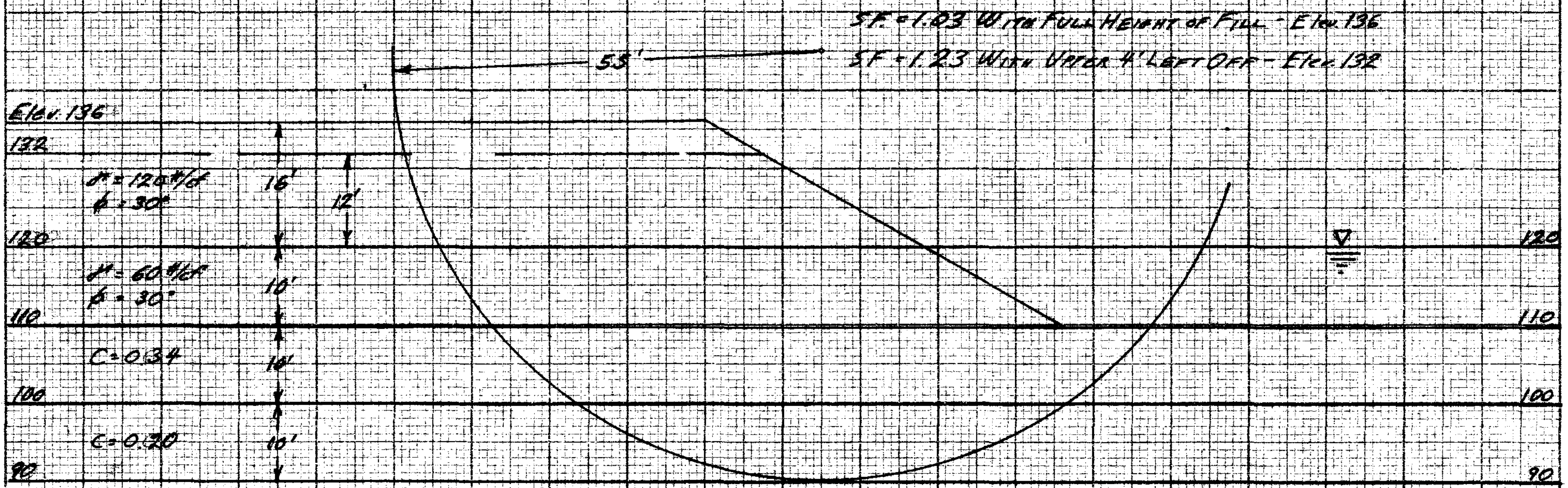
SOUADABSCOOK STREAM
CENTER BRIDGE
HAMPDEN

BOR. AB-30 SAMPLE 2U
Soils Engineering Lab U of M

SHEET No. 19



ABUT #1 N.B.L.
STRESS ANALYSIS - CENTER BRIDGE
ABUT #2 S.B.L.
Finished Grade Elev. 136
2:1 Side Slope
σe - EXISTING INTERGRANULAR PRESSURE
Δσ - CHANGE IN INTERGRANULAR PRESSURE
σf - FUTURE INTERGRANULAR PRESSURE
Finished Grade Elev. 136
2:1 Side Slope
Peat Layer Removed
Elev. 118
Elev. 110
STIFF GRAY SILTY CLAY
Possible Range of Preconsolidation Pressure
Probable Value
σe
σf
GRAY SILTY CLAY WITH BLACK SPOTS
Δσ
σe2
σf2
Δσ2
GRAY SILTY CLAY WITH BLACK SPOTS
GRAY VARVED SILTY CLAY
GRAY VARVED SILTY CLAY
DEPTH (FEET)
PRESSURE (TONS/SQ.FT.)
0
5
10
15
20
0.5
1.0
1.5
2.0
SHEET # 20




Maine State Highway Commission

SHEAR ANALYSIS

NBL - WEST ABUTMENT

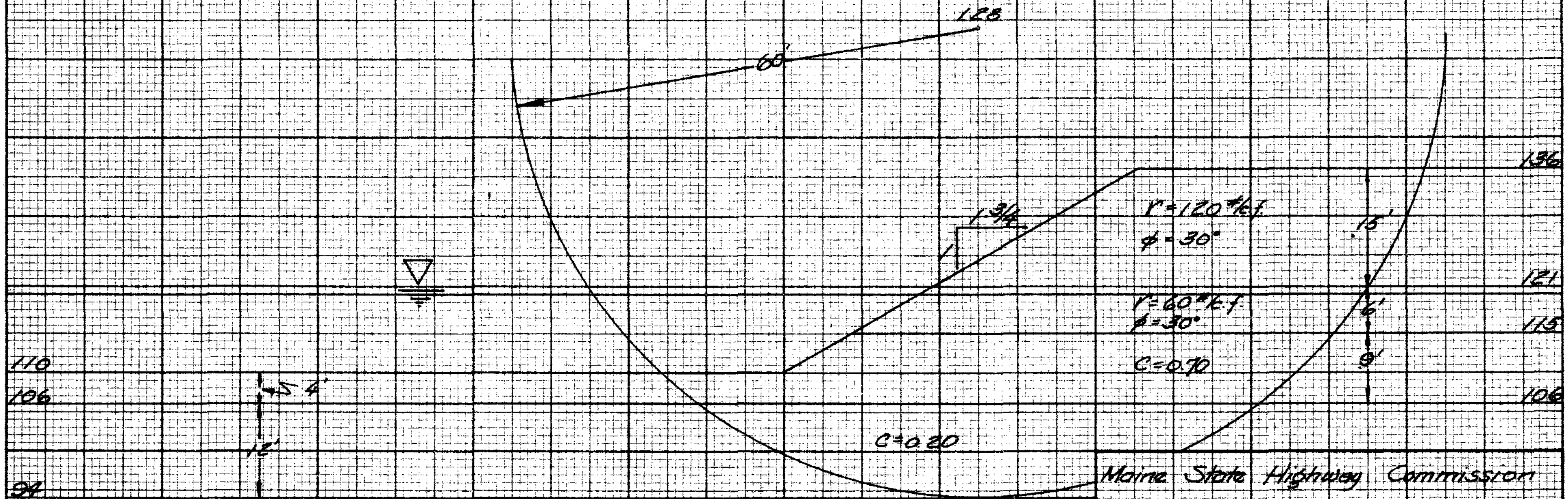
CENTER BRIDGE

HAMPDEN

Scale 1" = 20'    Aug 1961

Soils Engineering Lab.    U of M.

SHEET No. 21




Maine State Highway Commission

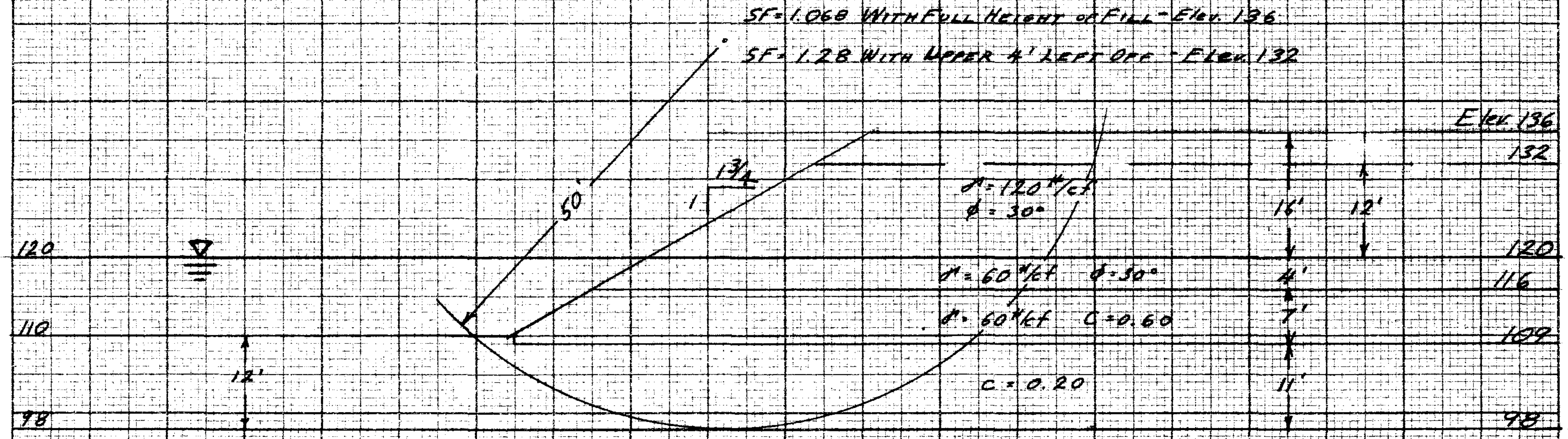
SHEAR ANALYSIS

NBL-EAST ABUTMENT
CENTER BRIDGE
HAMPDEN

Scale: 1"=20' Aug 1961

Soils Engineering Lab. U. of M.

SHEET No. 22




Maine State Highway Commission

SHEAR ANALYSIS

SBL - EAST ABUTMENT

CENTER BRIDGE

HAMPDEN

Scale: 1"=20' Aug. 1961

Soils Engineering Lab. U. of M.

SHEET No. 23


NOTE: SOIL STRATIFICATION INTERPRETED AT 15' LT. ℄ FROM BORINGS AB-34 & AB-33 & AT 15' RT. ℄ FROM BORINGS AB-35 & CB-24

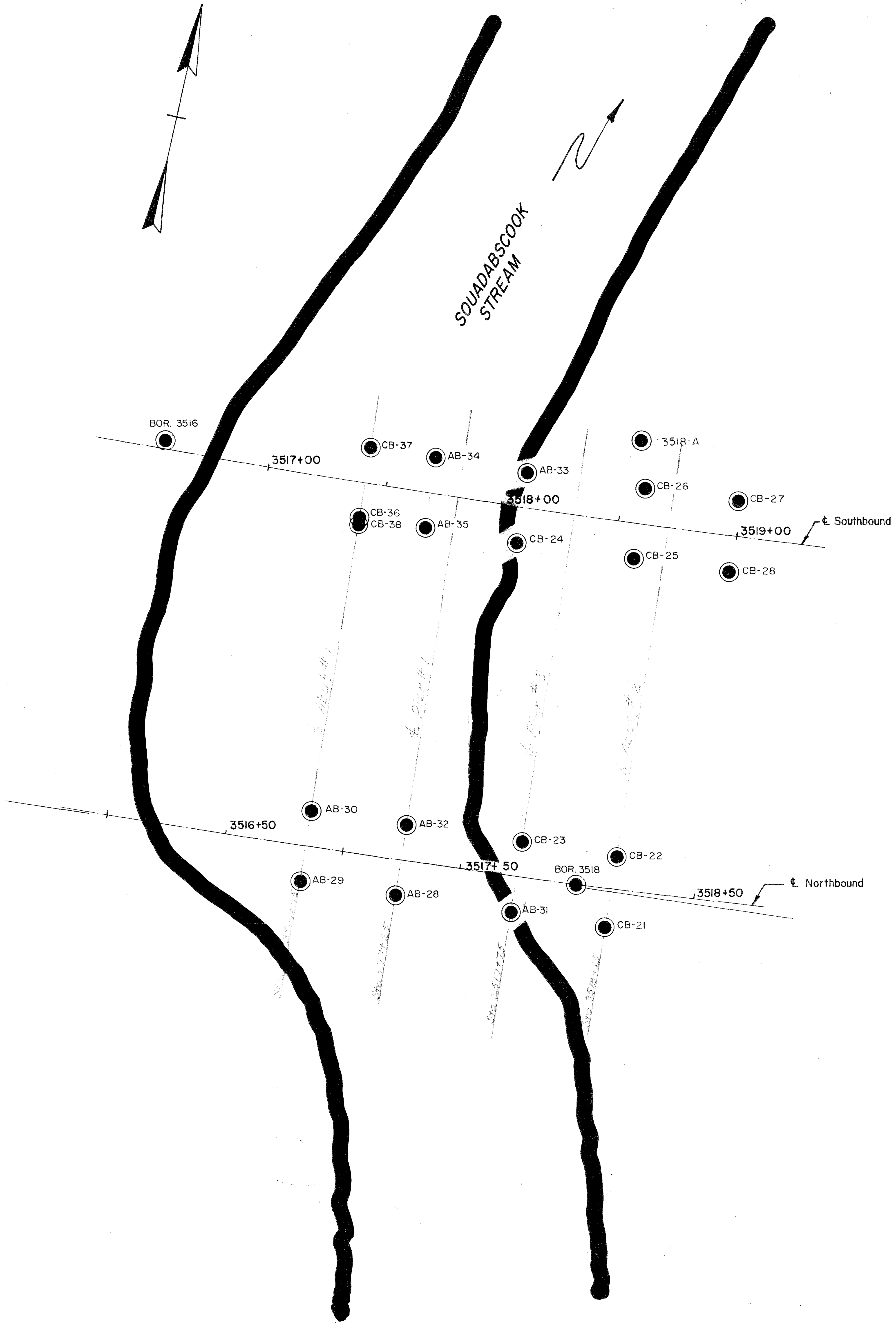
NOTE: SOIL STRATIFICATION INTERPRETED AT 15' LT. ℄ FROM BORINGS AB-33 & CB-26 & AT 15' RT. ℄ FROM BORINGS CB-24 & CB-25

NOTE: SOIL STRATIFICATION INTERPRETED AT 15' LT. ℄ FROM BORINGS CB-26 & CB-27 & AT 15' RT. ℄ FROM BORINGS CB-27 & CB-28

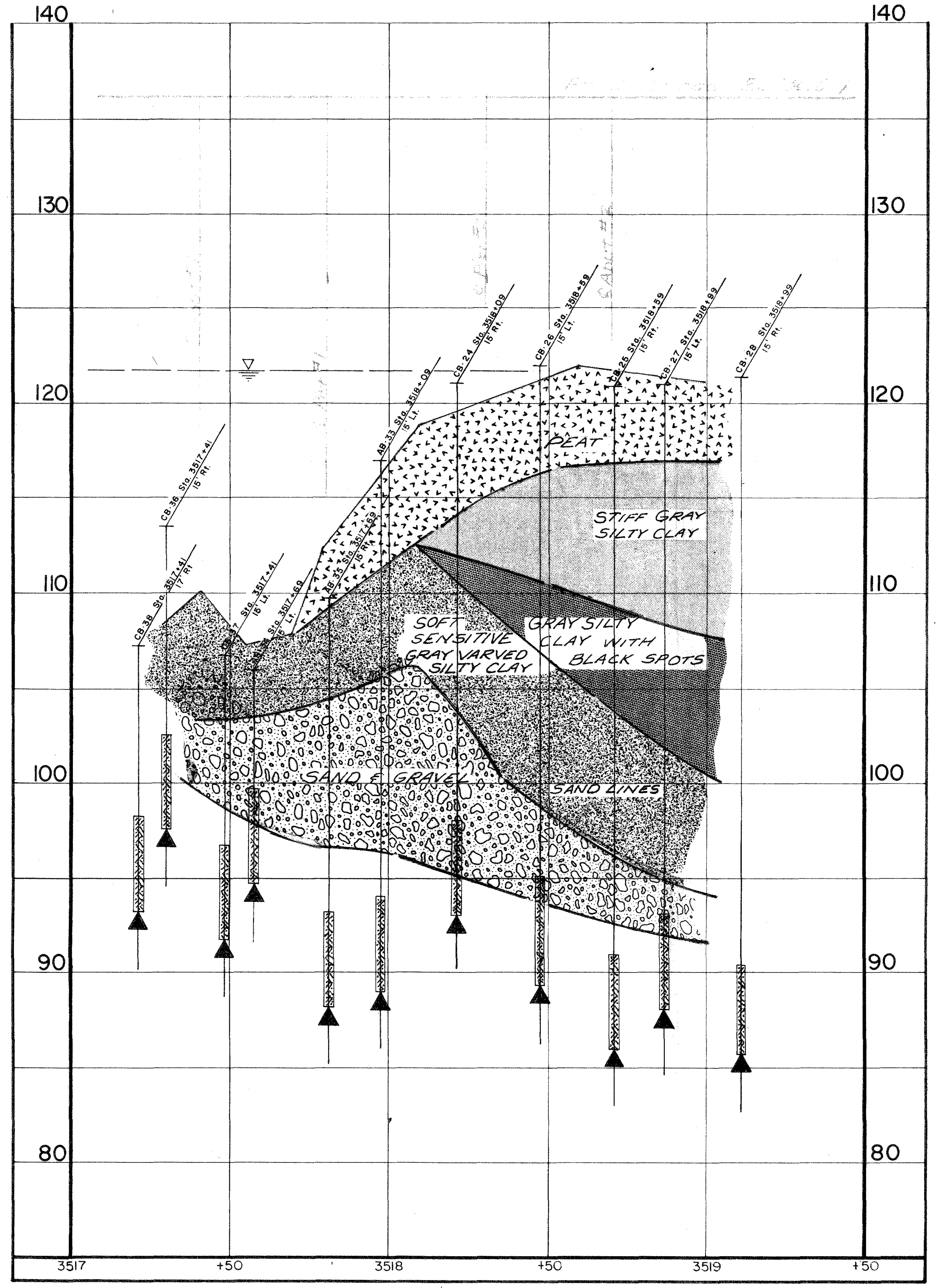
Maine State Highway Commission
Transverse Profiles
SOUADABSCOOK STREAM BRIDGE
CENTER
HAMPDEN
Scale: Vert. 1" = 5' Horiz. 1" = 10' 1961
Soils Engineering Lab. U of M.

SHEET No. 25

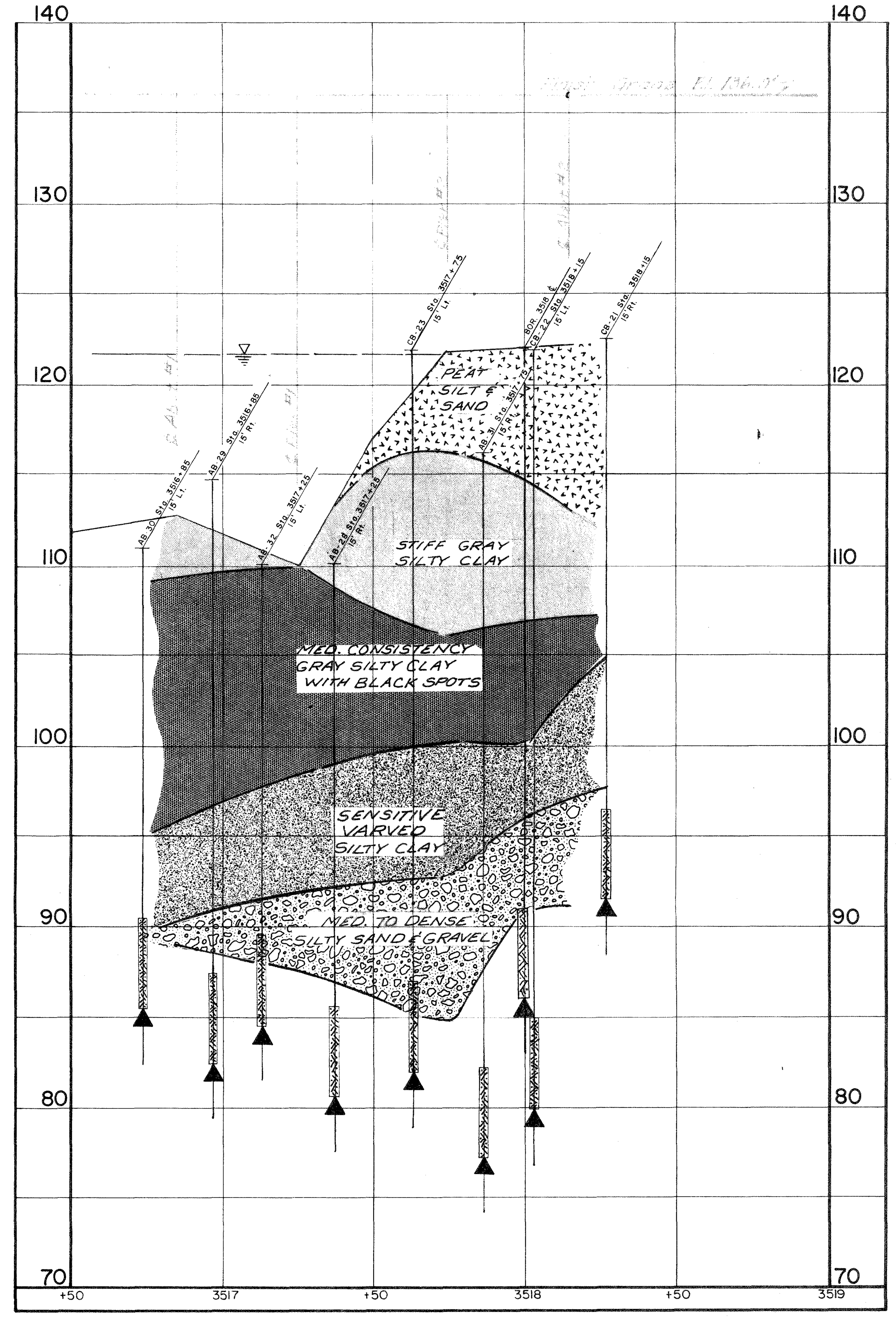
| B. P. R. REG. NO. | STATE | PROJECT NUMBER | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|
| 1 | MAINE | | | |




PLAN
SCALE 1" = 30'




℄ SOUTHBOUND PROFILE




℄ NORTHBOUND PROFILE

SCALE: HORIZ. 1" = 30'
VERTICAL 1" = 5'

| DESIGN—<br>TRACE—<br>CHECK— | BRIDGE NO.<br>SURVEY—<br>PLOT— |
|---|---|

STATE HIGHWAY COMMISSION
BRIDGE DIVISION

SOUADABSCOOK STREAM BRIDGE

CENTER

IN THE TOWN OF

HAMPDEN

PENOBSCOT COUNTY

FOUNDATION SURVEY

SHEET OF AUGUSTA, MAINE