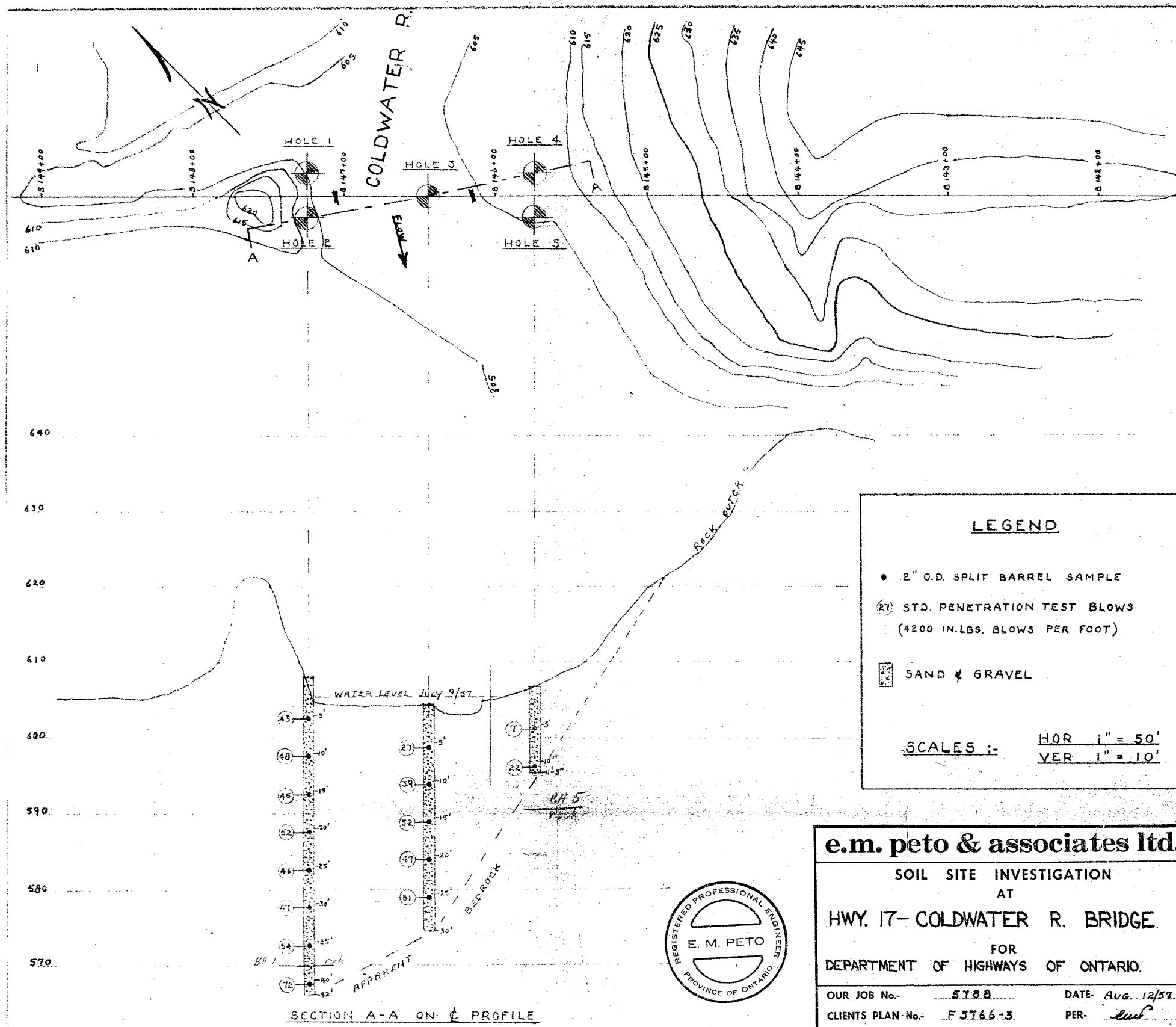


57-F-235C
Hwy. #17
COLDWATER RIVER



e. m. peto associates ltd., 850 roselawn avenue, Toronto 10, Ontario

Job No. 5788

Client's Ref. No.

Date August 13th/57

Report on
SOIL SITE INVESTIGATION

57-F-235C

at

COLDWATER RIVER BRIDGE - HIGHWAY 17

for

DEPARTMENT OF HIGHWAYS OF ONTARIO

TERMS OF REFERENCE:

It was originally proposed that 5 soil test holes were to be driven at the site for the proposed Coldwater River Bridge on Highway 17 in the Algoma District. The test hole locations were generally indicated on a marked copy of the general alignment site plan number T-3766-3.

The test holes were to be driven to determine the subsoil strata, the depth to bedrock where considered necessary, and to indicate the bearing values of the strata encountered. The report was also to indicate any potential site problems which might be noticed during the site investigation.

METHOD OF OPERATIONS:

This field investigation was performed by our number 3 unit, a Sullivan "12", skid-mounted diamond drill rig, which was moved to the site from the Sand River bridge site on July 4th, 1957. Work commenced at test hole number 4 on July 5th and the field work was completed by July 11th, 1957.

Each test hole was performed by driving and cleaning drill casing, sampling ahead of the casing at approximately 5 foot intervals with a 2" O.D. split barrel sampler. Standard penetration test results were recorded when sampling, these being the number of blows of a 140 lbs. hammer falling 30" required to drive the split barrel sampler a distance of one foot.

METHOD OF OPERATIONS: (Cont'd)

There was some minor difficulty at setting up at the marked locations shown on the Client's site plan. Some assistance was provided by the General Road Contractor, Mount Enterprises Ltd., in moving the equipment and in providing a working bed for the test machine.

OBSERVATIONS:

The test hole locations with their ground elevations were supplied to our field crew by the D. H.O. staff based at Coldwater camp. The locations are shown on the site plan attached to the rear of this report. The contours drawn on this plan have been transposed from the D.H.O. drawing number F-3766-3 to an enlarged scale, and may therefore only be regarded as approximate. The results obtained at each test hole are shown on the borehole logs attached at the rear of this report. A cross sectional view through test holes 2, 3 and 4 had been superimposed on the road centre line profile, to a much exaggerated vertical scale so that the basic information obtained may stand out.

Soil Conditions

Similarly to many of the rivers in this part of Ontario, the subsoil is granular, with varying gradations of sand and fine gravel. As may be expected so close to the mouth of a river discharging into Lake Superior, there is no well defined pattern of stratification; although the slightly silty fine sand stratum, appearing at test hole 1 between the 5 ft. and 15 ft. depth, was also found at test holes 2 and 3.

Generally, there exists a coarse sand and fine gravel for the top 5 ft. Below the 5 ft. depth, we found a generally fine silty sand, although there were gradations initially to medium and coarse sand at test holes 4 and 5. Below the 15 ft. depth at test holes 1, 2 and 3, the sand was generally medium to coarse with considerable fine gravel at various depths. Test hole 1 clearly established a stratum containing considerable silt, and this stratum was again encountered, but to a lesser extent, at test hole 2.

The standard penetration test results at test holes 1 and 2 were extremely consistent, varying on the whole, between 43 and 52 blows per foot. The results up to 10 ft. depth at test hole 3 were slightly lower and the penetration test results at test hole 4 were somewhat lower again. The results at test hole 5 were only compact below the top 5 ft.

OBSERVATIONS:Soil Conditions: (Cont'd)

Because of the close proximity (within about 100 ft. to the South East) of rock outcropping to test holes 4 and 5, which was being blasted out by the road construction company, we did not consider it necessary to obtain rock cores at either of these test hole locations.

We did however want to extract a core from Test Hole 3, the last hole to be put down, to verify the soundness of the rock on a sloping face, but this we were prevented from doing for the following reason. At the time of the investigation the semi permanent construction Bailey Bridge, for the by-pass, had not been erected, and the general contractor had consequently bulldozed a purely temporary track across the river; small diameter Argee culverting being used to carry off the dry season river flow. Unfortunately very heavy rains, which fell during the work at Test Hole 3 caused the river to rise, and the culverting was insufficient to cope with the increased flow. By the time our crew had reached refusal the water level had already risen some 4 ft., and was still rising, and the machine had to be removed hastily from the river. The delay, which would have followed waiting for the river level to fall, so that the machine could be moved back and a new hole put down, was considered unwarranted.

RECOMMENDATIONS AND CONCLUSIONS:

1. We felt from the locations chosen for the test holes by the D.H.O. staff, that it was expected to build a relatively short span bridge at this site. It was our opinion that the North West abutment would be located on the knoll of ground just to the North West of test holes 1 and 2. With the high shoulder of rock which outcrops on the approach to the South East end of the bridge, we assumed that the structure would be a high level bridge, to avoid excessive rock cut on this approach. Of course, such an assumption would require the placement of a considerable amount of fill at the North West approach.
2. There are indications that the river appears to have at least two branches immediately upstream from the proposed bridge site, and consequently the flood plain appears to be somewhat wider than it will be at the proposed bridge site. We feel that consideration should be given to some straightening and deepening of the river channel, immediately upstream from the bridge site, especially if a major fill is to be placed on the North West approach, as far East as the locations of test holes 1 and 2.

RECOMMENDATIONS AND CONCLUSIONS (Cont'd)

3. The generally dense to very dense sand stratum, at this site provides excellent bearing values for construction purposes. Load bearing values of the order of 4 tons per sq. ft. can easily be tolerated, except at shallow depths near test holes 4 and 5, but the inconsiderable depth to bedrock here tends to remove any foundation problem, even if the loadings suggested above were to be used for the abutment, based perhaps only 5 ft. below ground surface. However, the constriction of the general flood plain by the provision of a short span bridge with an approach embankment at the North West side, would encourage scour at the abutments, and the central pier if so provided. Scour could become excessive, and would require protection for a depth of up to 15 ft. or more below present river bottom.
4. With the densities which exist even at the 5 to 6 ft. depth at test holes 1, 2 and 3, there will be considerable difficulty in driving any kind of sheet piling, perhaps even with the assistance of jetting. It would be totally unnecessary to drive bearing piles at the locations of test holes 1, 2 and 3, and we do not consider it would be wise to use bearing piles for an abutment based near test holes 4 and 5 due to the pronounced inclination of the bedrock and its proximity to surface unless such piles were dowelled into the bedrock.
5. In view of all the foregoing we should like to suggest that very careful consideration be given to the provision of a multiple arched culvert, (such as Armo). Of course we do not have any information regarding water levels or the propensity of the Coldwater to flood, and our suggestion is made on this basis. We feel that there are very considerable advantages to be obtained from a series of culvert openings. For example the soil will support such a structure with minimum excavation, the high level of the approaches can be preserved, fill is available, piling difficulties can be avoided and the cost will probably be much reduced. Settlement, if any, will occur immediately, and will be inconsequential even under the high embankment required.

RECOMMENDATIONS AND CONCLUSIONS:

5. In addition some additional culverting could be placed under the approach fill on the North West side of the crossing to take care of the excess flow during spring flooding. Our impression is that it will be possible to provide culverting adequate to take care of the maximum flows. Stream diversion would not be difficult, to enable the main portion of the culverting to be constructed without interference from flowing water.

Of course we have no knowledge of the subsoil conditions upstream and downstream of the proposed centre line, over which the culverts would lie, although any great variation is unlikely. A substantial cut off wall, both upstream and downstream, would have to be provided for the culverts to prevent scour. We already know that the sand exists in a dense condition, and it will therefore be difficult to drive sheet piling, to prevent the ingress of water and sand during the excavation for the cut off walls. Even if the main stream be diverted, the sand would continue to remain in a saturated condition.

6. To sum up

- 1) Our first choice would be for a series of culverts for the reasons given above, but adequate protection against scour is necessary.
- 2) High level bridge of one or two spans, provides the most adequate waterway, and enables the approach grades to be maintained, but the greater and deeper excavations required for the abutments (and the centre pier if adopted although the soil bearing capacity is high) could become a problem. The bridge could be supported on spread footings, provided anti-scour measures are incorporated, although the abutment on the South East bank should be "keyed in" to the rock slope.
- 3) Load bearing values of 4 tons per sq. ft. can be used for design purposes, except at shallow depths near test holes 4 and 5.

E. M. PETO ASSOCIATES LTD.,



E. M. Peto, P. Eng.





EMP:sb

e. m. peto associates ltd.
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO
BOREHOLE LOG

Job Name Coldwater River Bridge Job No. 5788
Hwy. 17 Algoma Dist.
Client Dept. of Highways of Ontario Casing BX
Datum D.H.O. Compiled By D.H.H.

Borehole No. 1
Boring Date July 10th, 1957
Checked By E.M.P.

SAMPLE CONDITION

 UNDISTURBED
 FAIR
 DISTURBED
 LOST

SAMPLE TYPE

S. S. 2" STANDARD SPLIT TUBE SAMPLE
S. L. SPLIT BARREL WITH LINERS
S. T. THIN-WALLED SHELBY TUBE SAMPLE
W. S. WASH SAMPLE
R. C. ROCK CORE

ABBREVIATIONS

Y. T. IN SITU VANE SHEAR TEST
Q/u UNCONFINED COMPRESSIVE STRENGTH
W. L. WATER LEVEL IN CASING
W. T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
		Bed level	0'-0"					
FILL (SAND)			604.00					
BOULDERS & GRAVEL			5'-9"					
FINE SAND	LT GREY	VERY DENSE			1 X	S.S.	56	SATURATED
FINE SAND, SLIGHTLY SILTY	LT. GREY	VERY DENSE	10'-0"		2 X	S.S.	52	SATURATED
FINE TO COARSE SAND, SOME GRITS & PEBBLES, SLIGHTLY SILTY	GREY	DENSE	15'-0"		3 X	S.S.	46	SILT CONTENT IN POCKETS OR LAYERS
FINE TO COARSE SAND	REDDISH-GREY		20'-0"		4 X	W.S.	-	
MEDIUM TO COARSE SAND, VERY SILTY, GRITS & PEBBLES	REDDISH-GREY	VERY DENSE	25'-0"		5 X	S.S.	56	
COARSE TO VERY COARSE SAND	REDDISH-GREY	DENSE	30'-0"		6 X	S.S.	47	
PRESUMED BEDROCK			34'-0" 570.00	XXXX				
			REFUSAL					

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

BOREHOLE LOG

Borehole No. 2
Boring Date July 8th, 1957.
Checked By E.M.P.

ABBREVIATIONS

V. T. IN SITU VANE SHEAR TEST
Q/u UNCONFINED COMPRESSIVE STRENGTH
W. L. WATER LEVEL IN CASING
W. T. GROUND WATER TABLE IN SOIL

47610

Borehole No. 3
 Boring Date July 10th, 1957
 Checked By E.M.P.

ABBREVIATIONS

V. T. IN SITU VANE SHEAR TEST
Q/u UNCONFINED COMPRESSIVE STRENGTH
W. L. WATER LEVEL IN CASING
W. T. GROUND WATER TABLE IN SOIL




**SUPER IMPROVED DOCUMENT NOW
APPEAR AS MULTIFRAME ON FILM**

PRESUMED BEDROCK REFUSAL

e. m. peto associates ltd.
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO
BOREHOLE LOG

Job Name Coldwater River Bridge Job No. 5788 Borehole No. 4
Hwy. 17 Agloma Dist.
 Client Depth of Highways of Ontario Casing BX Boring Date July 5th, 1957.
 Datum D.H.O. Compiled By D.H.H. Checked By E.M.P.

SAMPLE CONDITION



 **UNDISTURBED**
 **FAIR**
 **DISTURBED**
 **LOST**

SAMPLE TYPE

S.S. 2" STANDARD SPLIT TUBE SAMPLE
S.L. SPLIT BARREL WITH LINERS
S.T. THIN-WALLED SHELBY TUBE SAMPLE
W.S. WASH SAMPLE
R.C. ROCK CORE

ABBREVIATIONS





V.T. IN SITU VANE SHEAR TEST
Q/u UNCONFINED COMPRESSIVE STRENGTH
W.L. WATER LEVEL IN CASING
W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
			0 - 0"					
			606.90					
SAND & GRAVEL FILL								
			5 - 0"					
MEDIUM TO COARSE SAND & FINE GRAVEL	REDDISH-BROWN	LOOSE			1 	S.S.	7	HARD AT 7'
			10 - 0"					
FINE TO VERY FINE VERY SILTY SAND, SOME STONES	LT. GRAY	COMPACT	11 - 3"		2 	S.S.	22	PRESUMED BED ROCK
			595.65					

**SUPER IMPOSED DOCUMENT MAY
 APPEAR AS DUPLICATED ON FILM**

Job Name Coldwater River Bridge,
Hwy. 17 Algoma Dist. Job No. 5788
Client Dept. of Highways of Ontario Casing BX Borehole No. 5
Datum D.H.O. Compiled By D.H.H. Boring Date July 6th, 1957.
Checked By E. M. P.

SAMPLE CONDITION

 UNDISTURBED
 FAIR
 DISTURBED
 LOST

SAMPLE TYPE

S. S. 2" STANDARD SPLIT TUBE SAMPLE
S. L. SPLIT BARREL WITH LINERS
S. T. THIN-WALLED SHELBY TUBE SAMPLE
W. S. WASH SAMPLE
R. C. ROCK CORE

ABBREVIATIONS

V. T. IN SITU VANE SHEAR TEST
 Q/u UNCONFINED COMPRESSIVE STRENGTH
 W. L. WATER LEVEL IN CASING
 W. T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
			0 - 3 696.70					
MIXED SAND, SOME FIBROUS ORGANIC MATTER								
			5 - 2					
FINE TO VERY COARSE SAND & FINE GRAVEL	REDDISH - BROWN	COMPACT			1 <input checked="" type="checkbox"/>	S S	20	
			10 - 0					
FINE TO VERY FINE SAND, SLIGHTLY SILTY, SOME FINE GRAVEL	LT. GREY	VERY DENSE			2 <input checked="" type="checkbox"/>	S S	59	
			12 - 0"					
MOSTLY FINE SAND, BUT WITH GRADATIONS FROM FINE TO VERY COARSE SAND, SOME GRAVEL	LT GREY	VERY DENSE			3 <input checked="" type="checkbox"/>	S S	72	
			16 - 2" 590	XXXX				PRESUMED BED ROCK