

# 67-F-272 M

CULVERT

ALTER CREEK

WILMOT TWP.

BA 3771  
37-37-248

E. M. PETO ASSOCIATES LTD.

67-F-161  
SOILS INVESTIGATION REPORT  
ALTER CREEK CULVERT

FOR

TOWNSHIP OF WILMOT  
c/o MCCARGAR AND HACHEORN LIMITED

DISTRIBUTION:

4 c.c. McCargar and Hachborn Limited  
1 c.c. File

JOB NO. 67-F161

AUGUST, 1967

**e. m. peto associates ltd.**

YOUR REFERENCE..

OUR REFERENCE..

67-Fl61

**1287 caledonia road,**

**TORONTO 19, ONTARIO**

**Telephone: 788-1126**

August 2, 1967

Township of Wilmot,  
c/o McCargar and Hachborn Limited,  
Consulting Engineers,  
546 Belmont Avenue West,  
Kitchener, Ontario.

Attention: Mr. E.G. Hachborn, P.Eng.

Dear Sir:

Re: Soil Investigation Report  
Alter Creek Culvert

With reference to your verbal request for the above soil investigation, we given below our report.

A. GENERAL INFORMATION

During the latter part of July, 1967, two boreholes were sunk on the site according to standard procedures. Hole No. 1 was taken down to 22 ft. and hole 2 was terminated at 16 ft. 6 inches as requested. The locations of the holes are shown on the appended drawing.

Detailed descriptions of the soil strata are shown on the appended borehole log sheets and a generalized soil profile is shown on the drawing. The surficial soils consist of loose Topsoil and Sand, and extend down to 3 ft. 3 inches in borehole 1 and to 5 ft. 6 inches in borehole 2. Below these, i.e. below elevation 89.5 in borehole 1 and 88.3 in borehole 2, are generally compact gravelly Sand layers, including a layer of Sandy Silt. However, there is also a 2 ft. thick layer of very stiff Clayey Silt at 11 ft. 3 inches in borehole 1 and at 9 ft. 6 inches in borehole 2.

Ground water was encountered in all the soils below about 1 ft. 0 inch from surface, down to the very stiff Clayey Silt. The flow of the water in these soils was fairly fast and the holes also caved in at various depths as given in the borehole logs. The very stiff Clayey Silt was generally dry but the ground water in the underlying gravelly Sand stratum was under artesian pressure. This water rose rapidly to an elevation of approximately 96.5, i.e. to 2 ft. 4 inches to 3 ft. 9 inches above the ground surface.

## B. CONCLUSIONS AND RECOMMENDATIONS

- B.1 Bearing Capacity and Settlements of Footings: The allowable bearing capacity of footings in the compact strata at about elevation 86.5, i.e. about 5 ft. below the creek bed, should be limited to 3.0 kips/sq.ft. due to the existence of the Sandy Silt layer at elevation 87. The settlements should be within the permissible limits for such a simply supported bridge structure. A depth of 5 ft. below the creek bed will be necessary to provide protection against frost action and scouring. If the scour conditions warrant it, additional protection may be provided by the use of rip rap or gabions.
- B.2 Excavation and Ground Water Control: Due to the existing ground water conditions, dewatering using perimeter wells, will be necessary before the excavations to elevation 86.5 for the footings are carried out. The well points should penetrate into the gravelly Sand stratum which underlies the very stiff Silt, i.e. below elevation 79, and piezometric level should be lowered to below the foundation level. Otherwise, blowouts at the bottom of the excavation are likely to occur and the subgrade will also be disturbed. The excavations will have to be either shored or sloped back to a stable slope of about 1 vertical to 2 horizontal.

B.3 Multiple Cell Box Culvert: The dewatering and excavation operations for the footing foundations are likely to be expensive. Hence, the feasibility and the cost of a multiple cell concrete box culvert should be given more serious consideration. Such a culvert should be constructed on a granular bedding layer at least 12 inches thick. The loose soils, which extended down to elevation 88.3 in borehole 2 should also be stripped and replaced with compact, clean granular fill. Hence, assuming the invert to be at elevation 91.5 and a concrete base thickness of 9 inches, the maximum thickness of fill should be 1 ft. 6 inches plus 12 inches of bedding layer. The excavations for these could be carried out without installing wells if backfilling is carried out soon after excavation. The water which flows into the excavations from the surficial layers could be pumped out, assuming that the water in the creek is diverted during the excavation and construction.

Normal wing walls and concrete aprons should be provided in order to minimize scouring around the culvert. Cut-off walls should also be provided at the upstream and downstream ends of the culvert in order to prevent underscour. These walls could be made up of steel sheet piles driven into the creek bed along the outer edges of the aprons.

The strength of the compact soils underlying such a box culvert should be adequate to support the loads from the culvert and the settlements should be within the acceptable limits.

B.4 Pile Support: It is not considered that the ground conditions are favourable to the use of piles, because of the generally dense conditions where pile augering would be necessary to achieve a satisfactory depth of pile penetration. The artesian ground water condition is also unfavourable to the use of piles.

B.5 Armco Culvert: The use of multiple elliptical Armco sections is possible; however, this solution is regarded as being somewhat of an expedient on this site, since the additional scouring effect from the adjoining walls of each section in the stream bed will not be easy to provide for in a simple effective and economic manner.

Accordingly, it is our opinion that a multiple concrete box culvert provides a proper and effective solution to the crossing of this creek.

Yours very truly,

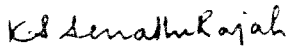
E. M. PETO ASSOCIATES LTD.



C.F. Freeman, P.Eng.,  
Chief Engineer.

KSS/hf

Report Prepared by:



K.S. Senathirajah, P.Eng.,  
Senior Soils Engineer.

## LIST OF ABBREVIATIONS

### PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

### DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

| <u>CONSISTENCY</u> | <u>'N' BLOWS / FT.</u>     | <u>c LB. / SQ FT.</u> | <u>DENSENESS</u> | <u>'N' BLOWS / FT.</u>   |
|--------------------|----------------------------|-----------------------|------------------|--------------------------|
| VERY SOFT          | 0 - 2                      | 0 - 250               | VERY LOOSE       | 0 - 4                    |
| SOFT               | 2 - 4                      | 250 - 500             | LOOSE            | 4 - 10                   |
| FIRM               | 4 - 8                      | 500 - 1000            | COMPACT          | 10 - 30                  |
| STIFF              | 8 - 15                     | 1000 - 2000           | DENSE            | 30 - 50                  |
| VERY STIFF         | 15 - 30                    | 2000 - 4000           | VERY DENSE       | > 50                     |
| HARD               | > 30                       | > 4000                |                  |                          |
| W.T.P.L.           | WETTER THAN PLASTIC LIMIT  |                       | D.T.P.L.         | DRIER THAN PLASTIC LIMIT |
|                    | A.P.L. ABOUT PLASTIC LIMIT |                       |                  |                          |

### TYPE OF SAMPLE

|     |                       |                               |                   |
|-----|-----------------------|-------------------------------|-------------------|
| S.S | SPLIT SPOON           | T.W                           | THINWALL OPEN     |
| W.S | WASHED SAMPLE         | T.P                           | THINWALL PISTON   |
| S.B | SCRAPER BUCKET SAMPLE | O.S                           | OESTERBERG SAMPLE |
| A.S | AUGER SAMPLE          | F.S                           | FOIL SAMPLE       |
| C.S | CHUNK SAMPLE          | R.C                           | ROCK CORE         |
| S.T | SLOTTED TUBE SAMPLE   |                               |                   |
|     | D.H                   | SAMPLE ADVANCED HYDRAULICALLY |                   |
|     | P.M                   | SAMPLE ADVANCED MANUALLY      |                   |

### SOIL TESTS

|                 |                                 |     |                 |
|-----------------|---------------------------------|-----|-----------------|
| Q <sub>u</sub>  | UNCONFINED COMPRESSION          | L.V | LABORATORY VANE |
| Q               | UNDRAINED TRIAXIAL              | F.V | FIELD VANE      |
| Q <sub>cu</sub> | CONSOLIDATED UNDRAINED TRIAXIAL | C   | CONSOLIDATION   |
| Q <sub>d</sub>  | DRAINED TRIAXIAL                |     |                 |

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Consulting soil engineers

## RECORD OF BOREHOLE NO. 1

JOB NO. 67-F161

JOB NAME Alter Creek Culvert

TECHNICIAN JL

BORING DATE July 20/67

CLIENT Township of Wilmot, c/o McCargar and Hachborn Ltd.

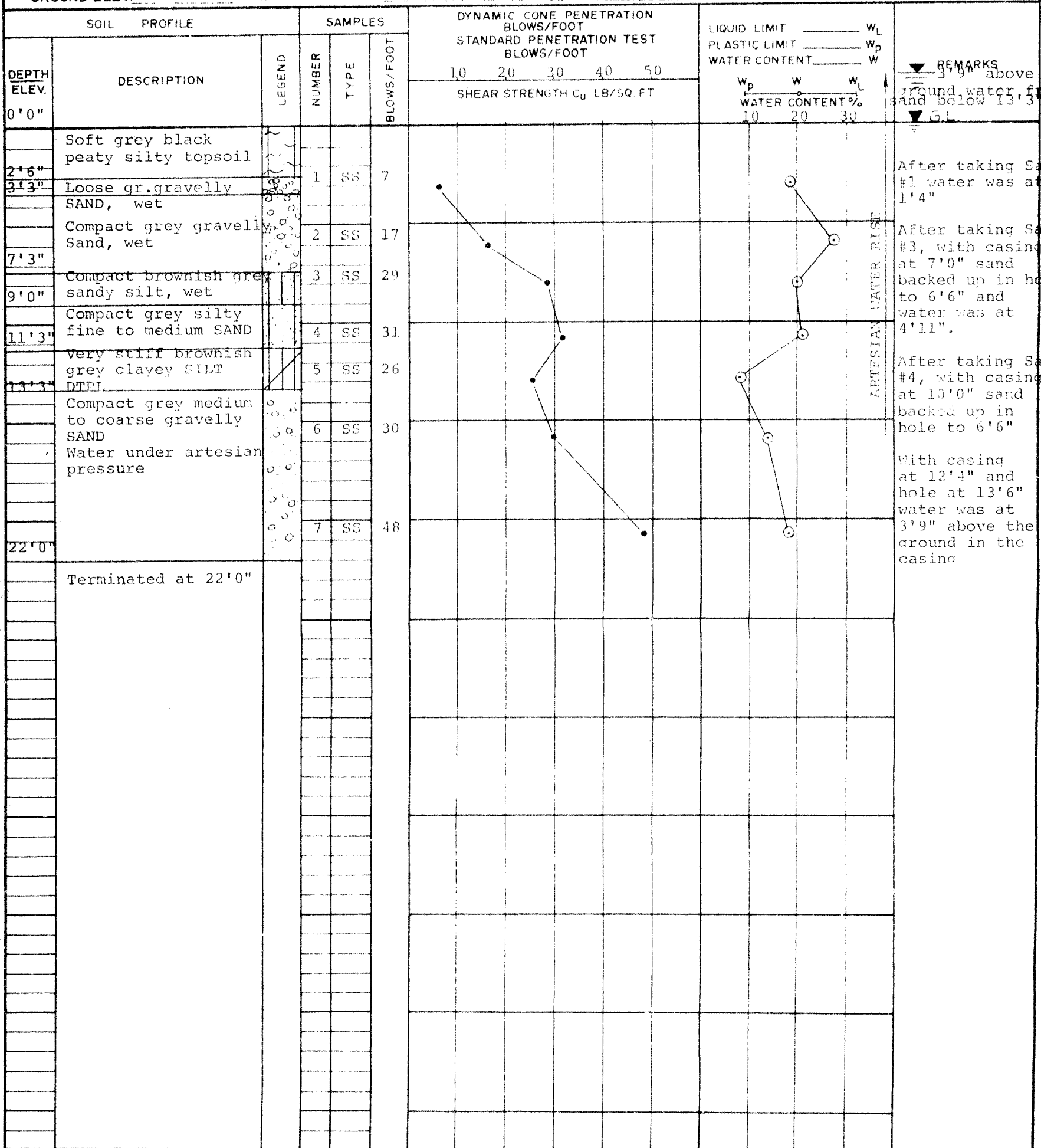
ENGINEER KSS

GROUND ELEV. 92.8

BOREHOLE TYPE

Standard Rig

TYPED BY HF

DEFECTS IN NEGATIVE DUE TO  
CONDITION OF ORIGINAL DOCUMENT



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## RECORD OF BOREHOLE NO.

2

Consulting soil engineers

JOB NO. 67-F161

JOB NAME Alter Creek Culvert

TECHNICIAN JL

BORING DATE July 21/67

CLIENT Township of Wilmot, c/o McCargar and Hachborn Ltd.

ENGINEER KSS

GROUND ELEV. 93.8

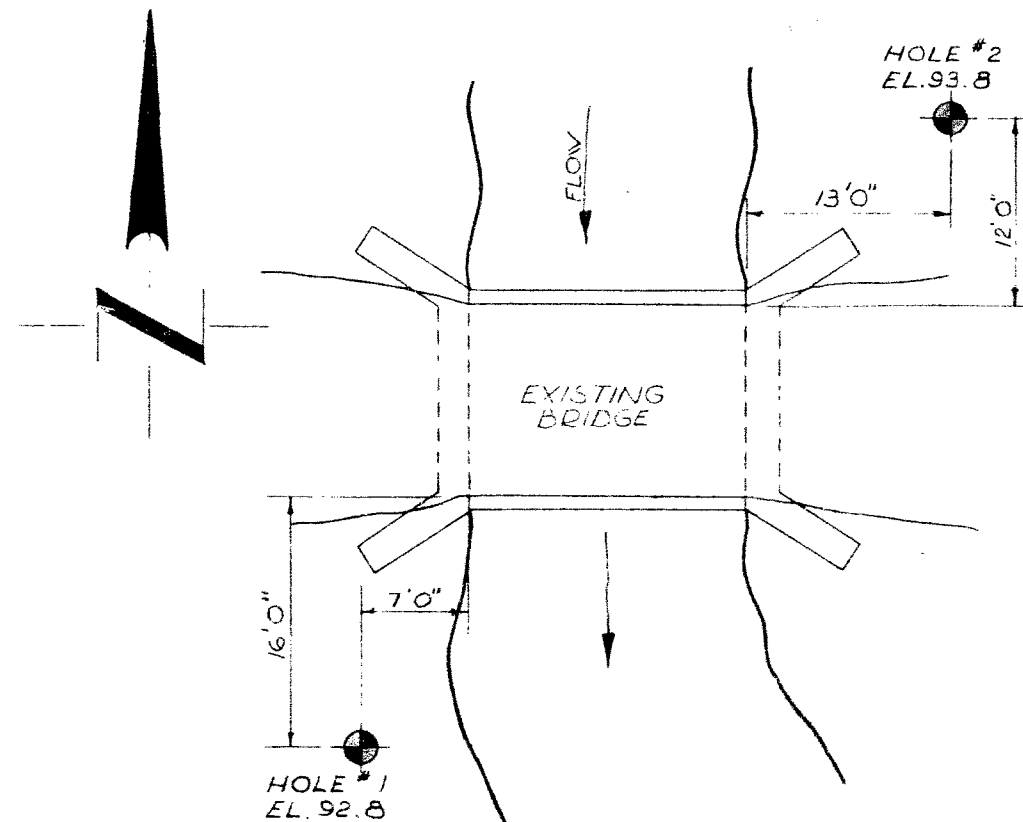
BOREHOLE TYPE

Standard Rig

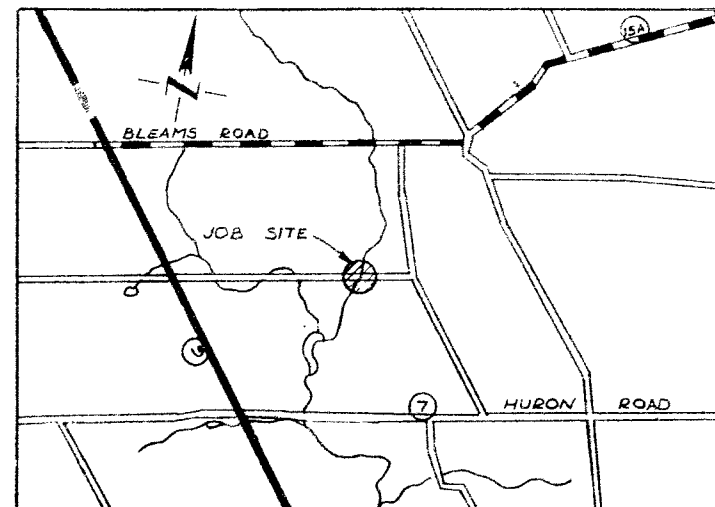
TYPED BY HF

| SOIL PROFILE   |                                                                                      |        | SAMPLES |      | DYNAMIC CONE PENETRATION<br>BLOWS/FOOT<br>STANDARD PENETRATION TEST<br>BLOWS/FOOT |    |    |    |    | LIQUID LIMIT _____ W <sub>L</sub><br>PLASTIC LIMIT _____ W <sub>p</sub><br>WATER CONTENT _____ W |                                                                               |  | REMARKS |                                                                                                                                                                       |
|----------------|--------------------------------------------------------------------------------------|--------|---------|------|-----------------------------------------------------------------------------------|----|----|----|----|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DEPTH<br>ELEV. | DESCRIPTION                                                                          | LEGEND | NUMBER  | TYPE | BLOWS/FOOT                                                                        | 10 | 20 | 30 | 40 | 50                                                                                               | W <sub>p</sub> W      W <sub>L</sub><br>WATER CONTENT %<br>10      20      30 |  |         |                                                                                                                                                                       |
| 0'0"           |                                                                                      |        |         |      |                                                                                   |    |    |    |    |                                                                                                  |                                                                               |  |         | 2'4" above ground water from sand below 11'9"                                                                                                                         |
| 2'6"           | Soft grey black peaty silty topsoil                                                  |        |         |      |                                                                                   |    |    |    |    |                                                                                                  |                                                                               |  |         | 1'3"                                                                                                                                                                  |
| 5'6"           | Loose sand and fill with pieces of wood. High penetration result at 2'0" due to wood |        | 1       | SS   | 20                                                                                |    |    |    |    |                                                                                                  |                                                                               |  |         | After taking Sa. #1 water was at 2'0". After taking Sa. #2 with casing at 5'0" water was at 1'3".                                                                     |
| 6'9"           | Compact grey very gravelly SAND                                                      |        | 2       | SS   | 25                                                                                |    |    |    |    |                                                                                                  |                                                                               |  |         | After taking Sa. #3 with casing at 5'0" water was at 1'3".                                                                                                            |
| 9'6"           | Loose brownish grey sandy silt with layers of fine sand                              |        | 3       | SS   | 9                                                                                 |    |    |    |    |                                                                                                  |                                                                               |  |         | After taking Sa. #4 with casing at 10' water was at 4'2".                                                                                                             |
| 11'9"          | Very stiff brownish grey clayey SILT                                                 |        | 4       | SS   | 36                                                                                |    |    |    |    |                                                                                                  |                                                                               |  |         | After taking Sa. #5 with casing at 10 ft. water was at 2'8".                                                                                                          |
| 16'6"          | Compact grey medium to coarse gravelly SAND. Water under artesian pressure           |        | 5       | SS   | 32                                                                                |    |    |    |    |                                                                                                  |                                                                               |  |         | 8 minutes later it was at 0'9" above ground. After taking Sa. #6, with casing at 15' sand backed up in hole to 12'0" and the water rose rapidly to 2'4" above ground. |
|                | Terminated at 16'6"                                                                  |        | 6       | SS   | 54                                                                                |    |    |    |    |                                                                                                  |                                                                               |  |         |                                                                                                                                                                       |

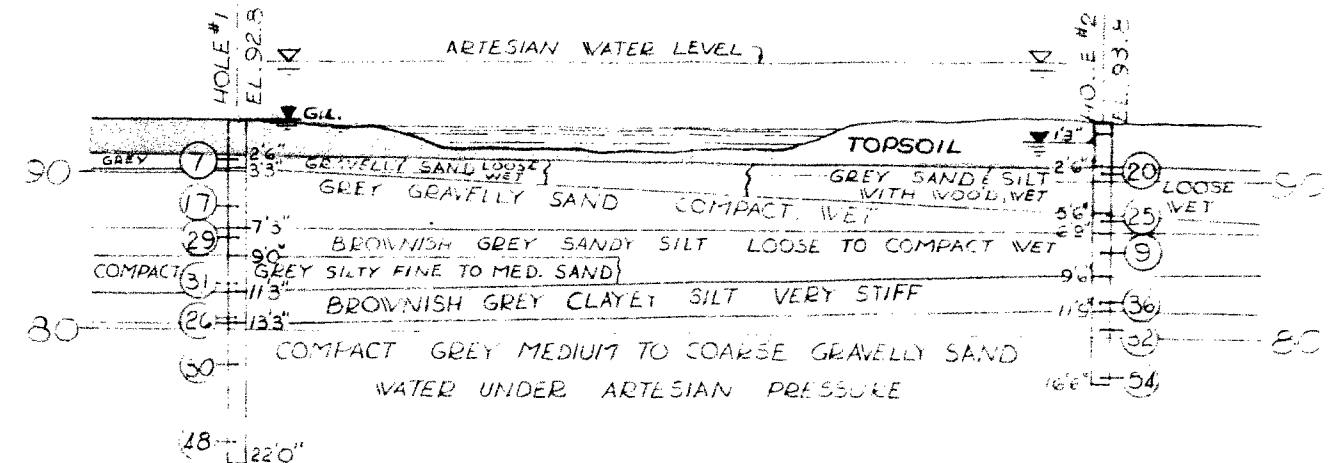
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SITE PLAN  
SCALE: 10' TO 1"






KEY PLAN  
SCALE 1 MILE TO 1"



SECTION THROUGH HOLES 1 & 2  
SCALE 10' TO 1" (NATURAL)

## LEGEND

-  BOREHOLE
-  BLOWS / FOOT
-  WATER LEVEL

## NOTE:

SEE BOREHOLE LOGS FOR COMPLETE SOIL AND GROUND WATER DETAILS.

NOTE: The actual soil stratification has been verified from data obtained at the borehole locations only. The inferred contacts shown are based on geological evidence and these may vary from those shown between borings.

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CONDITION OF ORIGINAL DOCUMENT



TOWNSHIP OF WILMOT  
% McCARGAR & HACHBORN LTD. CONS. ENGRS.

ALTER CREEK CULVERT

PREPARED BY  
e.m. peto associates ltd.

|                   |                    |                |                      |
|-------------------|--------------------|----------------|----------------------|
| JOB No.<br>67F161 | DATE:<br>AUG. 1967 | DRAWN BY<br>ZL | CHECKED BY<br>K.S.S. |
|-------------------|--------------------|----------------|----------------------|