

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 92-216



Ministry of
Transportation

INDEX

| <u>Page No:</u> | <u>DESCRIPTION</u> |
|-----------------|---|
| 1 | Index |
| 2 | Abbreviations & Symbols |
| 3 - 22 | Foundation Investigation Report for S.E. By-Pass Interchange Structures W.P. 83-88-02 & 03 Site 46-304 Hwy. 69 & 17, District 17, Sudbury Culverts C2, C3 and C4 W.P. 83-88-00, Site N/A Hwy. 69/17, District 17, Sudbury |

Note: For purposes of the contract, this report supersedes all other Foundation Reports prepared by, or for the Ministry in connection with the above mentioned project.

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N}

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

| c_u (kPa) | 0 - 12 | 12 - 25 | 25 - 50 | 50 - 100 | 100 - 200 | > 200 |
|-------------|-----------|---------|---------|----------|------------|-------|
| | VERY SOFT | SOFT | FIRM | STIFF | VERY STIFF | HARD |

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

| N (BLOWS/0.3m) | 0 - 5 | 5 - 10 | 10 - 30 | 30 - 50 | > 50 |
|----------------|------------|--------|---------|---------|------------|
| | VERY LOOSE | LOOSE | COMPACT | DENSE | VERY DENSE |

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

| RQD (%) | 0 - 25 | 25 - 50 | 50 - 75 | 75 - 90 | 90 - 100 |
|---------|-----------|---------|---------|---------|-----------|
| | VERY POOR | POOR | FAIR | GOOD | EXCELLENT |

JOINTING AND BEDDING:

| SPACING | 50mm | 50 - 300mm | 0.3m - 1m | 1m - 3m | > 3m |
|----------|------------|------------|------------|---------|------------|
| JOINTING | VERY CLOSE | CLOSE | MOD. CLOSE | WIDE | VERY WIDE |
| BEDDING | VERY THIN | THIN | MEDIUM | THICK | VERY THICK |

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

| | | | |
|-----|---------------------|-----|----------------------------|
| S S | SPLIT SPOON | T P | THINWALL PISTON |
| W S | WASH SAMPLE | O S | OSTERBERG SAMPLE |
| S T | SLOTTED TUBE SAMPLE | R C | ROCK CORE |
| B S | BLOCK SAMPLE | P H | T W ADVANCED HYDRAULICALLY |
| C S | CHUNK SAMPLE | P M | T W ADVANCED MANUALLY |
| T W | THINWALL OPEN | F S | FOIL SAMPLE |

STRESS AND STRAIN

| | | |
|--------------------------------------|-----|-------------------------------|
| u_w | kPa | PORE WATER PRESSURE |
| u | l | PORE PRESSURE RATIO |
| σ | kPa | TOTAL NORMAL STRESS |
| σ' | kPa | EFFECTIVE NORMAL STRESS |
| τ | kPa | SHEAR STRESS |
| $\sigma_1, \sigma_2, \sigma_3$ | kPa | PRINCIPAL STRESSES |
| ϵ | % | LINEAR STRAIN |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | % | PRINCIPAL STRAINS |
| E | kPa | MODULUS OF LINEAR DEFORMATION |
| G | kPa | MODULUS OF SHEAR DEFORMATION |
| μ | l | COEFFICIENT OF FRICTION |

MECHANICAL PROPERTIES OF SOIL

| | | |
|----------------|-------------------|--------------------------------------|
| m_v | kPa ⁻¹ | COEFFICIENT OF VOLUME CHANGE |
| C_c | l | COMPRESSION INDEX |
| C_s | l | SWELLING INDEX |
| C_α | l | RATE OF SECONDARY CONSOLIDATION |
| c_v | m ² /s | COEFFICIENT OF CONSOLIDATION |
| H | m | DRAINAGE PATH |
| T_v | l | TIME FACTOR |
| U | % | DEGREE OF CONSOLIDATION |
| σ'_{vo} | kPa | EFFECTIVE OVERBURDEN PRESSURE |
| σ'_p | kPa | PRECONSOLIDATION PRESSURE |
| τ_f | kPa | SHEAR STRENGTH |
| c' | kPa | EFFECTIVE COHESION INTERCEPT |
| ϕ' | -° | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| c_u | kPa | APPARENT COHESION INTERCEPT |
| ϕ_u | -° | APPARENT ANGLE OF INTERNAL FRICTION |
| τ_R | kPa | RESIDUAL SHEAR STRENGTH |
| τ_r | kPa | REMOULDED SHEAR STRENGTH |
| S_t | l | SENSITIVITY = $\frac{c_u}{\tau_r}$ |

PHYSICAL PROPERTIES OF SOIL

| | | | | | | | | |
|----------------|-------------------|--------------------------------|-----------|------|---|-----------|-------------------|---|
| ρ_s | kg/m ³ | DENSITY OF SOLID PARTICLES | e | l, % | VOID RATIO | e_{min} | l, % | VOID RATIO IN DENSEST STATE |
| γ_s | kN/m ³ | UNIT WEIGHT OF SOLID PARTICLES | n | l, % | POROSITY | I_D | l | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| ρ_w | kg/m ³ | DENSITY OF WATER | w | l, % | WATER CONTENT | D | mm | GRAIN DIAMETER |
| γ_w | kN/m ³ | UNIT WEIGHT OF WATER | S_r | % | DEGREE OF SATURATION | D_n | mm | n PERCENT - DIAMETER |
| ρ | kg/m ³ | DENSITY OF SOIL | w_L | % | LIQUID LIMIT | C_u | l | UNIFORMITY COEFFICIENT |
| γ | kN/m ³ | UNIT WEIGHT OF SOIL | w_p | % | PLASTIC LIMIT | h | m | HYDRAULIC HEAD OR POTENTIAL |
| ρ_d | kg/m ³ | DENSITY OF DRY SOIL | w_s | % | SHRINKAGE LIMIT | q | m ³ /s | RATE OF DISCHARGE |
| γ_d | kN/m ³ | UNIT WEIGHT OF DRY SOIL | I_p | % | PLASTICITY INDEX = $w_L - w_p$ | v | m/s | DISCHARGE VELOCITY |
| ρ_{sat} | kg/m ³ | DENSITY OF SATURATED SOIL | I_L | l | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$ | i | l | HYDRAULIC GRADIENT |
| γ_{sat} | kN/m ³ | UNIT WEIGHT OF SATURATED SOIL | I_C | l | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ | k | m/s | HYDRAULIC CONDUCTIVITY |
| ρ' | kg/m ³ | DENSITY OF SUBMERGED SOIL | e_{max} | l, % | VOID RATIO IN LOOSEST STATE | j | kN/m ³ | SEEPAGE FORCE |
| γ' | kN/m ³ | UNIT WEIGHT OF SUBMERGED SOIL | | | | | | |

FOUNDATION INVESTIGATION REPORT
For
S.E. By-Pass Interchange Structures
W.P. 83-88-02/03 Site 46-304
Hwy. 69/17, District 17, Sudbury

INTRODUCTION

This report summarizes the foundation investigation for two structures to carry Hwy. 17 over Hwy. 69 for the proposed S.E. By-Pass. The report is applicable to the two proposed structures, their immediate approaches, and related retaining structures.

SITE DESCRIPTION

The site is located at the proposed Hwy. 69/17 interchange, in the Regional Municipality of Sudbury, approximately 0.5 km south of the existing intersection of Hwy. 69 and the S.W. By-Pass.

The immediate area is exposed bedrock with occasional areas of shallow overburden. The topography is moderately steep and rugged with Hwy. 69 in a rock cut up to 6 to 8 m deep at the proposed structure locations. The east and west abutments of the proposed W.B. structure and the west abutment of the proposed E.B. structure are on exposed bedrock. The east abutment of the proposed E.B. structure is in an area of shallow overburden.

Just beyond the north-west quadrant of the site there is a commercial building, and beyond the immediate west approaches there are a few residential buildings. Otherwise the land is not in use.

INVESTIGATION PROCEDURES

A foundation investigation for this site was conducted on 89 11 10 and between 89 12 12 and 89 12 14. The investigation consisted of an examination of the exposed bedrock surfaces and cut faces, and the excavation of test pits at the east abutment of the proposed EB structure to classify the overburden material and determine the elevations of the bedrock surface. The contract drawings and Geotechnical Section boreholes

for previous highway widening in this area (Contract 78-79, W.P. 22-77-01) were also reviewed in order to approximate the depth to bedrock at the proposed pier locations.

SUBSURFACE CONDITIONS

Refer to Drawings No. 83-88-02/03 A&B* for contours of the bedrock surface and details of bedrock elevations determined from the test pits at the east abutment of the proposed EB structure.

The east and west abutments of the proposed WB structure, and the west abutment of the proposed EB structure are on exposed bedrock. The bedrock at these locations is essentially flat.

At the east abutment of the proposed EB structure the bedrock surface dips N to S at approximately 15° , and is overlain by approximately 1 to 2.5 m of a heterogeneous mixture of sand, silt, cobbles and boulders.

From a review of documents from Contract 78-79, and assuming standard MTO construction procedures were followed, it is assumed that the bedrock surface at the pier locations for both proposed structures are under 0.5 to 0.9 m of road subgrade material, which in turn is underlain by approximately 0.3 to 0.5 m of shattered rock.

Groundwater was not encountered at the test pit at the SE quadrant. However, water was flowing in the Hwy. 69 ditches.

Bedrock

The bedrock is basically a thinly bedded metamorphic gabbro containing occasional slaty layers. It has essentially E-W trending features and near vertical bedding. There are numerous fractures - typically spaced at 1 to 2 m horizontal and 2 to 3 m vertical, that tend to make the rock blocky and brittle.

* DWG NO 2 OF THE CONTRACT DWG'S

The east face is relatively stable probably due to superior blasting control. The drill traces are still visible, except for the most southerly 1/3 of the cut.

The west face is less stable with numerous overhanging blocky zones up to 1.2 m thick. This face has more, if minor, rock fall along the ditch line. There is some undercutting of the base, probably due to poor blasting control, especially in the area of Sta. 11+875 to Sta. 11+885 (Hwy. 69 chainage.).

MISCELLANEOUS

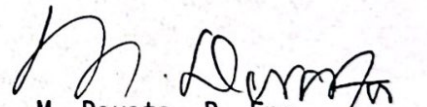
The field work for this project was carried out under the supervision of S. Holmes, Foundation Engineer and D. Dundas, Sr. Foundation Engineer.

The equipment used was hired by MTO District 17.

The report was written by D. Dundas and reviewed by M. Devata, Chief Foundation Engineer.




D. Dundas, P. Eng.
Sr. Foundation Engineer


M. Devata, P. Eng.
Chief Foundation Engineer

FOUNDATION INVESTIGATION REPORT

For

Culverts #C2, #C3 and #C4
W.P. 83-88-00; Site N/A
Hwy. 69/17 IC, District 17, Sudbury

This report summarizes the foundation investigation for the above-noted project.

The site is located at the proposed Hwy. 69/17 interchange, in the City of Sudbury, as shown on Figure 1.

The fieldwork was conducted between 91 04 29 and 91 05 02 and consisted of 13 boreholes (BH #1 to #13 attached). Borehole locations are shown in Figure 2.

Refer to the attached Record of Borehole Sheets for subsurface conditions at the borehole locations.



D. Dundas
D. Dundas, P. Eng.
Sr. Foundation Engineer

M. Devata
M. Devata, P. Eng.
Chief Foundation Engineer

INDEX

SITE PLAN

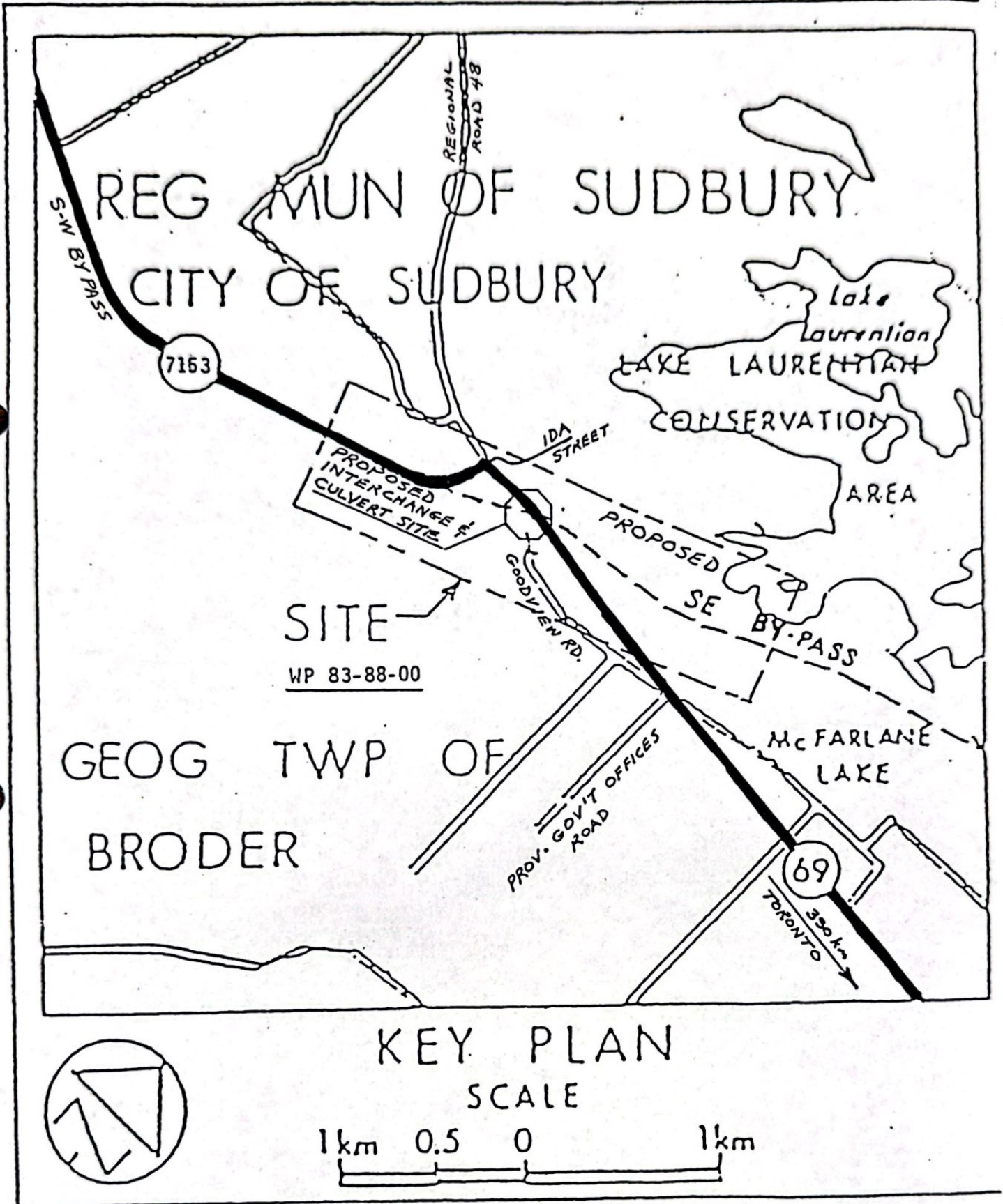
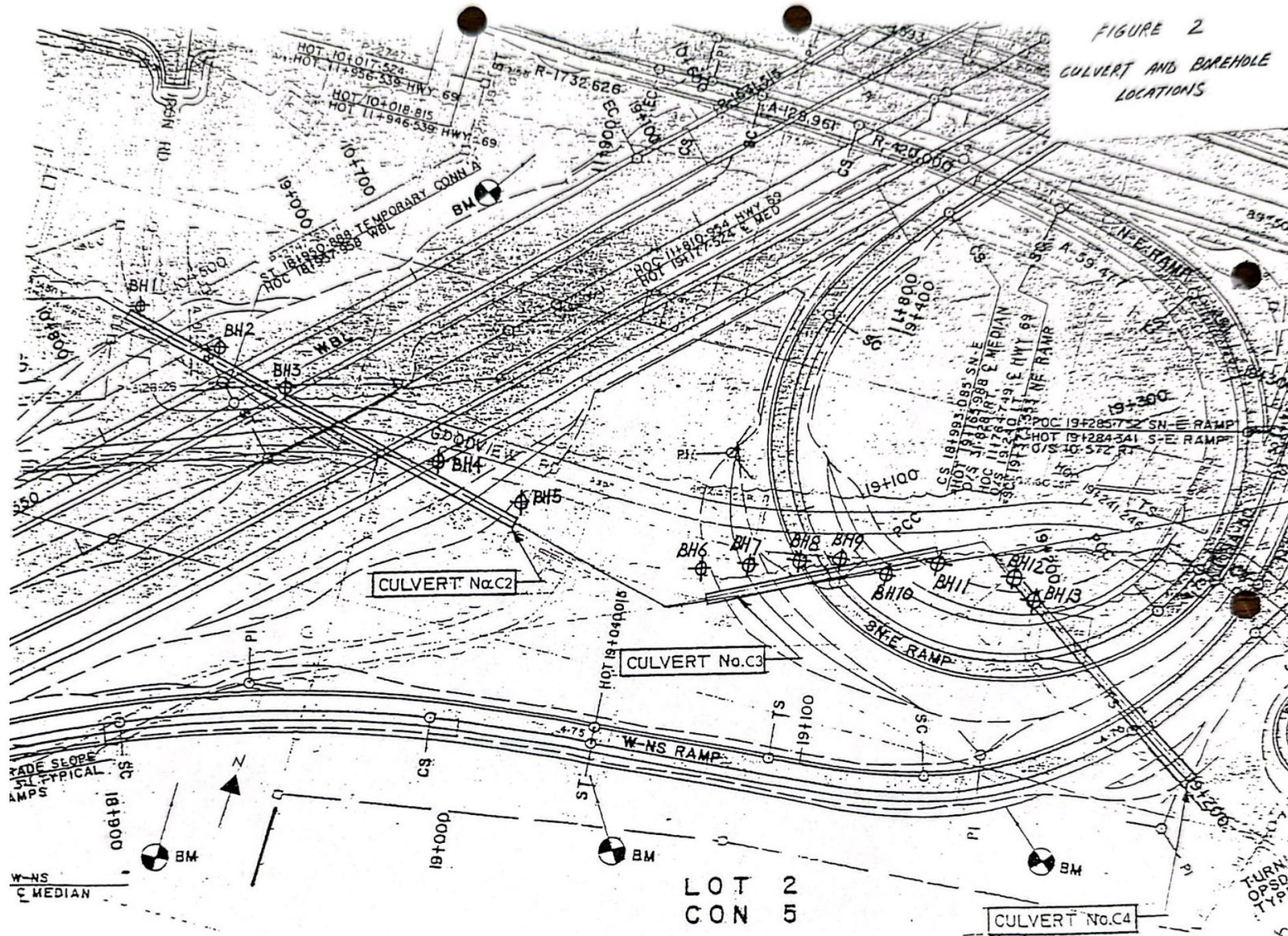


FIGURE 2
CULVERT AND BOREHOLE
LOCATIONS



RECORD OF BOREHOLE No 1

1 OF 1 METRIC

W.P. 83-88-00 LOCATION Culvert #2, N 5145867.E 307033 ORIGINATED BY BS
 DIST 17 HWY 17/69 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY 00
 DATUM Geodetic DATE 91 04 29 CHECKED BY 00

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT WL | UNIT WEIGHT 7 kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|-----------------------|-------------------------------------|-----------------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 263.8 | Ground Surface | | | | | | | | | | | | | | | | |
| 0.0 | | | | | | | | | | | | | | | | | |
| | Silty Sand | | | | | | | | | | | | | | | | |
| | Some Gravel Zones | | 1 | SS | 7 | | | | | | | | | | | | |
| | Loose To Dense | | 2 | SS | 32 | | | | | | | | | | | | |
| 260.4 | | | 3 | SS | 5 | | | | | | | | | | | | |
| 3.4 | | | | | | | | | | | | | | | | | |
| | Silty Clay | | | | | | | | | | | | | | | | |
| | With Silt Varves | | 4 | SS | 4 | | | | | | | | | | | | |
| | Soft | | 5 | SS | 8 | | | | | | | | | | | | |
| 257.7 | | | | | | | | | | | | | | | | | |
| 6.1 | | | 6 | SS | 7 | | | | | | | | | | | | |
| | Silt | | 7 | SS | 8 | | | | | | | | | | | | |
| | Loose To Compact | | 8 | SS | 14 | | | | | | | | | | | | |
| | Occ. Cobbles And Boulders | | 9 | SS | 11 | | | | | | | | | | | | |
| 254.0 | | | | | | | | | | | | | | | | | |
| 9.8 | Heterogeneous Mixture Sandy Silt Trace Clay Trace Gravel Occ. Cobbles And Boulders | | | | | | | | | | | | | | | | |
| 252.7 | Compact to Very Dense | | 10 | SS | 125 | | | | | | | | | | | | |
| 11.1 | End of Borehole Probable Bedrock | | | | | | | | | | | | | | | | |
| | • 91 04 30 | | | | | | | | | | | | | | | | |

+3, x3, Numbers refer to
Sensitivity

20
15-25 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 83-88-00 LOCATION Culvert #2, N 5147062.E 307059 ORIGINATED BY BS
 DIST 17 HWY 17/89 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY 00
 DATUM Geodetic DATE 91 04 30 CHECKED BY 00

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT 7 kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|--------|------|----------------------------|-----------------|---|----|----|----|-----|--|---|----------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | 20 | 40 | 60 | 80 | 100 | W _p | W | W _L | | |
| 262.3 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | Cobbles And Boulders Very Dense | | | | DRY | | | | | | | | | | | |
| 261.3 | (FILL) | | | | | | | | | | | | | | | |
| 0.8 | End of Borehole Refusal To Auger • 91 04 30 | | | | | | | | | | | | | | | |

+3, x³: Numbers refer to
Sensitivity

20
15-20 (X) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 5 1 OF 1 METRIC

W.P. 83-88-00 LOCATION Culvert #2, N 5145853.E 307080 ORIGINATED BY BS
 DIST 17 HWY 17/69 BOREHOLE TYPE Cone Test, Hollow-Stem Auger COMPILED BY 00
 DATUM Geodetic DATE 91 04 30 CHECKED BY 00

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | | |
|--------------|--|------------|---------|------|------------|-------------------------|-----------------|--|----|---------------------------------|-------------------------------|--------------------------------|---------------------------------------|--|----|----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | | | | | | 60 | 80 |
| 262.3 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | Silty Sand Some Gravel Zones Compact | | 1 | SS | 15 | | 262 | | | | | | | | | |
| 260.8 | | | | | | | 261 | | | | | | | | | |
| 1.3 | Silty Clay With SILT Varnes Firm | | 2 | SS | 7 | | 260 | | | | | | | | | |
| 260.0 | | | | | | | 259 | | | | | | | | | |
| 2.3 | | | 3 | WW | 43 | | 258 | | | | | | | | | |
| | | | 4 | SS | 56 | | 257 | | | | | | | | | |
| | | | 5 | SS | 36 | | 256 | | | | | | | | | |
| | | | 6 | SS | 87 | | 255 | | | | | | | | | |
| | | | 7 | SS | 22 | | 254 | | | | | | | | | |
| | | | 8 | SS | 33 | | 253 | | | | | | | | | |
| | | | 9 | SS | 5 | | | | | | | | | | | |
| 253.5 | | | | | | | | | | | | | | | | |
| 8.8 | Heterogeneous Mixture Sandy SILT Trace Clay Trace Gravel Occ. Cobbles And Boulders Compact To Very Dense | | 10 | SS | 26 | | | | | | | | | | | |
| 252.2 | | | | | | | | | | | | | | | | |
| 10.1 | End of Borehole Probable Bedrock • 91 05 03 | | | | | | | | | | | | | | | |

+3, x3 Numbers refer to Sensitivity 20 15-20 (%) STRAIN AT FAILURE 10

RECORD OF BOREHOLE No 4

1 OF 1 METRIC

W.P. 83-88-00 LOCATION Culvert #2, N 51°36'48"E 307129 ORIGINATED BY BS
 DIST 17 HWY 17/69 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY CO
 DATUM Geodetic DATE 91 04 30 CHECKED BY DO

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC NATURAL LIQUID UNIT | | | UNIT WEIGHT | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
|--------------|---|------------|--------|------|-------------------------|-----------------|--|----|-----------------------------|----|----|-------------|---------------------------------------|-----|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | 20 | 40 | 60 | 80 | | | 100 |
| 262.0 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Silt, some organics Loose | | 1 | SS | 4 | | | | | | | | | |
| 260.7 | | | | | | | | | | | | | | |
| 1.3 | Silty Clay With Sand Zones Firm | | 2 | SS | 6 | | | | | | | | | |
| 259.8 | | | | | | | | | | | | | | |
| 2.2 | | | 3 | SS | 9 | | | | | | | | | |
| | | | 4 | SS | 10 | | | | | | | | | |
| | | | 5 | SS | 9 | | | | | | | | | |
| | Silt | | 6 | SS | 10 | | | | | | | | | |
| | | | 7 | SS | 12 | | | | | | | | | |
| | Loose to Compact | | 8 | SS | 15 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | becoming dense | | 9 | SS | 36 | | | | | | | | | |
| 253.0 | | | | | | | | | | | | | | |
| 9.0 | End of Borehole Probable Bedrock • 91 05 03 | | | | | | | | | | | | | |

+3, x-3: Numbers refer to Sensitivity
 20
 15-20 (X) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 83-88-00 LOCATION Culvert #2, N 5143841, E 307155 ORIGINATED BY BS
 DIST 17 HWY 17/89 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY GO
 DATUM Geodetic DATE 91 04 30, 05 01 CHECKED BY DO

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT | | UNIT WEIGHT 7 KN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|--------------------|--|--|--|--|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | SHEAR STRENGTH kPa • UNCONFINED • FIELD VANE • QUICK TRIAXIAL • LAB VANE | WATER CONTENT (%) W _p W W _L | | | | |
| 263.4 | Ground Surface | | | | | | | | | | | | |
| 0.0 | Silty Clay With Sand Zones Trace Gravel Stiff | | 1 | SS | 8 | | 263 | | | | | | |
| 261.3 | | | 2 | SS | 12 | | 262 | | | | | | |
| 2.1 | | | 3 | SS | 12 | | 261 | | | | | | |
| | | | 4 | SS | 12 | | 260 | | | | | | |
| | | | 5 | SS | 25 | | 259 | | | | | | |
| | Silt, Some Sand | | 6 | SS | 19 | | 258 | | | | | | |
| | | | 7 | SS | 14 | | 257 | | | | | | |
| | Compact | | 8 | SS | 10 | | 256 | | | | | | |
| | | | 9 | SS | 14 | | 255 | | | | | | |
| 254.9 | | | | | | | 254 | | | | | | |
| 8.5 | Heterogeneous Mixture Sandy Silt Trace Clay Trace Gravel Occ. Cobbles and Boulders Very Dense | | 10 | SS | 63 | /36cm | | | | | | | |
| 253.3 | | | | | | | | | | | | | |
| 10.1 | End of Borehole Probable Bedrock • Water Level Not Established Hole Covered In | | | | | | | | | | | | |

+3, x 5, Numbers refer to
Sensitivity 20
15-9 (X) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6

1 of 1 METRIC

W.P. 83-88-00 LOCATION Culvert #3, N 51°36'36"E 307211 ORIGINATED BY BS
DIST 17 HWY 17/69 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY CO
DATUM Geodetic DATE 91 05 01 CHECKED BY DD

| SOIL PROFILE | | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|----------------------------|------------|---------|------|----------------------------|-----------------|---|-----------------|--|---------------------------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | 'N' VALUES | 20 40 60 80 100 | 20 40 60 80 100 | W _p W W _L | | |
| 261.3 | Ground Surface | | | | | | | | | | | |
| 0.0 | Sandy Silt | | | | | | | | | | | |
| | Compact | | 1 | SS | 13 | | | | | | | |
| 260.1 | | | | | | | | | | | | |
| 1.4 | Clay | | 2 | SS | 23 | | | | | | | |
| | With 25 mm Silt Varnes | | | | | | | | | | | |
| 259.4 | Very Stiff | | | | | | | | | | | |
| 2.1 | | | 3 | SS | 25 | | | | | | | |
| | Silt | | 4 | SS | 11 | | | | | | | |
| | | | 5 | SS | 18 | | | | | | | |
| | With Some Sandy Silt Zones | | 6 | SS | 14 | | | | | | | |
| | | | 7 | SS | 17 | | | | | | | |
| | Compact | | 8 | SS | 18 | | | | | | | |
| | | | 9 | SS | 16 | | | | | | | |
| 252.4 | Occ. Cobbles and Boulders | | | | | | | | | | | |
| 9.1 | End of Borehole | | | | | | | | | | | |
| | Probable Bedrock | | | | | | | | | | | |
| | • 91 05 03 | | | | | | | | | | | |

+3, x3: Numbers refer to
Sensitivity

20
15-25 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 7

1 OF 1 METRIC

W.P. 83-88-00 LOCATION Culvert 13, N 51°38'40"E 307224 ORIGINATED BY BS
 DIST 17 HWY 17/89 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY CO
 DATUM Geodetic DATE 91 05 02 CHECKED BY DO

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|-----------------|--|----------|--|---|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | W _p W W _L | 20 40 60 | | | |
| 261.3 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Silty Sand With Organics Compact | | 1 | SS | 18 | | 261 | | | | | | | |
| 259.3 | | | 2 | SS | 21 | | 260 | | | | | | | |
| 1.8 | | | | | | | 259 | | | | | | | |
| | Silt, Some Sand | | 3 | SS | 7 | | 258 | | | | | | | |
| | Compact | | | | | | 257 | | | | | | | |
| | | | 4 | SS | 19 | | 256 | | | | | | | |
| | | | | | | | 255 | | | | | | | |
| | | | 5 | SS | 14 | | 254 | | | | | | | |
| 252.9 | | | | | | | 253 | | | | | | | |
| 8.4 | Heterogeneous Mixture Silty Sand Trace Clay Trace Gravel Occ. Cobbles and boulders Compact | | 6 | SS | 24 | | 252 | | | | | | | |
| 251.2 | | | | | | | | | | | | | | |
| 10.1 | End of Borehole Probable Bedrock • 91 05 03 | | | | | | | | | | | | | |

+3, x⁵, Numbers refer to 20
Sensitivity 15-25 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

W.P. 83-88-00 LOCATION Culvert #3, N 5143044.E 307238 ORIGINATED BY BS
 DIST 17 HWY 17/69 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY CO
 DATUM Geodetic DATE 91 05 02 CHECKED BY DD

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT | | | UNIT WEIGHT 7 kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|------------------|------------|--------|------|----------------------------|-----------------|---|--------------------|----|-----|----|--|-------------------|--|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | 'N' VALUES | SHEAR STRENGTH kPa | | | | | WATER CONTENT (%) | | | |
| | | | | | | 20 | 40 | 60 | 80 | 100 | 20 | 40 | 60 | | | |
| 260.9 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 260.6 | Topsoil and Peat | | | | | | | | | | | | | | | |
| 0.3 | | | | | | | | | | | | | | | | |
| | Silty Sand | | | | | | | | | | | | | | | |
| 259.4 | | | | | | | | | | | | | | | | |
| 1.3 | End of Borehole | | | | | | | | | | | | | | | |
| | Probable Bedrock | | | | | | | | | | | | | | | |
| | • 91 05 03 | | | | | | | | | | | | | | | |

+3, x3: Numbers refer to
Sensitivity

20
15-25 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 9

1 OF 1

METRIC

W.P. 83-88-00 LOCATION Culvert #3, N 51°36'47"E 307249 ORIGINATED BY BS
 DIST 17 HWY 17/69 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY CO
 DATUM Geodetic DATE 91 05 02 CHECKED BY CO

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC NATURAL LIQUID | | | UNIT WEIGHT | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|------------------|------------|--------|------|-------------------------|-----------------|--|----|----|----|----|------------------------|----------------|---|-------------|---------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | "N" VALUES | 20 | 40 | 60 | 80 | 100 | W _p | W | | |
| 260.7 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | Silty Sand | | | | | | | | | | | | | | | |
| 259.3 | | | | | | | | | | | | | | | | |
| 1.2 | End of Borehole | | | | | | | | | | | | | | | |
| | Probable Bedrock | | | | | | | | | | | | | | | |
| | • 91 05 03 | | | | | | | | | | | | | | | |

+3, x3: Numbers refer to Sensitivity
 20
 15-25 (X) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 10

1 OF 1

METRIC

W.P. 83-88-00 LOCATION Culvert #3, N 5140648, E 307264 ORIGINATED BY BS
 DIST 17 HWY 17/89 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY CO
 DATUM Geodetic DATE 91 05 02 CHECKED BY 00

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---|------------|--------|------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 261.7 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | | | | | DRY | | | | | | | | | | | |
| 260.9 | | | | | | | | | | | | | | | | |
| 0.8 | End of Borehole Probable Bedrock • 91 05 03 | | | | | | | | | | | | | | | |

+3, x³: Numbers refer to
Sensitivity

20
15-20 (X) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 11

1 OF 1

METRIC

W.P. 83-88-00

LOCATION Culvert #3, N 5147553.E 307276

ORIGINATED BY BS

DIST 17 HWY 17/69

BOREHOLE TYPE Hollow-Stem Auger

COMPILED BY CD

DATUM Geodetic

DATE 91 05 02

CHECKED BY DD

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC NATURAL LIQUID LIMIT WIP W WL | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|---|------------|--------|------|-------------------------|-----------------|--|---|--|--|--|---------------------------------------|-------------------------------|--|---|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | *N* VALUES | SHEAR STRENGTH kPa 20 40 60 80 100 • UNCONFINED • FIELD VANE • QUICK TRIAXIAL • LAB VANE | | | | | WATER CONTENT (%) 20 40 60 | | | |
| 261.8 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | | | | | | | | | | | | | | | | |
| | Silty Sand | | | | | DRY * | | | | | | | | | | |
| 260.3 | | | | | | | | | | | | | | | | |
| 1.1 | End of Borehole Probable Bedrock • 91 05 03 | | | | | | | | | | | | | | | |

+3, x³ Numbers refer to 20
Sensitivity 15-25 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 12

1 OF 1 METRIC

W.P. 83-88-00 LOCATION Culvert #4, N 51°36'55"E 307.300 ORIGINATED BY BS
 DIST 17 HWY 17/69 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY CO
 DATUM Geodetic DATE 91 05 02 CHECKED BY DO

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC NATURAL LIQUID LIMIT WIPPLE CONTENT UNIT | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|--------|------|----------------------------|-----------------|---|----|----|----|----|---|----------------|---|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | 'N' VALUES | 20 | 40 | 60 | 80 | 100 | W _p | W | | |
| 261.3 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | Silty Sand | | | | | | | | | | | | | | | |
| 259.8 | | | | | | | | | | | | | | | | |
| 1.5 | End of Borehole Probable Bedrock • 91 05 03 | | | | | | | | | | | | | | | |

+ . x . 3 ; Numbers refer to Sensitivity 20 15-25 (%) STRAIN AT FAILURE 10

RECORD OF BOREHOLE No 13 1 OF 1 METRIC

W.P. 83-88-00 LOCATION Culvert #4, N 51°36'50"E 307307 ORIGINATED BY BS
 DIST 17 HWY 17/69 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY CO
 DATUM Geodetic DATE 91 05 02 CHECKED BY DD

| SOIL PROFILE | | STRAT PLOT | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|---------|------|-------------------------|-----------------|--|-----------------|---------------------------------|-------------------------------|--------------------------------|---------------------------------------|--|
| ELEV DEPTH | DESCRIPTION | | NUMBER | TYPE | | | "N" VALUES | 20 40 60 80 100 | | | | | |
| 260.8 | Ground Surface | | | | | | | | | | | | |
| 0.0 | Silt Some Sand Compact to Dense | | 1 | SS | 14 | | | | | | | | |
| | | | 2 | SS | 24 | | | | | | | | |
| 257.8 | With Varved Clay Layers 5mm Thick | | 3 | SS | 34 | | | | | | | | |
| 2.9 | Heterogeneous Mixture Sandy Silt Some Gravel | | 4 | SS | 30 | | | | | | | | |
| 256.5 | Occasional Cobbles and Boulders Dense | | | | | | | | | | | | |
| 4.3 | End of Borehole Probable Bedrock • 91 05 03 | | | | | | | | | | | | |

+3, x3: Numbers refer to Sensitivity 20 13-0-3 (X) STRAIN AT FAILURE 10