Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL INVESTIGATION
RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD (BRUCE ROAD 9)
COUNTY OF BRUCE, ONTARIO

for

COUNTY OF BRUCE

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PML Ref.: 10KF006
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March 9, 2010

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Mr. Martin Campbell, CET
County of Bruce
Highways Department
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Dear Mr. Campbell

Geotechnical Investigation
Reconstruction of West Road
Pike Road to Ferndale Road (Bruce Road 9)
County of Bruce, Ontario

Peto MacCallum Ltd. (PML) is pleased to report on the geotechnical investigation recently carried out at the above referenced site. This work was authorized via electronic mail from Mr. Martin Campbell, on behalf of the County of Bruce, on January 20, 2010 with a signed engineering services agreement to be returned.

The project involves the proposed reconstruction of an 8 km section of West Road in Bruce County, from Pike Bay Road (station 0+000), north to Ferndale Road (station 8+065), as shown on the attached Key Plan, Drawing 1.

The section of roadway being investigated for this project is currently a two lane rural cross section roadway with a gravel surface south of Little Pike Bay Road (station 4+060) and an asphalt surface to the north. The current speed limit is 60 km/hr for the gravel section and 80 km/hr for the paved section. The road existing road travels through swampy areas (station 1+680 to 1+800) and near several bodies of water. The existing road profile features minor curves and an elevation change of about 13.0 m within the project limits. The vertical gradients are typically less than 4%.

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It is understood that the roadway within the project limits will continue to be a two lane road, with an anticipated speed limit of 80 km/hr. The proposed works will include improvements to the roadway profile along with a proposed widening of the roadway platform from 7.0 to 11.0 m. It is understood that the current 2010 average annual daily traffic (AADT) is about 1,000 vehicles per day (vpd), with 5% commercial traffic and an assumed 2% yearly growth rate.

The purpose of the geotechnical investigation was to explore the existing pavement structure, soil and groundwater conditions along the project route, as well as topsoil thicknesses in the ditch and embankment toe of slope areas. Based on the investigation findings, geotechnical design and construction recommendations were to be provided to address:

- excavation and groundwater control
- cut-and-fill grading considerations, including
    - stripping depths and subgrade preparation for widenings
    - reusability of material from cut sections
    - embankment widening rehabilitation
- structural design(s) and construction recommendations for the new pavement system
- swamp section treatments.

It should be noted that environmental considerations were not within PML's terms of reference for this assignment. If disposal of surplus materials is required, laboratory analyses will be needed to determine the chemical properties of the material and evaluate options for off-site disposal.

Field Work

The field work was carried out on February 1 and 2, 2010, and comprised 42 conventional sampled boreholes located at typical 200 m intervals along the project route, including both drive lanes, as depicted on the appended Test Hole Location Plan, Drawings 2 to 12. One of the boreholes (Borehole 27A) was advanced on the shoulder. The boreholes were drilled to depths of between 0.50 and 2.40 m below existing grade, using a Mobile D50 truck-mounted drillrig, equipped with continuous flight solid stem augers. The drilling equipment was supplied and operated by a specialist drilling contractor. In addition, a total of 20 hand excavated test holes were completed within the roadside ditches and fence line areas.

The field work was supervised throughout by a member of our engineering staff who directed the drilling and sampling operations, prepared the stratigraphic logs, monitored groundwater conditions and processed the recovered samples.

Representative samples of the overburden were recovered from the boreholes at regular intervals throughout the depths explored. Standard penetration tests were carried out during sampling operations using conventional split spoon equipment.

The borehole and test hole locations were established in the field by PML and the ground surface elevation survey was completed by the Client.

All samples obtained during the investigation were returned to our laboratory for detailed visual examination and natural moisture content determinations. The laboratory testing program also included six particle size distribution analyses on insitu pavement and subgrade materials.

Subsurface Conditions

Reference is made to the appended Log of Borehole sheets for detailed findings of the field work including existing pavement structures, soil descriptions, inferred stratigraphy, standard penetration N values, groundwater observations during and upon completion of drilling, and natural moisture content determinations. Topsoil thickness measurements in the test pits are presented on the appended Table 1. The results of the particle size distribution analyses are presented on Figures 1 to 6 appended.

In general, the stratigraphy encountered in the boreholes comprised pavement structure overlying varying deposits of fill and topsoil over native deposits comprised primarily of silts and sands. Boreholes were terminated on bedrock in several areas, including at Boreholes 3, 6 to 8, 10 to 11, 13 to 21 and 36 to 38.

Pavement Structure

The roadway surface for the southern portion of the project (south of Little Pike Bay Road, station 4+060) was gravel surfaced, comprising gravelly sand. The pavement structure through this portion of the project was typically between 500 and 1000 mm thick with an average thickness of 730 mm. Elevated silt contents, in the range of 23.5 to 26.1%, were encountered in this layer, as demonstrated in the particle size distribution analyses graphs, completed on three samples collected from this portion of the site (Figures 1 to 3 attached).

North of Little Pike Bay Road, the roadway was asphalt surfaced, comprising a single lift of hot mix asphaltic concrete (HMAC). The thickness of the HMAC was typically between 40 and 50 mm with an overall average thickness of 45 mm. The existing asphalt surface was generally in poor condition with a poor to fair ride quality. In general, the primary pavement distresses included noticeable wheel rutting with alligator, map and transverse cracking. A portion of the road surface between approximately 6+500 and 7+650 was in good condition with little to minor cracking and minimal wheel rutting.

In general, the asphalt surface north of Little Pike Bay Road was underlain by an average of about 700 mm of gravelly sand. The gravelly sand through this portion of the project, which was between 450 and 850 mm thick, comprised less silt than the southern unpaved portion, and was generally described as containing trace (less than 10%) to some (10 to 20%) silt. Particle size distribution analyses were completed on two samples from this pavement section and are appended in Figures 4 and 5, demonstrating silt levels between 16.1 and 20.0%.

A clearly discernable Granular A type crushed gravelly sand base was evident in Boreholes 23 and 24 only. The crushed material was described as having trace silt and the thickness of the layer was 260 and 305 mm in Boreholes 23 and 24 respectively.

It should be noted that the elevated silt content encountered in the pavement structure materials, may in part have been caused by augering through frozen granular material.

Fill

Fill deposits were encountered in 14 of the boreholes under the pavement structure materials. Where encountered, the thickness of the fill deposits varied between about 1.00 and 1.80 m. Fill deposits typically comprised sandy soils with elevated silt levels, including silty sand, gravelly sand and sand, and were typically described as moist. In many of the boreholes, fill deposits were overlying shallow bedrock (Boreholes 7, 11, 13, 20, 36 and 37) and was likely used as a drainage material over the relatively impermeable bedrock. Although elevated silt content (up to 25%) was described, much of the fill materials encountered appeared to be a continuation of the pavement structure materials. Organics and / or topsoil inclusions were encountered in the fill deposits in Boreholes 13 and 37.

Topsoil and Organic Deposits

Remnants of the original topsoil layer were present at approximately 21 borehole locations within the roadway. The topsoil layers typically ranged in thickness from 100 to 900 mm, with an average thickness of approximately 360 mm. The topsoil material was typically classified as low organic clayey silt, grading to silt and was generally described as wetter than plastic limit for cohesive soils and wet for cohesionless soils. Medium organic topsoil deposits and high organic peats were also encountered in localized areas.

Within the roadside ditches and embankment toe of slope areas, the topsoil thickness in the test holes was typically between 50 and 300 mm (average 245 mm) with localized areas of up to 800 mm encountered (Test Holes 2 and 8), as listed in Table 1 appended.

Native Soil Stratigraphy

The underlying native subgrade was highly variable throughout the project limits. Silty soils were the primary unit encountered, however deposits of clayey silt, silt, sandy silt / silty sand and sand / gravelly sand were present in the subsurface stratigraphy. Native soils were encountered in 33 of the 41 boreholes. In general, the native cohesionless soils were described as very loose to loose and the cohesive soils were described as very soft to compact. Organic materials were also described in several of the more cohesive soil deposits. The native soils were typically described as moist to wet, and about plastic limit (APL) to WTPL.

A particle size distribution analysis was completed for the predominate silt unit encountered and is appended as Figure 6.

Bedrock was encountered in 18 of the boreholes at depths of between 0.7 and 2.4 m below existing grades.

Groundwater Conditions

Free groundwater and/or inferred groundwater seepage was observed in 10 of the boreholes. The groundwater seepage was generally attributable to perched conditions within fills and permeable soil lenses, controlled by less permeable clayey and sandy silts below. It was noted that ground conditions were exceedingly wet at the time of the field work, and standing water was present at numerous locations alongside the roadway. Perched groundwater can vary significantly with weather events and seasonal weather conditions.

It is believed that the long term groundwater level will generally correspond to water levels in nearby creeks and water bodies.

Discussion and Recommendations

Pavement Recycling and General Approach

The observed pavement structure typically comprises either surficial gravelly sand or between 40 and 50 mm of HMAC, underlain by pit run gravelly sand base/subbase with an elevated silt content – in the order of 15% to 25%. In general, the insitu pavement materials are therefore not considered suitable for use in the new pavement structure. Furthermore, the pavement structure is underlain by topsoil at relatively shallow depth (less than 1.20 m below proposed grades), at numerous borehole locations including Boreholes 2, 3, 4, 8, 14, 19, 20, 22 and 23.

Accordingly, the following general approach is recommended for the reconstruction and widening portions of the project:

- Strip topsoil and organics and prepare a stable roadway widening subgrade for roadway embankment widening, as per detailed recommendations outlined in the following sections of this report.
- Using 'full depth reclamation' techniques, pulverize the existing HMAC (where present and not acceptable as part of the new pavement structure) and underlying granular / fill soils to a depth of 200 mm.
- In fill sections, utilize the pulverized material (a mixture of asphaltic concrete and silty granular) to place the initial lift(s) of roadway widening embankment.
- In sections to remain at grade, subexcavate the pulverized material together with underlying mineral soil to an approximate depth of 685 mm (i.e. sufficient to accommodate the new pavement structure) and reuse this material as fill for the initial lift(s) of roadway widening embankment.
- Complete cut and fill grading operations to establish the revised subgrade profile across the full new width of the road. Care should be taken to ensure uniform subgrade soil conditions exist within the frost zone, typically 1.4 m below final grade.
- Dispose any organic soils/topsoil or excessively wet material encountered within the subexcavated depths (potentially in vicinity of Boreholes 2, 3, 4, 8, 14, 19, 20, 22 and 23).

- Subexcavate buried topsoil layers that occur within 300 mm below the revised subgrade elevation (potentially in the vicinity of 21 boreholes that penetrated topsoil layers) and replace with engineered fill to establish uniform and stable subgrade support conditions.
- Proofroll the subgrade and similarly subexcavate and replace any zones/pockets of wet, unstable subgrade material disclosed by the proofrolling operation.
- Construct the new pavement system.

With this approach, it may be possible to maintain single lane traffic during construction. Sections of roadway involving widenings through swamp terrain, will require a special approach outlined in the following sections of this report.

Widening and Grading Earthwork

The recommended embankment widening approach will depend on the contact depth of competent mineral soil subgrade material. For project sections of roadway through swamp terrain (between stations 1+680 and 1+800 for example), it might not be feasible to subexcavate all organic and low strength materials, and special construction techniques will be required. For the remainder of the roadway, the embankment widening subgrade should be prepared by subexcavating all insitu organic (topsoil) and deleterious materials to the level of stable, mineral soil. Each case is discussed in greater detail in the following report sections.

Swamp Terrain

A potential section of swamp terrain occurs at station 1+680 to 1+800. Although the boreholes at this location did not contact deep organic deposits, there is a potential for local sections of organic subgrade to depths that might not be feasible to excavate. Typically, the feasible limit for subexcavation is about 2.0 m.

For roadway embankment construction techniques through swamp terrain, if encountered, reference is made to Ontario Provincial Standard (OPS) Drawings 203.030 and 208.010. Benching is recommended where the existing embankment height exceeds 1 m, and the existing slope is steeper than 3 horizontal to 1 vertical (3H:1V).

Preparation of the fill subgrade should involve removal of trees and brush, cut to the level of the ground surface. The existing vegetation root mat should be left in place to enhance the subgrade strength. In addition, the placement of a geogrid reinforcement on the subgrade surface is recommended to further improve the subgrade strength and mitigate the potential for a subgrade bearing failure under the weight of the fill front. Terrafix BX1100, or approved equivalent, is recommended.

The initial lift of fill should consist of reclaimed pavement material off the roadway, and/or imported sand and gravel, and/or excess blast rock from shallow bedrock cut sections. The initial lift thickness should be maintained as necessary to support the construction equipment and control subgrade failure. Generally this can be accomplished with a lift thickness of between 700 and 1200 mm, although the actual thickness is best determined in the field based on the contractor's selection of equipment and local subgrade variability. Also, the fill embankment side slope should be no steeper than 4H:1V.

The initial lift of fill should be nominally compacted as soon as possible after fill placement, before the material can become saturated by surface water. If the water depth exceeds approximately 0.6 m, it is envisaged that the fill placement area will require a perimeter berm and dewatering. Once a stable base is achieved, the fill should be compacted to at least 95% of the material's standard Proctor maximum dry density (SPMDD). Reference is made to Appendix A of this report for detailed recommendations pertaining to engineered fill construction.

Significant consolidation settlement will occur within the organic soil strata under the weight of the newly placed fill. Differential settlements in the order of 50 to 200 mm can be expected within the first one to three years after construction. A temporary, surface treatment pavement surface should therefore be considered, and the settlement process should be monitored for scheduling of the final hot mix surface placement.

Differential settlement may also cause undue deflection of culvert installations, and replacement of some culverts may be necessary as the consolidation process nears completion.

A surcharge program would be required if long term settlement is not tolerable.

Non-Swamp Terrain

For roadway embankment construction techniques through non-swamp terrain, reference is made to Ontario Provincial Standard (OPS) Drawing 209.010.

Prior to construction of the widening embankments, all insitu topsoil, peat or otherwise soft and deleterious materials should be subexcavated to the level of stable, mineral soil subgrade. It is noted that the depth of topsoil in the roadside test pits was generally in the order of 50 to 300 mm, with local depths as great as 800 mm, as documented on Table 1, appended. The exposed subgrade should be proofrolled and inspected to identify any local wet/unstable areas. Depending on the depth below the final subgrade surface, any wet/unstable areas encountered might have to be further subexcavated, and backfilled with similar drier material. On unconfined, sloped subgrade surfaces steeper than 3H:1V, suitable benching should be provided to mitigate long term movement of the new fill zone. Reference is made to Ontario Provincial Standard (OPS) Drawing 208.010, for particulars.

The majority of the insitu mineral soils should also be suitable for reuse in fill sections and for the embankment widening. Any organic soils / topsoil or excessively wet material encountered within the subexcavated depths (potentially in vicinity of Boreholes 2, 3, 4, 8, 14, 19, 20, 22 and 23) should be segregated and disposed, or used to dress the ground surface.

Any bulk fill that is imported to construct the roadway widenings, should be free draining sand or sand and gravel with a maximum 15% silt content. The moisture content of the material should be controlled to facilitate compaction to the recommended compaction level of 95% SPMDD. Prior to importing material, the borrow source should be inspected and the material tested to ensure that the required gradation and compactibility characteristics are available. Again, uniformity of subgrade conditions within the frost zone is critical to avoid potential frost heave problems.

Reference is made to Appendix A of this report for detailed recommendations pertaining to engineered fill construction.

Pavement Design

It is understood that the roadway will continue to be a two lane rural cross section roadway, with an anticipated speed limit of 80 km/h. The existing roadway platform is expected to increase in width from 7.0 to 11.0 m. It is understood that the current average annual daily traffic (AADT) is about 1,000 vehicles per day (vpd), with 5% commercial traffic and a growth rate of 2% per year.

Four different pavement designs have been provided as follows, based on existing subgrade conditions, bedrock availability and existing pavement structure performance. The pavement designs were derived based on the AASHTO design method, using 'DARWin' pavement design software, along with the MTO Routine Method.

Station 0+000 to 2+300 and Station 3+600 to 6+500

The first pavement design considers the section of the project beginning at the southern limit (0+000), and continuing north to an area of relatively shallow bedrock (approximately station 2+300) and also the section north of the shallow bedrock (3+600) to a section with good existing pavement conditions (6+500). The boreholes throughout these two sections (Boreholes 1 to 13 and 21 to 35) demonstrated poor existing subgrade conditions, typically comprising silt soils (clayey silt to sandy silt) that were described as very soft to soft for cohesive soils and very loose to loose for cohesionless soils. Organic topsoil and/or peat soils were encountered in many of the boreholes along these sections. In general, the proposed roadway profile along these two sections of the project demonstrates that these sections of roadway will typically require fills of up to about 1.0 m. Shallow cuts will be also required in local crest sections.

The recommended pavement design for these two lengths of the project is based on very soft to soft clayey silt and very loose to loose silt with organics, which is expected to be representative of subgrade conditions throughout these areas. A subgrade soil resilient modulus of 20,000 kPa was used for the pavement design.

Based on the traffic loading and subgrade conditions, the following pavement design is recommended for an 18 year design life.

MATERIAL	THICKNESS (mm)
HL 3 Surface Course	35
HL 4 Binder Course	50
Granular A Base Course	150
Granular B Type I Subbase Course	450
Structural Number (SN)	97
Granular Base Equivalency (GBE)	622

The above recommended pavement design satisfies both the AASHTO and MTO routine method design numbers. The recommended design structural number (SN) for this section is 87 mm based on AASHTO design method which is equivalent to a granular base equivalency (GBE) of approximately 550 mm as per the MTO routine method. For comparison purposes, the existing SN for the southern most section currently averages 30 mm and the existing SN between stations 3+600 and 6+500 is typically about 37 mm. The calculations for the existing structural thickness took into account reduced structural coefficients.

It should be noted with regard to this pavement design, and the anticipated new road grade, topsoil and organic layers will potentially be encountered within 1.20 m of the final roadway elevation. Topsoil encountered within 1.20 m of the proposed roadway elevation, (in the vicinity of Boreholes 2, 4, 5, 8, 22 and 23, as well as potentially Boreholes 6, 7 and 24) should be subexcavated at this stage.

The existing asphaltic concrete north of station 4+060 should be pulverized to a depth of 200 mm and set aside for road embankment widening fill prior to the construction of this pavement design.

Station 2+300 to 3+600

The following pavement design is for the portion of the project where bedrock is shallow and rock blast/shatter may be used in lieu of a Granular subbase. Relevant boreholes to this design (Boreholes 14 to 20) indicated that this option may be used between approximately stations 2+300 and 3+600. The subsurface stratigraphy through this section comprises pavement structure granular type material (no HMAC), typically overlying gravelly sand and clayey silt materials. Topsoil was encountered in four of these boreholes, and organics were present in some of the gravelly sand materials.

Bedrock was encountered in all seven of the boreholes throughout this section, typically between 0.70 and 1.8 m below existing grades. Locally, at Borehole 15, bedrock was encountered at 2.4 m below grade, however this is not indicative of the average bedrock depth through this section. In general, the proposed roadway profile along this section of the project will require fills of up to 1.0 m with some shallow cuts anticipated as well. It is anticipated that the proposed roadway profile through the bedrock zone will change depending on the amount of available rock fill/shatter.

The recommended pavement design for this portion of the project is based upon a bedrock subgrade. A subgrade soil resilient modulus of 90,000 kPa was used for the pavement design. If through the bedrock subgrade section of the project, a bedrock subgrade is not contacted within 635 mm below the final design grade, the pavement design recommended for stations 0+000 to 2+300 (provided above) may be used.

Based on the traffic loading and subgrade conditions, the following pavement design is recommended for an 18 year design life.

MATERIAL	THICKNESS (mm)
HL 3 Surface Course	35
HL 4 Binder Course	50
Granular A Base Course	250
Rock Shatter	300 min.
Structural Number (SN)	71
Granular Base Equivalency (GBE)	420

The above recommended pavement design satisfies both the AASHTO and MTO routine method design numbers. The recommended design SN for this section is 50 mm based on AASHTO design method which is equivalent to a GBE of approximately 550 mm as per the MTO routine method. For comparison purposes, the existing SN between stations 2+300 and 3+600 is typically about 28 mm. The calculations for the existing structural thickness took into account reduced structural coefficients.

It should be noted that this pavement design assumes that the overburden encountered throughout this section will be subexcavated to bedrock. It is recommended that any pockets of loose / soft, organic material and soils with high silt contents are removed prior to placement of rock shatter. It is also assumed that a minimum of 300 mm of rock shatter will be provided below the pavement structure, however additional rock shatter may be required for grading purposes, specifically in regard to the area around Boreholes 15 and 20. Additional Granular A may also be utilized in sections with deeper bedrock to raise grades. Some material loss should be anticipated during the placement of Granular A on the rock shatter, however, the use of Type I Granular B should be avoided due to the high sand percentage of such materials. In this regard, it would be prudent to visually examine the shatter-rock surface to check for the presence of voids which could allow loss of granulars.

Due to the depth of the bedrock at several borehole locations, it may be prudent to lower the proposed grade profile through this section by an average of approximately 1.0 m to minimize the use of fill material.

Due to the impermeable bedrock subgrade, pavement subdrains should be provided at the bedrock / rock shatter interface to prevent water accumulation in the pavement materials (where ditching is not feasible in bedrock cuts). The bedrock should be shaped to ensure that it is sloped away from the centerlines so that no pooling occurs on the bedrock surface. Subdrains should be discharged in to the catch basins. The subdrains may consist of 3 m long stubs of filter wrapped 150 mm diameter perforated plastic pipe, set within the subbase layer at or just below the subgrade surface. An approved, proprietary drainage board product (i.e. 'TREMDrain 1000' or equivalent) may be used in lieu of a filtered, perforated pipe system.

Reference is made to OPS Drawing 201.010 and OPS Standard 206 for rock grading details and requirements.

Station 6+500 to 7+650

The existing pavements between stations 6+500 and 7+650 were constructed in approximately 2002 and are performing adequately at this time with minimal distress evident at the time of the investigation. The boreholes through this section (Boreholes 36 to 38) indicated that between 40 and 45 mm of asphaltic concrete was overlying between 610 and 760 mm of gravelly sand pavement structure and sand fill or silty sand deposits. Bedrock was contacted in all three boreholes, between 1.00 and 1.60 m below existing grades. The proposed roadway profile throughout this section indicates that the existing grades will remain approximately the same.

The recommended pavement design for this length of the project is based on silty sand, which is expected to be representative of subgrade conditions throughout this portion of the project. A subgrade soil resilient modulus of 40,000 kPa was used for the pavement design in this section.

Based on the traffic loading and subgrade conditions, a 35 mm HL 3 surface asphalt overlay is recommended for this portion of the project. The above rehabilitation provides an average SN of 68 mm and a GBE of 490 mm

The above recommended pavement design satisfies both the AASHTO and MTO routine method design numbers. The recommended design structural number (SN) for this section is 68 mm based on AASHTO design method which is equivalent to a granular base equivalency (GBE) of approximately 450 mm as per the MTO routine method. The calculations for the existing structural thickness took into account reduced structural coefficients as shown in the following table:

BOREHOLE	THICKNESS (mm)				SN[1]
	HL 3 ASPHALTIC CONCRETE OVERLAY	EXISTING ASPHALTIC CONCRETE	EXISTING GRANULAR SUBBASE	TOTAL	
136	35	40	610	685	63
137	35	40	760	835	72
138	35	45	705	785	70
AVERAGE	35	45	690	770	68

NOTES:

1. SN coefficients for pavement materials based on AASHTO recommended values, adjusted as deemed appropriate based on sieve analysis results and visual appearance. Factors applied were: new asphaltic concrete – 0.42, existing asphaltic concrete – 0.25, existing Granular subbase – 0.062

It should be noted that with a pavement rehabilitation option being utilized as opposed to a full reconstruction, any existing deformations in the pavement may reflect through the overlay asphalt. Care should be taken to use an HL 2 material to pad any existing rutting or surface deformations on the existing asphalt surface. In addition, it is recommended that a tack coat is placed on the asphalt surface prior to paving the new HL 3 overlay.

Station 7+650 to 8+065

The existing pavements in the northern section of the project exhibited significant distresses in the form of rutting and map cracking and hence, wouldn't be acceptable for a pavement rehabilitation such as above. The boreholes in this section (Boreholes 39 to 41) demonstrated between 40 and 50 mm of asphaltic concrete overlying between 770 and 810 mm of gravelly sand granular and sand fill extending to between 1.20 and 1.30 m below grade. Underlying the sand fill were very loose to compact silt and sandy silt native deposits. In general, the proposed roadway profile along the northern most section indicated that the grades were to remain about the same, however it has been indicated to PML that a slight grade raise could be accommodated through this section.

The recommended pavement design for this section is based on loose silt, which is expected to be representative of subgrade conditions throughout these areas. A subgrade soil resilient modulus of 20,000 kPa was used for the pavement design.

Based on the traffic loading and subgrade conditions, the following pavement design is recommended for an 18 year design life.

MATERIAL	THICKNESS (mm)
HL 3 Surface Course	35
HL 4 Binder Course	50
Granular A Base	100
Pulverized Asphalt/Granular mixture	200
Existing granular materials	--

The above recommended pavement design satisfies both the AASHTO and MTO routine method design numbers. The recommended design structural number (SN) for this section is 87 mm based on AASHTO design method which is equivalent to a granular base equivalency (GBE) of approximately 550 mm as per the MTO routine method. For comparison purposes, the existing SN for the northern most section currently averages about 37 mm. The calculations for the existing structural thickness took into account reduced structural coefficients as shown in the following table:

BOREHOLE	THICKNESS (mm)					SN[1]
	NEW ASPHALTIC CONCRETE	NEW GRANULAR A BASE	PULVERIZED ASPHALT / GRANULAR MIXTURE	EXISTING GRANULAR SUBBASE	TOTAL	
139	85	100	200	650	1035	94
140	85	100	200	600	985	92
141	85	100	200	600	985	92
AVERAGE	85	100	200	615	1000	92

NOTES:

1. SN coefficients for pavement materials based on AASHTO recommended values, adjusted as deemed appropriate based on sieve analysis results and visual appearance. Factors applied were: new asphaltic concrete – 0.42, new Granular A base – 0.14, pulverized mix – 0.09, existing Granular subbase – 0.04

Pavement Design Summary

The project was split into various sections depending on borehole findings, bedrock availability and existing pavement performance. The following new pavement design/pavement rehabilitation options are recommended:

- Stations 0+000 to 0+300 and 3+600 to 6+500 – reconstruct using 85 mm asphalt, 150 mm Granular A base and 450 mm Granular B subbase;
- Station 2+300 to 3+600 – reconstruct using 85 mm asphalt, 250 mm Granular A base and 300 mm rock shatter minimum (or Granular A in lieu);
- Station 6+500 to 7+650 – rehabilitate with 35 mm asphalt overlay (with HL 2 padding and tack coat); and,
- Station 7+650 to 8+065 – reconstruct using 85 mm asphalt, 100 mm Granular A base and 200 mm pulverized asphalt and gravelly sand mixture.

In general, the pavement materials should conform to current OPS specifications. The Granular A base and Granular B subbase courses should be placed in thin lifts and compacted to a minimum of 100% SPMDD, and asphaltic concrete should be placed and compacted to between 92% and

96.5% of the material's maximum relative density (MRD). Reference is made to OPS Specification 310, revised April 2008.

The pavement designs consider that the construction will be carried out during the drier time of the year and that the subgrade is stable, as determined by proofrolling inspected by PML personnel. If the subgrade is wet and unstable, additional granular subbase material will be required. Also, the exposed pavement subgrade should be proofrolled and inspected to identify any local wet/unstable areas, which should be subexcavated and replaced with similar drier material.

Frost tapers (10H:1V) must be installed where abrupt changes in pavement or granular thickness occur (between pavement design transitions), otherwise frost heave problems will result. It should be noted that the existing subsurface stratigraphy may vary between borehole locations, and that the new pavement design transitions are approximate. More accurate delineation of the transitions can be determined during construction.

Satisfactory pavement performance is highly dependent on adequate drainage of the pavement granulars and subgrade. The embankment widening material should not be allowed to impede drainage from the existing pavement subgrade surface. Unless free draining sand and gravel fill is used for the widenings, the subgrade level within the widening should not be higher than the existing subgrade. Also, the subgrade elevation throughout should be maintained at least 0.5 m above side ditches and above the water level of any adjacent water bodies or short-term ponded water areas. The design roadway profile should be reviewed in this regard. Improvements to the roadside ditching may be required in certain areas. Extensive areas of roadside ponding were evident at the time of the field work for this investigation. Reference is made to OPS Drawings 200.020, 206.020 and 209.010 for further guidance on the roadway cross section design.

During construction, testing should be conducted to confirm the gradation and compactibility characteristics of the granular base and subbase materials and the mix design properties of the asphaltic concrete. Proofrolling procedures and the placement and compaction of all the fill and granular materials and asphaltic concrete for the pavement construction and backfilling at the site should be inspected on a continuous basis by PML technicians.

We trust this preliminary report has been completed within our terms of reference, and sufficient for your immediate requirements. If you have any questions or require further information, please do not hesitate to contact our office.

Sincerely

Peto MacCallum Ltd.

Ken Hanes, BASc.
Project Supervisor

LICENSED PROFESSIONAL ENGINEER
M.S. MOLODECKI
32339013
PROVINCE OF ONTARIO

M. Molodecki
March 9/10

Marian S. Molodecki, P.Eng.
Senior Consultant
Geotechnical and Geoenvironmental Services

KH:sh

Enclosure(s):
Table 1 - Test Hole Logs
Figures 1 to 6 - Particle Size Distribution Charts
List of Abbreviations
Log of Boreholes 1 to 41
Drawing 1 - Key Plan
Drawings 2 to 12 – Test Hole Location Plan
Appendix A - Engineered Fill

TABLE 1

TEST HOLE LOGS

TEST HOLE 1	Elev. 191.225
0.00 – 0.20	Topsoil: Dark brown to black silt, wet
0.20 – 0.30	Silty Sand: Brown silty sand, wet

TEST HOLE 2	Elev. 187.064
0.00 – 0.30	Water: Surface water
0.30 – 1.1	Topsoil: Dark brown to black silt, wet
1.1 – 1.2	Sandy Silt: Brown fine sandy silt, wet

TEST HOLE 3	Elev. 188.202
0.00 – 0.20	Topsoil: Dark brown silt, wet
0.20	Bedrock: No forward progress bedrock

TEST HOLE 4	Elev. 190.069
0.00 – 0.30	Topsoil: Dark brown silty sand, moist
0.30	Bedrock: No forward progress bedrock

TEST HOLE 5	Elev. 193.484
0.00 – 0.25	Topsoil: Dark brown silt, moist
0.25 – 0.30	Silty Sand: Brown silty sand, occasional cobbles, moist

TEST HOLE 6	Elev. 191.966
0.00 – 0.30	Topsoil: Dark brown to black silt, wet
0.30 – 0.40	Silty Sand: Brown silty sand, wet

TEST HOLE 7	Elev. 195.271
0.00 – 0.00	Surface Bedrock

TABLE 1

TEST HOLE LOGS

TEST HOLE 8	Elev. 191.086
0.00 – 0.80	Topsoil/Peat: Dark brown silt, wet
0.80 – 1.0	Clayey Silt: Grey clayey silt, WTPL
TEST HOLE 9	Elev. 186.816
0.00 – 0.20	Topsoil: Dark brown silt, wet
0.20 – 0.30	Silt: Brown silt, moist to wet
TEST HOLE 10	Elev. 185.240
0.00 – 0.10	Topsoil: Dark brown silt, wet
0.10 – 0.20	Silt: Brown silt, wet
TEST HOLE 11	Elev. 185.107
0.00 – 0.07	Topsoil: Dark brown sandy silt, wet
0.07 – 0.60	Silty Sand: Grey silty sand, wet
TEST HOLE 12	Elev. 185.395
0.00 – 0.05	Topsoil: Dark brown silt, wet
0.05 – 0.1	Silt: Brown silt, wet
TEST HOLE 13	Elev. 185.718
0.00 – 0.05	Topsoil: Dark brown silt, wet
0.05 – 0.20	Silt: Brown silt, wet
TEST HOLE 14	Elev. 186.347
0.00 – 0.05	Topsoil: Dark brown silt, moist
0.05 – 0.10	Silt: Brown silt, wet
TEST HOLE 15	Elev. 186.843
0.00 – 0.30	Topsoil: Dark brown silt, wet
0.30 – 0.40	Silt: Brown silt, some sand, wet

TABLE 1

TEST HOLE LOGS

TEST HOLE 16	Elev. 186.701
0.00 – 0.05	Topsoil: Dark brown silt, wet
0.05 – 0.20	Sandy Silt: Brown sandy silt, wet
TEST HOLE 17	Elev. 187.860
0.00 – 0.30	Topsoil: Dark brown silt, moist
0.30 – 0.40	Sandy Silt: Brown sandy silt, moist
TEST HOLE 18	Elev. 190.219
0.00 – 0.20	Topsoil: Dark brown silt, wet
0.20 – 0.40	Silt: Brown silt, wet
TEST HOLE 19	Elev. 193.141
0.00 – 0.30	Topsoil: Dark brown silt, moist
0.30 – 0.40	Silt: Brown silt, moist
TEST HOLE 20	Elev. 197.442
0.00 – 0.10	Topsoil: Dark brown silt, moist
0.10 – 0.20	Silty Sand: Brown silty sand, moist

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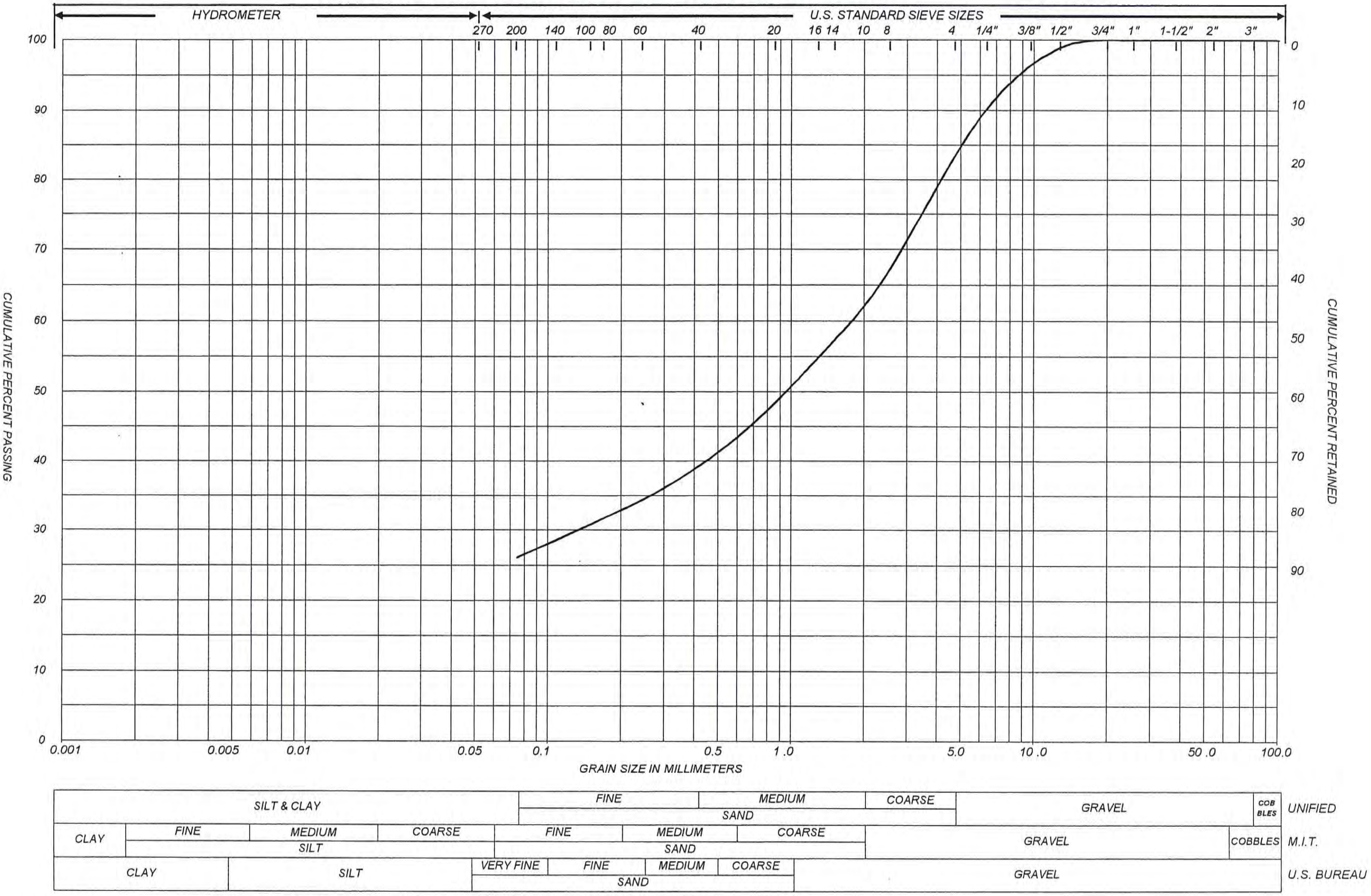
PML REF. 10KF006
FIGURE NO. 1

PARTICLE SIZE DISTRIBUTION CHART



REMARKS Borehole 6, Sample AS1, Depth 0.00 to 0.60 m

GRAVELLY SILTY SAND

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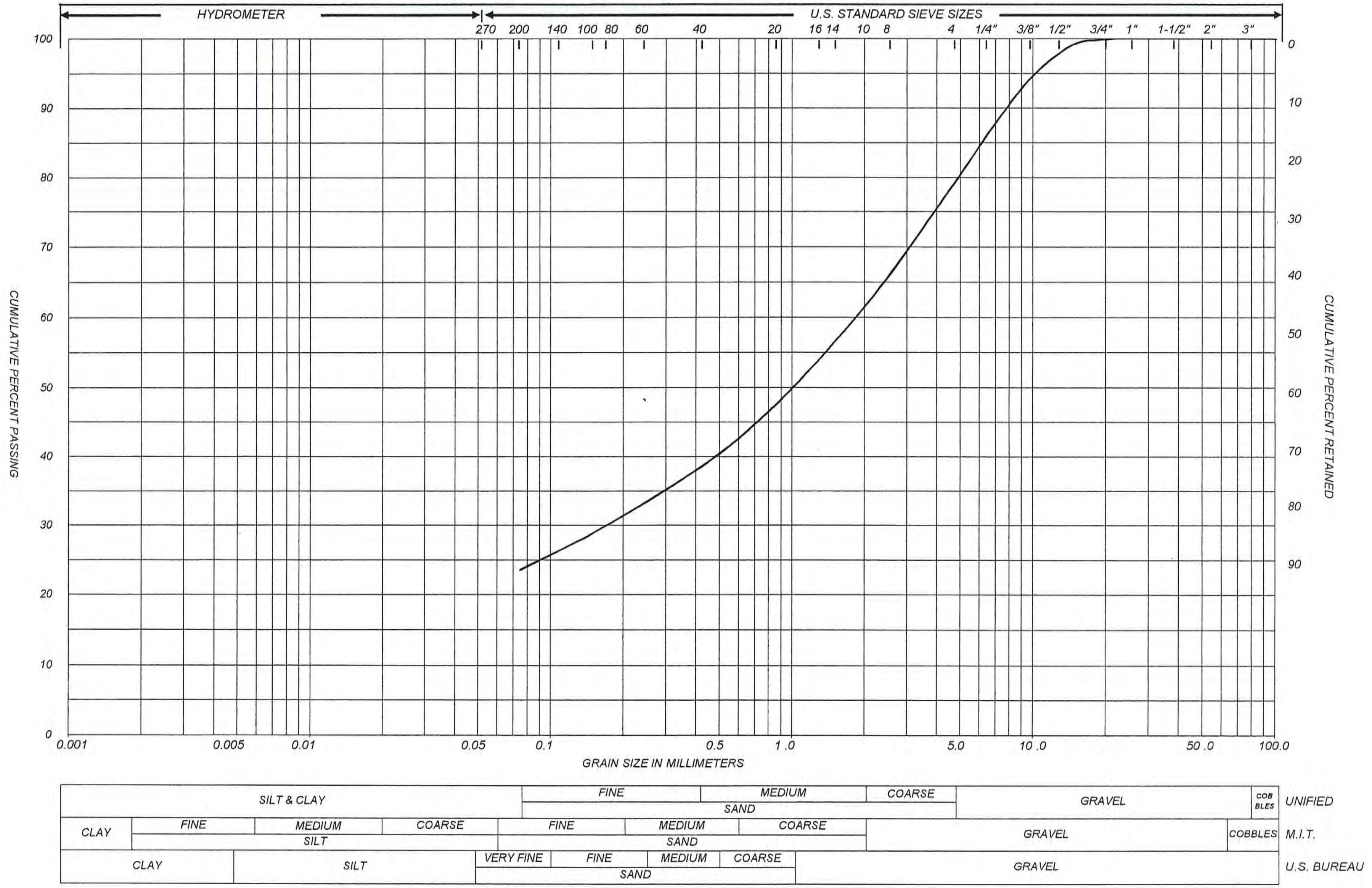
PML REF. 10KF006
FIGURE NO. 2

PARTICLE SIZE DISTRIBUTION CHART



REMARKS Borehole 14, Sample AS1, Depth 0.00 to 0.60

GRAVELLY SILTY SAND

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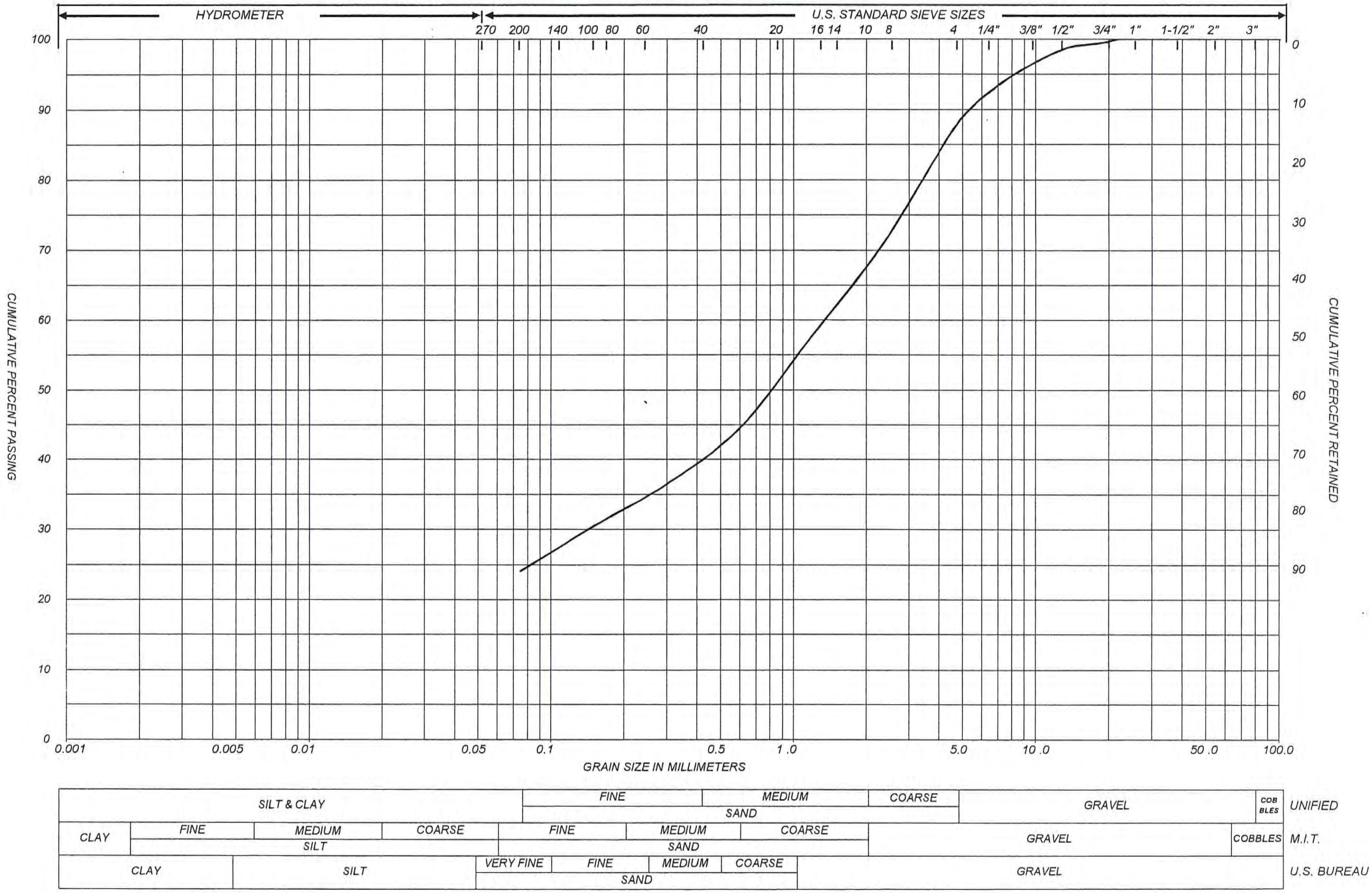
PML REF. 10KF006
FIGURE NO. 3

PARTICLE SIZE DISTRIBUTION CHART



REMARKS Borehole 22, Sample AS1, Depth 0.00 to 0.60 m

GRAVELLY SILTY SAND

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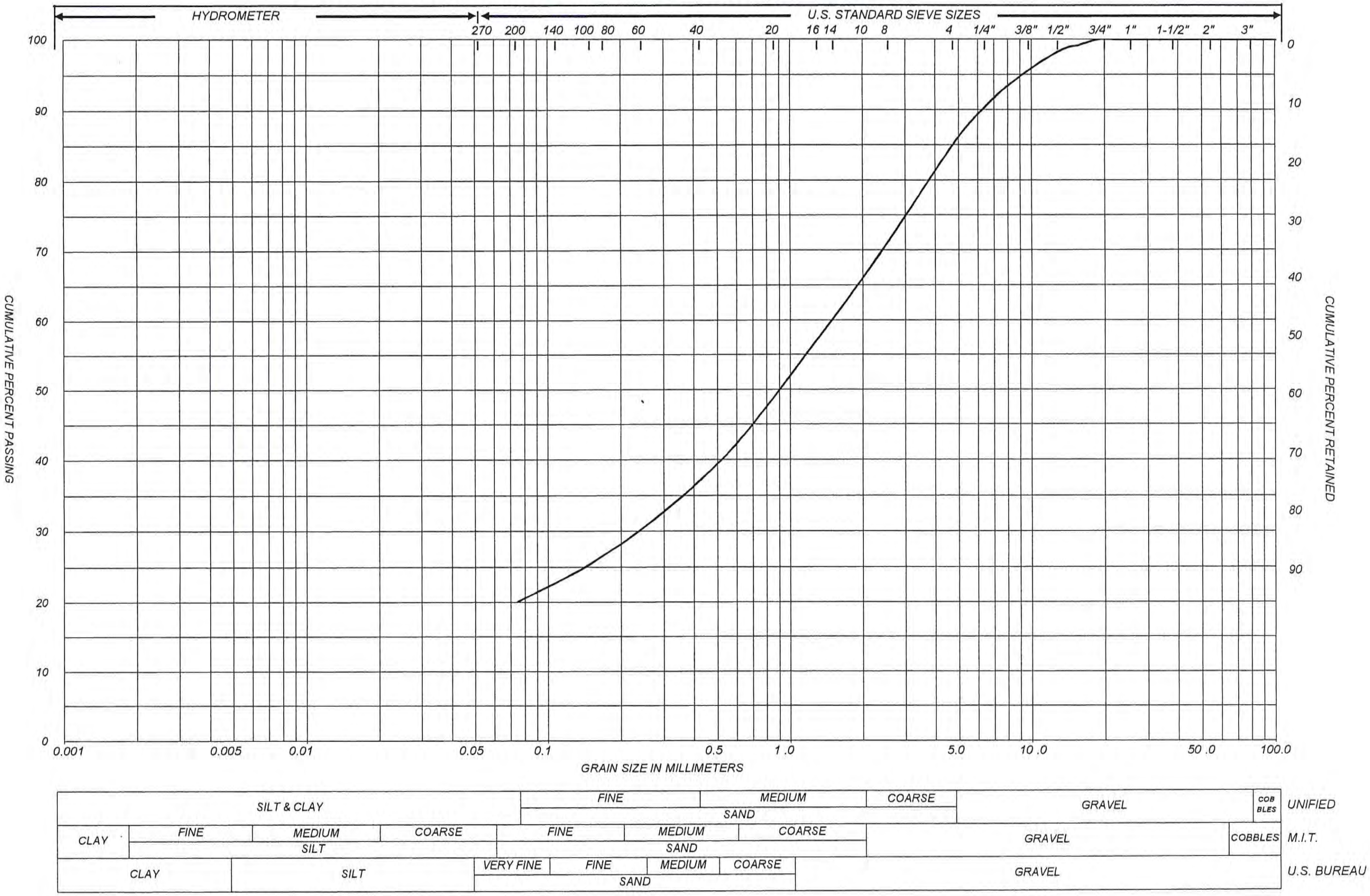
PML REF. 10KF006
FIGURE NO. 4

PARTICLE SIZE DISTRIBUTION CHART



REMARKS Borehole 22, Sample AS1, Depth 0.30 to 0.65 m
GRAVELLY SAND, SOME SILT

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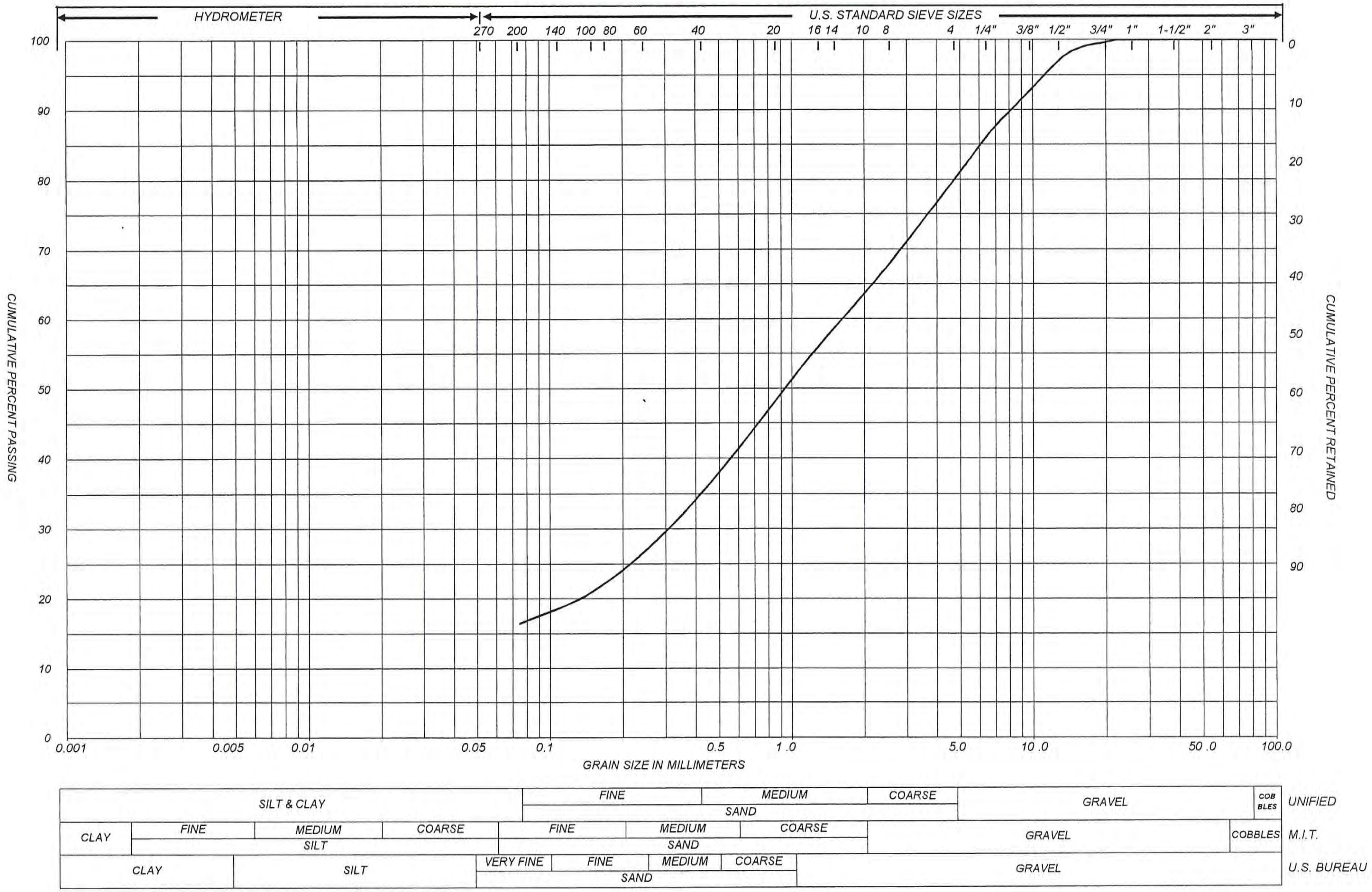
PML REF. 10KF006
FIGURE NO. 5

PARTICLE SIZE DISTRIBUTION CHART



REMARKS Borehole 35, Sample AS1, Depth 0.30 to 0.80 m
GRAVELLY SAND, SOME SILT

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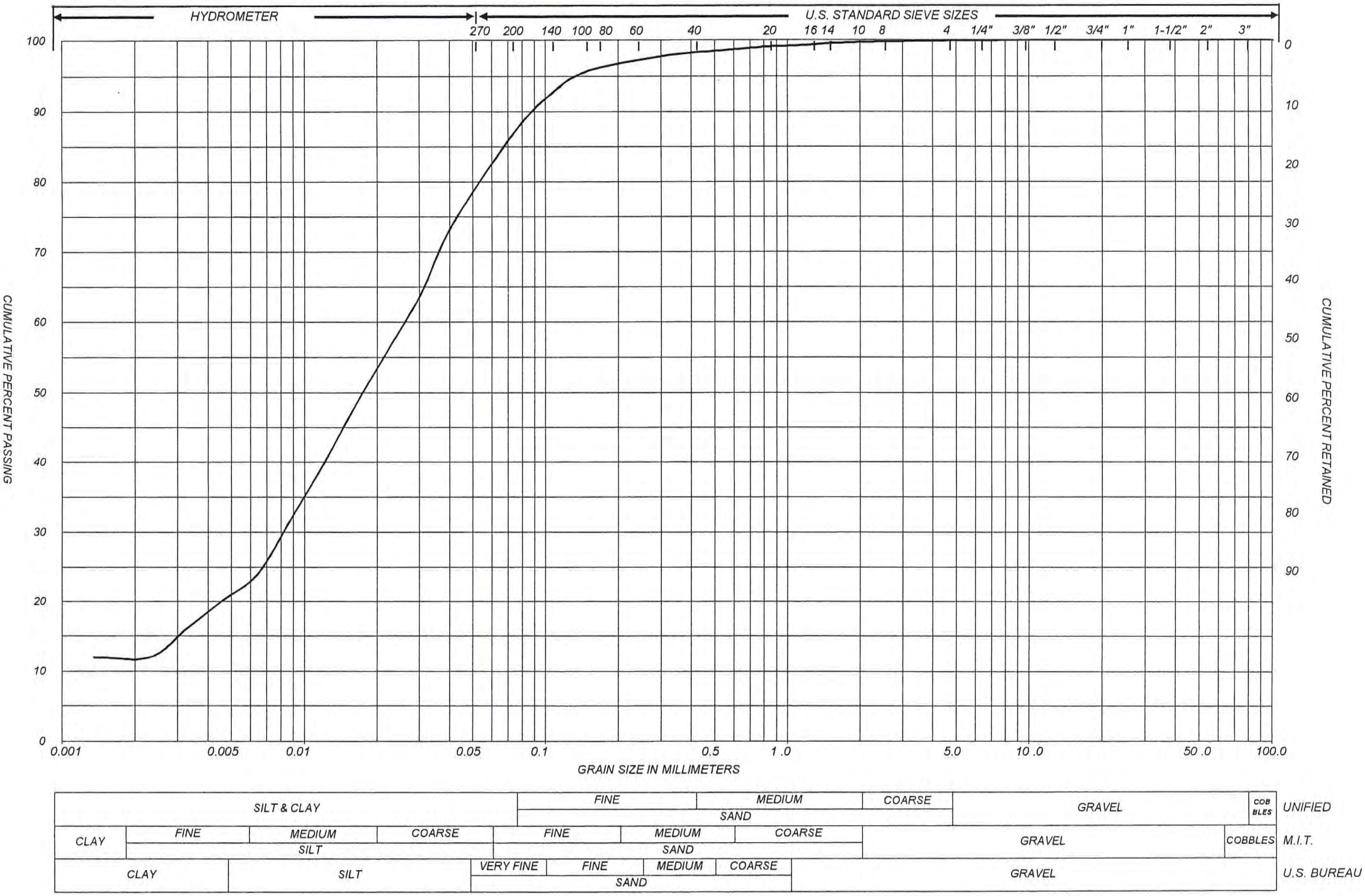
PML REF. 10KF006
FIGURE NO. 6

PARTICLE SIZE DISTRIBUTION CHART



REMARKS Borehole 25, Sample SS1, Depth 1.50 to 2.15 m

SILT, TRACE SAND

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. - Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J 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:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	TW	Thinwall Open
WS	Washed Sample	TP	Thinwall Piston
SB	Scraper Bucket Sample	OS	Oesterberg Sample
AS	Auger Sample	FS	Foil Sample
CS	Chunk Sample	RC	Rock Core
ST	Slotted Tube Sample	USS	Undisturbed Shear Strength
PH	Sample Advanced Hydraulically	RSS	Remoulded Shear Strength
PM	Sample Advanced Manually		

SOIL TESTS

Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

LOG OF BOREHOLE NO. 1

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 192.31	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist		192						
0.70	TOPSOIL: Dark brown silt, wet								
1.00	SAND: Brown sand, some silt, wet		191						
1.5				1	SS	11	●	⊙	
2.00									
2.10	CLAYEY SILT: Firm brown clayey silt, some sand, APL								Upon completion of drilling, free water at 0.9 m.
	BOREHOLE TERMINATED AT 2.10 m								

LOG OF BOREHOLE NO. 2

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 193.57	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
0.50	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist		193	1	AS			⊙	Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 0.50 m NO FURTHER PROGRESS PROBABLE BOULDER								

NOTES

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LOG OF BOREHOLE NO. 3

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT — W_L PLASTIC LIMIT — W_P WATER CONTENT — W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 188.37	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
1.00	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, numerous cobbles, moist		188						
1.60	TOPSOIL: Dark brown silt, moist to wet (highly organic)		187	1	AS			57⊙	
1.5 1.90	SILT: Very loose grey silt, trace clay, trace sand, wet			2	SS	2 blows/150 mm 50 blows/50 mm*	● ●	⊙	Upon completion of drilling, borehole caved to 1.4 m with free water at 1.2 m.
	BOREHOLE TERMINATED AT 1.90 m NO FURTHER PROGRESS PROBABLE BEDROCK								

LOG OF BOREHOLE NO. 4

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT — W_L PLASTIC LIMIT — W_P WATER CONTENT — W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 188.74	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
0.60	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist		188						
1.00	TOPSOIL: Dark brown sandy silt, moist to wet								
1.5 1.60	SANDY SILT: Very loose brown sandy silt, occasional roots, occasional topsoil inclusions, wet		187	1	SS	3	●	⊙	
2.10	CLAYEY SILT: Soft grey clayey silt, APL to WTPL								Upon completion of drilling, borehole wet caved to 1.2 m.
	BOREHOLE TERMINATED AT 2.10 m								

NOTES * Sample bouncing on probable bedrock

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LOG OF BOREHOLE NO. 5

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 01
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

DEPTH in METRES	SOIL PROFILE: DESCRIPTION	LEGEND	ELEVATION	SAMPLES: NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH C_u ▲ 50 100 150 200; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●; BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L; PLASTIC LIMIT ___ W_P; WATER CONTENT ___ W; W_P W W_L; WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 189.09								
0.80	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist								
1.70	TOPSOIL: Dark brown sandy silt, wet		188						
1.5	BOREHOLE TERMINATED AT 1.70 m NO FURTHER PROGRESS PROBABLE BEDROCK			1	SS	50 blows/125 mm*	●		Upon completion of drilling, borehole open with no free water.

LOG OF BOREHOLE NO. 6

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 01
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

DEPTH in METRES	SOIL PROFILE: DESCRIPTION	LEGEND	ELEVATION	SAMPLES: NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH C_u ▲ 50 100 150 200; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●; BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L; PLASTIC LIMIT ___ W_P; WATER CONTENT ___ W; W_P W W_L; WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 189.31								
0.80	PAVEMENT STRUCTURE: Brown gravelly silty sand, moist		189						
1.40	TOPSOIL: Dark brown to black clayey silt, WTPL		188						
1.5									
1.90	SANDS AND SILTS: Layers of grey silty sand and clayey silt, some gravel, wet/APL			1	SS	6 blows/150 mm 50 blows/125 mm*	● ●	⊙	Upon completion of drilling, borehole caved to 1.2 m with no free water.
	BOREHOLE TERMINATED AT 1.90 m NO FURTHER PROGRESS PROBABLE BEDROCK								

NOTES * Sample bouncing on probable bedrock

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LOG OF BOREHOLE NO. 7

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 01
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 190.51	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
0.60	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist	⁘	190						
1.00	FILL: Brown silty sand, moist	▨							
1.20	TOPSOIL: Dark brown silty sand, moist	∽							Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 1.20 m NO FURTHER PROGRESS PROBABLE BEDROCK								

LOG OF BOREHOLE NO. 8

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 01
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 190.63	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
0.70	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist	⁘	190						
1.30	TOPSOIL: Dark brown to black sandy silt, wet	∽							
1.5 1.70	SILT: Layers of brown sandy silt and clayey silt, wet/APL	▥	189	1	SS	50 blows/150 mm	●	⊙	Upon completion of drilling, borehole caved to 0.9 m with free water at 0.7 m.
	BOREHOLE TERMINATED AT 1.70 m NO FURTHER PROGRESS PROBABLE BEDROCK								

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 9

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

DEPTH in METRES	SOIL PROFILE: DESCRIPTION GROUND ELEVATION 193.74	LEGEND	ELEVATION	SAMPLES: NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH C_u ▲ (50 100 150 200) DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M (20 40 60 80)	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W WATER CONTENT % (10 20 30)	GROUND WATER OBSERVATIONS AND REMARKS
0.50	PAVEMENT STRUCTURE: Brown gravelly sand, trace silt, moist								
1.00	FILL: Dark brown silty sand, some gravel, moist		193						
1.5	GRAVELLY SAND: Grey and brown gravelly sand, some silt, occasional cobbles, moist		192	1	SS	7	●	⊙	
2.10									
	BOREHOLE TERMINATED AT 2.10 m								Upon completion of drillling, borehole open with no free water.

LOG OF BOREHOLE NO. 10

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

DEPTH in METRES	SOIL PROFILE: DESCRIPTION GROUND ELEVATION 192.61	LEGEND	ELEVATION	SAMPLES: NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH C_u ▲ (50 100 150 200) DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M (20 40 60 80)	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W WATER CONTENT % (10 20 30)	GROUND WATER OBSERVATIONS AND REMARKS
0.75	PAVEMENT STRUCTURE: Brown gravelly sand, trace silt, moist		192						
1.00	TOPSOIL: Dark brown silt, wet								
1.5 1.75	SAND: Brown sand, some silt, wet		191	1	SS	50 blows/75 mm	●	⊙	
	BOREHOLE TERMINATED AT 1.75 m NO FURTHER PROGRESS PROBABLE BEDROCK								Upon completion of drillling, borehole open with no free water.

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2 PAGE LOGS 10KF006 BOREHOLE LOGS.GPJ PETOMAC.GDT 2010 03 08

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 11

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH Cu ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT WL PLASTIC LIMIT WP WATER CONTENT W WP W WL WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	GROUND ELEVATION 193.63								
	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist		193						
1.00	FILL: Dark brown silty sand topsoil, moist		192						
1.5 1.70	BOREHOLE TERMINATED AT 1.70 m NO FURTHER PROGRESS PROBABLE BEDROCK			1	SS	50 blows/50 mm*	●	⊙	Upon completion of drilling, borehole open with no free water.

LOG OF BOREHOLE NO. 12

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH Cu ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT WL PLASTIC LIMIT WP WATER CONTENT W WP W WL WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	GROUND ELEVATION 192.35								
	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist		192	1	AS			⊙	
0.70	SAND: Very loose brown sand, some silt, wet		191						
1.5				2	SS	2	●	⊙	
2.00 2.15	CLAYEY SILT: Very soft grey clayey silt, WTPL								Upon completion of drilling, borehole caved to 1.2 m with free water at 0.9 m.
	BOREHOLE TERMINATED AT 2.15 m								

NOTES * Sample bouncing on probable bedrock

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PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 13

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 192.47	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	PAVEMENT STRUCTURE: Brown gravelly sand, trace silt, moist		192						
0.90	FILL: Dark brown sandy silt, numerous topsoil layers, wet	▨	191						
1.5 1.70	BOREHOLE TERMINATED AT 1.70 m NO FURTHER PROGRESS PROBABLE BEDROCK			1	SS	50 blows/25 mm*	●	⊙	Upon completion of drilling, borehole open with no free water.

LOG OF BOREHOLE NO. 14

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 195.55	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	PAVEMENT STRUCTURE: Brown gravelly silty sand, moist		195	1	AS				
0.80	TOPSOIL: Dark brown gravelly sand, moist	~							Upon completion of drilling, borehole open with no free water.
1.00	BOREHOLE TERMINATED AT 1.00 m NO FURTHER PROGRESS PROBABLE BEDROCK								

NOTES * Sample bouncing on probable bedrock

CHECKED BY

LOG OF BOREHOLE NO. 15

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 01
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SHEAR STRENGTH C_u ▲ 50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M 20 40 60 80
LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % 10 20 30

DEPTH in METRES	DESCRIPTION (GROUND ELEVATION 193.41)	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	STANDARD PENETRATION TEST ●	WATER CONTENT %	GROUND WATER OBSERVATIONS AND REMARKS
0.80	PAVEMENT STRUCTURE: Brown gravelly sand, trace silt, moist	193						
1.20	TOPSOIL: Dark brown clayey silt, APL		1	AS			53	
1.5 2.40	CLAYEY SILT: Stiff mottled brown and grey clayey silt, trace sand, trace gravel, APL	192	2	SS	7	●	⊙	
	BOREHOLE TERMINATED AT 2.40 m NO FURTHER PROGRESS PROBABLE BEDROCK							Upon completion of drilling, borehole open with no free water.

LOG OF BOREHOLE NO. 16

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 01
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SHEAR STRENGTH C_u ▲ 50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M 20 40 60 80
LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % 10 20 30

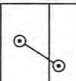
DEPTH in METRES	DESCRIPTION (GROUND ELEVATION 196.04)	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
0.60	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist					
1.5 1.50	SAND AND GRAVEL: Brown sand and gravel, some silt, moist	195				
	BOREHOLE TERMINATED AT 1.50 m NO FURTHER PROGRESS PROBABLE BEDROCK					Upon completion of drilling, borehole open with no free water.

NOTES

CHECKED BY

LOG OF BOREHOLE NO. 17

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 01
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 196.17	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist	▨	196	1 2	SS SS				Upon completion of drilling, borehole open with no free water.
0.75	GRAVELLY SAND: Dark brown gravelly sand, trace organics, trace topsoil, moist	▨							
1.10	BOREHOLE TERMINATED AT 1.10 m NO FURTHER PROGRESS PROBABLE BEDROCK								

LOG OF BOREHOLE NO. 18

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 01
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 195.57	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	PAVEMENT STRUCTURE: Brown gravelly sand, some silt, moist	▨							Upon completion of drilling, borehole open with no free water.
0.50	GRAVELLY SAND: Dark brown gravelly sand, trace organics, trace topsoil, moist	▨	195						
0.70	BOREHOLE TERMINATED AT 0.70 m NO FURTHER PROGRESS PROBABLE BEDROCK								

NOTES

CHECKED BY

LOG OF BOREHOLE NO. 19

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 195.23	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
0.80	PAVEMENT STRUCTURE: Brown gravelly sand, trace to some silt, moist		195						
1.00	TOPSOIL: Dark brown clayey silt, moist		194						
1.5 1.80	CLAYEY SILT: Brown to grey clayey silt, APL			1	SS	50 blows/100 mm*	●	⊕	Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 1.80 m NO FURTHER PROGRESS PROBABLE BEDROCK								

LOG OF BOREHOLE NO. 20

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 01
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 194.21	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
0.70	PAVEMENT STRUCTURE: Brown gravelly sand, trace to some silt, moist		194						
1.50	FILL: Brown gravelly sand, trace to some silt, moist		193						
1.5 1.80	SILTY SAND: Brown silty sand, moist			1	SS	50 blows/150 mm*	●		Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 1.80 m NO FURTHER PROGRESS PROBABLE BEDROCK								

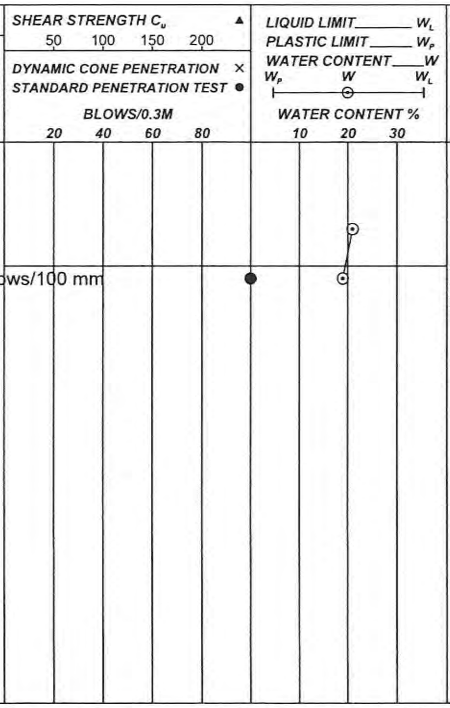
NOTES * Sample bouncing on probable bedrock

CHECKED BY

LOG OF BOREHOLE NO. 21

PROJECT RECONSTRUCTION OF WEST ROAD — **OUR PROJECT NO.** 10KF006
LOCATION County of Bruce, Ontario — **BORING DATE** 2010 02 01 — **ENGINEER** M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** W. Loghrin

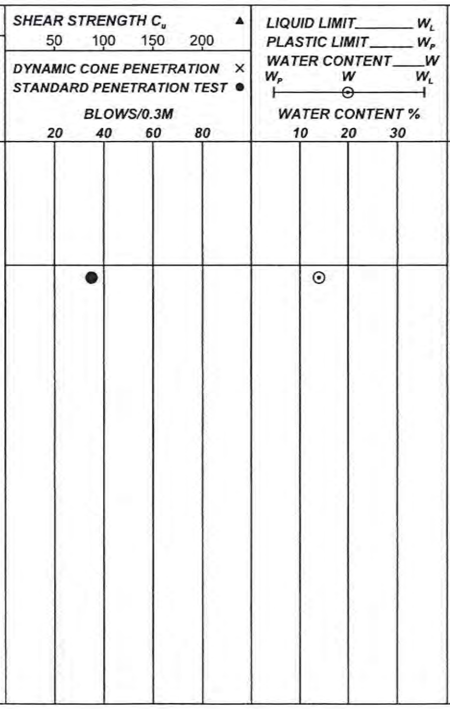
DEPTH in METRES	SOIL PROFILE DESCRIPTION	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 189.20						
	PAVEMENT STRUCTURE: Brown gravelly sand, trace to some silt, moist		189				
0.90							
1.20	TOPSOIL: Dark brown clayey silt, APL		188	1	AS		
1.5 1.60	CLAYEY SILT: Brown clayey silt, some sand, APL			2	SS	50 blows/100 mm	Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 1.60 m NO FURTHER PROGRESS PROBABLE BEDROCK						



LOG OF BOREHOLE NO. 22

PROJECT RECONSTRUCTION OF WEST ROAD — **OUR PROJECT NO.** 10KF006
LOCATION County of Bruce, Ontario — **BORING DATE** 2010 02 01 — **ENGINEER** M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** W. Loghrin

DEPTH in METRES	SOIL PROFILE DESCRIPTION	LEGEND	ELEVATION	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m N - VALUES	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 187.42						
0.65	PAVEMENT STRUCTURE: Brown gravelly silty sand, moist		187				
1.00	TOPSOIL: Dark brown clayey silt, WTPL						
1.5	SILT: Dense brown silt, trace clay, moist		186	1	SS	35	
2.10							Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 2.10 m						



NOTES * Sample bouncing on probable bedrock

CHECKED BY

LOG OF BOREHOLE NO. 23

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2101 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

DEPTH in METRES	SOIL PROFILE: DESCRIPTION	LEGEND	ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH Cu ▲ (50 100 150 200); DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ● BLOWS/0.3M (20 40 60 80)	LIQUID LIMIT WL; PLASTIC LIMIT WP; WATER CONTENT W (WP ⊝ WL) WATER CONTENT % (10 20 30)	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 186.86								
0.80	PAVEMENT STRUCTURE: 40 mm of asphaltic concrete over 260 mm of brown crushed gravelly sand, trace silt, moist, over 500 mm brown gravelly sand, trace silt, moist		186						
1.20	TOPSOIL: Dark brown silt, wet								
1.5									
2.00	SILT: Brown to grey very dense silt, some fine sand, moist		185	1	SS	73	●	⊙	Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 2.00 m								

LOG OF BOREHOLE NO. 24

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

DEPTH in METRES	SOIL PROFILE: DESCRIPTION	LEGEND	ELEVATION	SAMPLES: NUMBER	SAMPLES: TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH Cu ▲ (50 100 150 200); DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ● BLOWS/0.3M (20 40 60 80)	LIQUID LIMIT WL; PLASTIC LIMIT WP; WATER CONTENT W (WP ⊝ WL) WATER CONTENT % (10 20 30)	GROUND WATER OBSERVATIONS AND REMARKS
	GROUND ELEVATION 186.78								
0.80	PAVEMENT STRUCTURE: 45 mm of asphaltic concrete, over 305 mm of brown crushed gravelly sand, trace silt, moist, over 450 mm of brown gravelly sand, trace silt, moist		186						
1.10	TOPSOIL: Dark brown silt, wet								
1.5									
2.00	SAND: Loose brown sand, some silt, wet		185	1	SS	6	●	⊙	Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 2.00 m								

NOTES

CHECKED BY

LOG OF BOREHOLE NO. 25

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 186.80	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
0.80	PAVEMENT STRUCTURE: 40 mm of asphaltic concrete, over 760 mm of gravelly sand, trace silt, moist		186						
1.10	TOPSOIL: Dark brown silt, moist								
1.5 2.15	SILT: Very loose to loose brown silt, trace sand, trace clay, moist to wet		185	1	SS	4	●		
	BOREHOLE TERMINATED AT 2.15 m								Upon completion of drilling, borehole open with no free water.

LOG OF BOREHOLE NO. 26

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 187.01	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
0.75	PAVEMENT STRUCTURE: 50 mm of asphaltic concrete, over 700 mm of brown gravelly sand, some silt, moist			1	AS				
1.20	SILT: Dense brown silt, trace fine sand, moist		186						
1.5 2.00	becoming grey			2	SS	35	●	⊙	
	BOREHOLE TERMINATED AT 2.00 m								Upon completion of drilling, borehole open with no free water.

NOTES

CHECKED BY

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 27

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 02
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	GROUND ELEVATION 187.33								
0.90	PAVEMENT STRUCTURE: 50 mm of asphaltic concrete, over 850 mm of brown gravelly sand, some silt, moist		187						
1.10	TOPSOIL: Dark brown silt, moist		186						
1.50	SANDY SILT: Brown sandy silt, wet								Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 1.50 m								

1.5

LOG OF BOREHOLE NO. 27A

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 02
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	GROUND ELEVATION 187.23								
0.20	TOPSOIL: Dark brown gravelly sand, moist		187						
1.20	FILL: Dark brown sandy silt, wet		186						
1.50	SANDY SILT: Brown to grey sandy silt, wet								Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 1.50 m								

1.5

NOTES

CHECKED BY

LOG OF BOREHOLE NO. 28

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 02
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

DEPTH in METRES	DESCRIPTION GROUND ELEVATION 187.51	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
0.70	PAVEMENT STRUCTURE: 50 mm of asphaltic concrete, over 650 mm of brown gravelly sand, some silt, moist		187						
1.50	SANDY SILT: Dense brown fine sandy silt, wet		186						
1.5 2.00	becoming grey			1	SS	44	●	⊙	Upon completion of drilling, borehole wet caved to 1.2 m.
	BOREHOLE TERMINATED AT 2.00 m								

LOG OF BOREHOLE NO. 29

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 02
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

DEPTH in METRES	DESCRIPTION GROUND ELEVATION 187.95	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
0.75	PAVEMENT STRUCTURE: 45 mm of asphaltic concrete, over 705 mm of brown gravelly sand, some silt, moist		187						
0.90	TOPSOIL: Dark brown silt, wet								
1.5 2.10	SANDY SILT: Brown and grey sandy silt, occasional clayey silt layers, wet		186	1	SS	4	●	⊙	Upon completion of drilling, borehole wet caved to 1.2 m.
	BOREHOLE TERMINATED AT 2.10 m								

NOTES

CHECKED BY

LOG OF BOREHOLE NO. 30

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 02
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	GROUND ELEVATION 189.08								
0.70	PAVEMENT STRUCTURE: 45 mm of asphaltic concrete, over 655 mm of brown gravelly sand, some silt, moist								
1.20	SANDY SILT: Brown sandy silt, wet		188						
1.5 2.00	CLAYEY SILT: Firm mottled brown and grey clayey silt, trace sand, APL			1	SS	5	●	⊙	Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 2.00 m								

LOG OF BOREHOLE NO. 31

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 02
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	GROUND ELEVATION 191.09								
0.75	PAVEMENT STRUCTURE: 50 mm of asphaltic concrete, over 700 mm of brown gravelly sand, some silt, moist								
1.5 2.00	CLAYEY SILT: Soft brown and grey clayey silt, numerous layers of fine sandy silt, APL/Wet		190	1	SS	4	●	⊙	Upon completion of drilling, borehole wet caved to 1.20 m.
	BOREHOLE TERMINATED AT 2.00 m								

NOTES

CHECKED BY

LOG OF BOREHOLE NO. 32

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES					
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 194.84	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
0.90	PAVEMENT STRUCTURE: 50 mm of asphaltic concrete, over 850 mm of brown gravelly sand, some silt, moist		194						
1.50	FILL: Brown gravelly sand, some silt, occasional cobbles, moist								
1.5 1.70	TOPSOIL: Dark brown clayey silt, APL		193	1	SS	10	●	⊙	
2.00	CLAYEY SILT: Stiff brown clayey silt, APL								Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 2.00 m								

LOG OF BOREHOLE NO. 33

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES					
DEPTH in METRES	DESCRIPTION GROUND ELEVATION 198.04	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
0.65	PAVEMENT STRUCTURE: 50 mm of asphaltic concrete, over 600 mm of brown gravelly sand, some silt, moist								
	SAND AND GRAVEL: Dense brown sand and gravel, trace silt, moist		197						
1.5				1	SS	31	●	⊙	
2.00	BOREHOLE TERMINATED AT 2.00 m								Upon completion of drilling, borehole caved to 1.1 m with no free water.

NOTES

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LOG OF BOREHOLE NO. 34

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SHEAR STRENGTH C_u ▲ 50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M 20 40 60 80
LIQUID LIMIT ——— W_L
PLASTIC LIMIT ——— W_P
WATER CONTENT ——— W
W_P W W_L
WATER CONTENT % 10 20 30

GROUND ELEVATION 196.69

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	STANDARD PENETRATION TEST	WATER CONTENT	GROUND WATER OBSERVATIONS AND REMARKS
0.65	PAVEMENT STRUCTURE: 40 mm of asphaltic concrete, over 610 mm of brown gravelly sand, trace to some silt, moist	196						
1.5 1.80	FILL: Brown sand, trace gravel, some silt, moist	195	1	SS	10	●	⊙	
2.00	SAND AND GRAVEL: Brown sand and gravel, moist							Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 2.00 m							

LOG OF BOREHOLE NO. 35

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SHEAR STRENGTH C_u ▲ 50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
BLOWS/0.3M 20 40 60 80
LIQUID LIMIT ——— W_L
PLASTIC LIMIT ——— W_P
WATER CONTENT ——— W
W_P W W_L
WATER CONTENT % 10 20 30

GROUND ELEVATION 197.03

DEPTH in METRES	DESCRIPTION	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	STANDARD PENETRATION TEST	WATER CONTENT	GROUND WATER OBSERVATIONS AND REMARKS
0.85	PAVEMENT STRUCTURE: 40 mm of asphaltic concrete, over 810 mm of brown gravelly sand, trace to some silt, moist	196	1	AS				
1.40	FILL: Brown sand, trace silt, moist							
1.5 2.00	TOPSOIL: Dark brown sandy silt, wet	195	2	SS	4	●		
2.10	SANDY SILT: Brown sandy silt, wet							Upon completion of drilling, borehole wet caved to 1.5 m.
	BOREHOLE TERMINATED AT 2.10 m							

NOTES

CHECKED BY

LOG OF BOREHOLE NO. 36

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	GROUND ELEVATION 198.63								
0.65	PAVEMENT STRUCTURE: 40 mm of asphaltic concrete, over 610 mm of brown gravelly sand, some silt, moist		198						Upon completion of drilling, borehole open with no free water.
1.00	FILL: Brown sand, some silt, moist								
	BOREHOLE TERMINATED AT 1.00 m NO FURTHER PROGRESS PROBABLE BEDROCK								

LOG OF BOREHOLE NO. 37

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	GROUND ELEVATION 200.39								
0.80	PAVEMENT STRUCTURE: 40 mm of asphaltic concrete, over 760 mm of brown gravelly sand, some silt, moist		200						
1.5 1.50	FILL: Brown sand, some silt, moist		199						
1.60	occasional topsoil inclusions			1	SS	50 blows/75 mm*	●		
	BOREHOLE TERMINATED AT 1.60 m NO FURTHER PROGRESS PROBABLE BEDROCK								

NOTES * Sample bouncing on probable bedrock

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Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 38

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

GROUND ELEVATION 194.05

DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH C_u ▲ (50, 100, 150, 200) DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M (20, 40, 60, 80)	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % (10, 20, 30)	GROUND WATER OBSERVATIONS AND REMARKS
0.75	PAVEMENT STRUCTURE: 45 mm of asphaltic concrete, over 705 mm of brown gravelly sand, some silt, moist								Upon completion of drilling, borehole open with no free water.
1.00	SILTY SAND: Brown silty sand, some gravel, moist								
	BOREHOLE TERMINATED AT 1.00 m NO FURTHER PROGRESS PROBABLE BEDROCK								

LOG OF BOREHOLE NO. 39

PROJECT RECONSTRUCTION OF WEST ROAD
OUR PROJECT NO. 10KF006
LOCATION County of Bruce, Ontario
BORING DATE 2010 02 02
ENGINEER M. Molodecki
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN W. Loghrin

GROUND ELEVATION 189.80

DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES	SHEAR STRENGTH C_u ▲ (50, 100, 150, 200) DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M (20, 40, 60, 80)	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P W W_L WATER CONTENT % (10, 20, 30)	GROUND WATER OBSERVATIONS AND REMARKS
0.85	PAVEMENT STRUCTURE: 40 mm of asphaltic concrete, over 810 mm of brown gravelly sand, some silt, moist		189						
1.30	FILL: Brown sand, trace silt, moist								
1.5 1.40	TOPSOIL: Dark brown sandy silt, moist		188	1	SS	8	●	⊙	
2.10	SANDY SILT: Grey and brown sandy silt, moist								Upon completion of drilling, borehole open with no free water.
	BOREHOLE TERMINATED AT 2.10 m								

NOTES

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Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 40

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 02
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	GROUND ELEVATION 188.90								
0.80	PAVEMENT STRUCTURE: 50 mm asphaltic concrete, over 750 mm of brown gravelly sand, some silt, moist		188						
1.20	FILL: Brown sand, trace silt, moist	☒							
1.5 2.00	SILT: Compact brown silt, trace sand, occasional sand layers, moist		187	1	SS	10	●	⊙	
	BOREHOLE TERMINATED AT 2.00 m								Upon completion of drilling, borehole open with no free water.

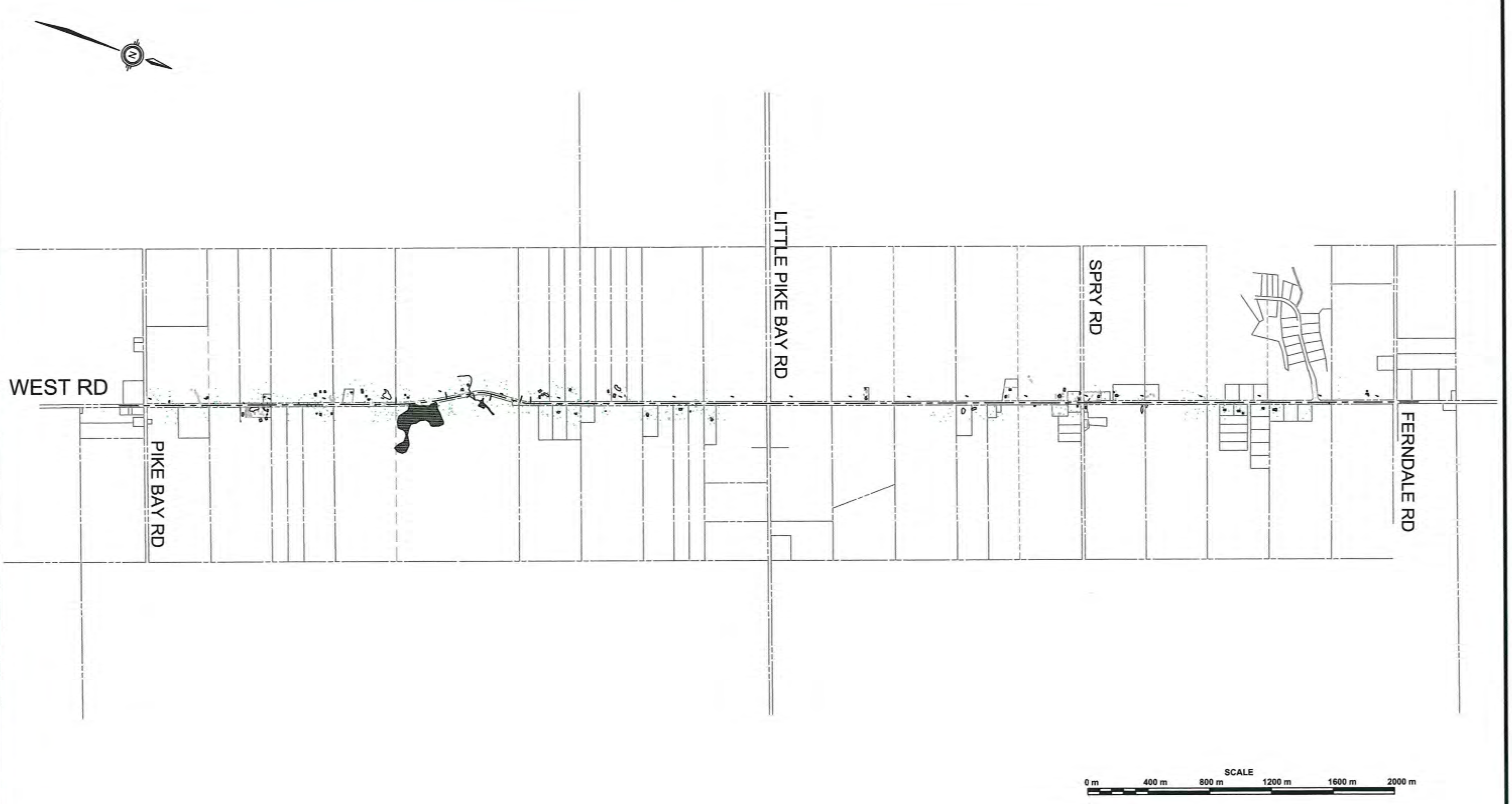
LOG OF BOREHOLE NO. 41

PROJECT RECONSTRUCTION OF WEST ROAD
LOCATION County of Bruce, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE 2010 02 02
OUR PROJECT NO. 10KF006
ENGINEER M. Molodecki
TECHNICIAN W. Loghrin

SOIL PROFILE				SAMPLES			SHEAR STRENGTH C_u ▲ 50 100 150 200 DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ● BLOWS/0.3M 20 40 60 80	LIQUID LIMIT ___ W_L PLASTIC LIMIT ___ W_P WATER CONTENT ___ W W_P W W_L WATER CONTENT % 10 20 30	GROUND WATER OBSERVATIONS AND REMARKS
DEPTH in METRES	DESCRIPTION	LEGEND	ELEVATION	NUMBER	TYPE	BLOWS/0.3m N - VALUES			
	GROUND ELEVATION 188.35								
0.80	PAVEMENT STRUCTURE: 50 mm asphaltic concrete, over 750 mm of brown gravelly sand, some silt, moist		188						
1.20	FILL: Brown sand, trace silt, moist	☒	187						
1.5 2.10	SILT: Very loose to loose grey silt, trace clay, occasional wood pieces, wet			1	SS	4	●	⊙	
	BOREHOLE TERMINATED AT 2.10 m								Upon completion of drilling, borehole open with free water at 1.5 m.

NOTES

CHECKED BY



REFERENCE:

TEST HOLE LOCATION PLAN REPRODUCED FROM DRAWING SUPPLIED BY CLIENT.

NOTE:

THE INFERRED STRATIGRAPHY REFERRED TO IN THE REPORT IS BASED ON THE DATA FROM THESE TEST HOLES SUPPLEMENTED BY GEOLOGICAL EVIDENCE. THE ACTUAL STRATIGRAPHY BETWEEN THE TEST HOLES MAY VARY.

LEGEND:

COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

KEY PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	**DATE**	**SCALE**	**PML REF.**	**DWG. NO.**
CHECKED	M. MOLODECKI	MARCH 2010	AS SHOWN	10KF006	DWG. 1
APPROVED	M. MOLODECKI				

REFERENCE:

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NOTE:

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LEGEND:

⊕ BOREHOLE

⊞ TEST HOLE

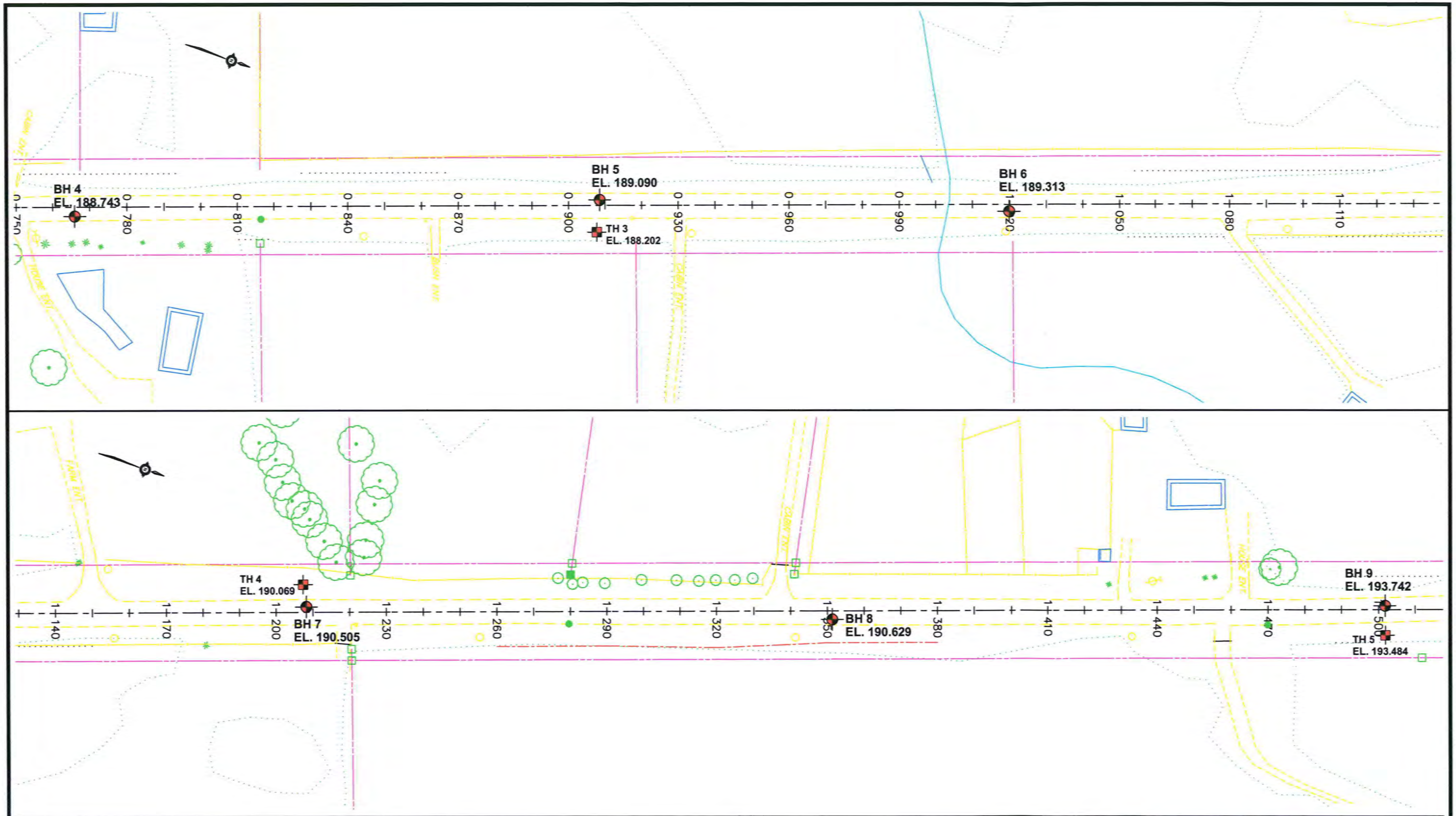
COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	**DATE**	**SCALE**	**PML REF.**	**DWG. NO.**
CHECKED	M. MOLODECKI	MARCH 2010	1:1000	10KF006	DWG. 2 0+000 - 0+750
APPROVED	M. MOLODECKI				



REFERENCE:

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LEGEND:

- ⊕ BOREHOLE
- ⊞ TEST HOLE

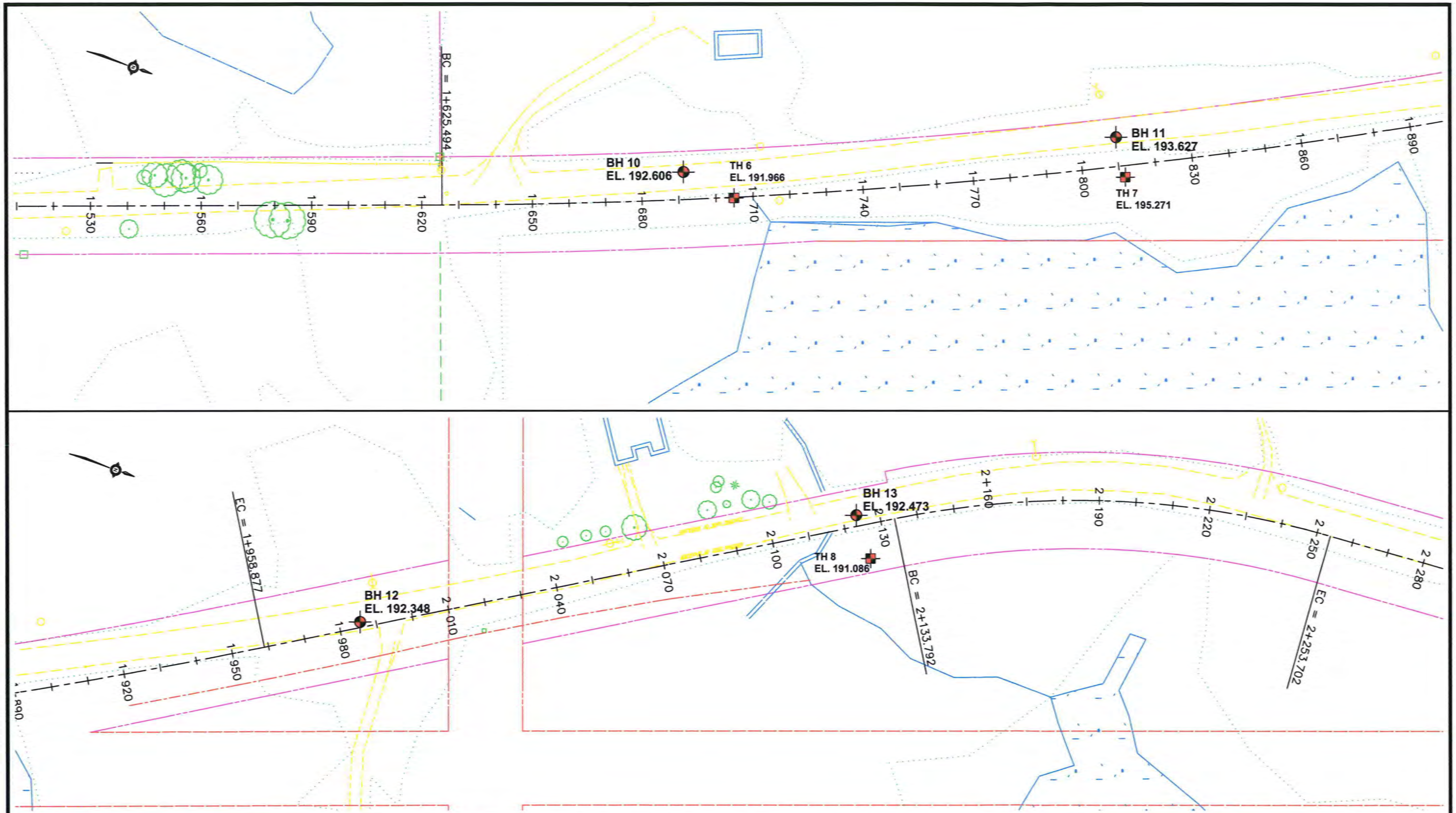
COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	**DATE**	**SCALE**	**PML REF.**	**DWG. NO.**
CHECKED	M. MOLODECKI	MARCH 2010	1:1000	10KF006	DWG. 3 0+750 - 1+510
APPROVED	M. MOLODECKI				



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LEGEND:

⊕ BOREHOLE

■ TEST HOLE

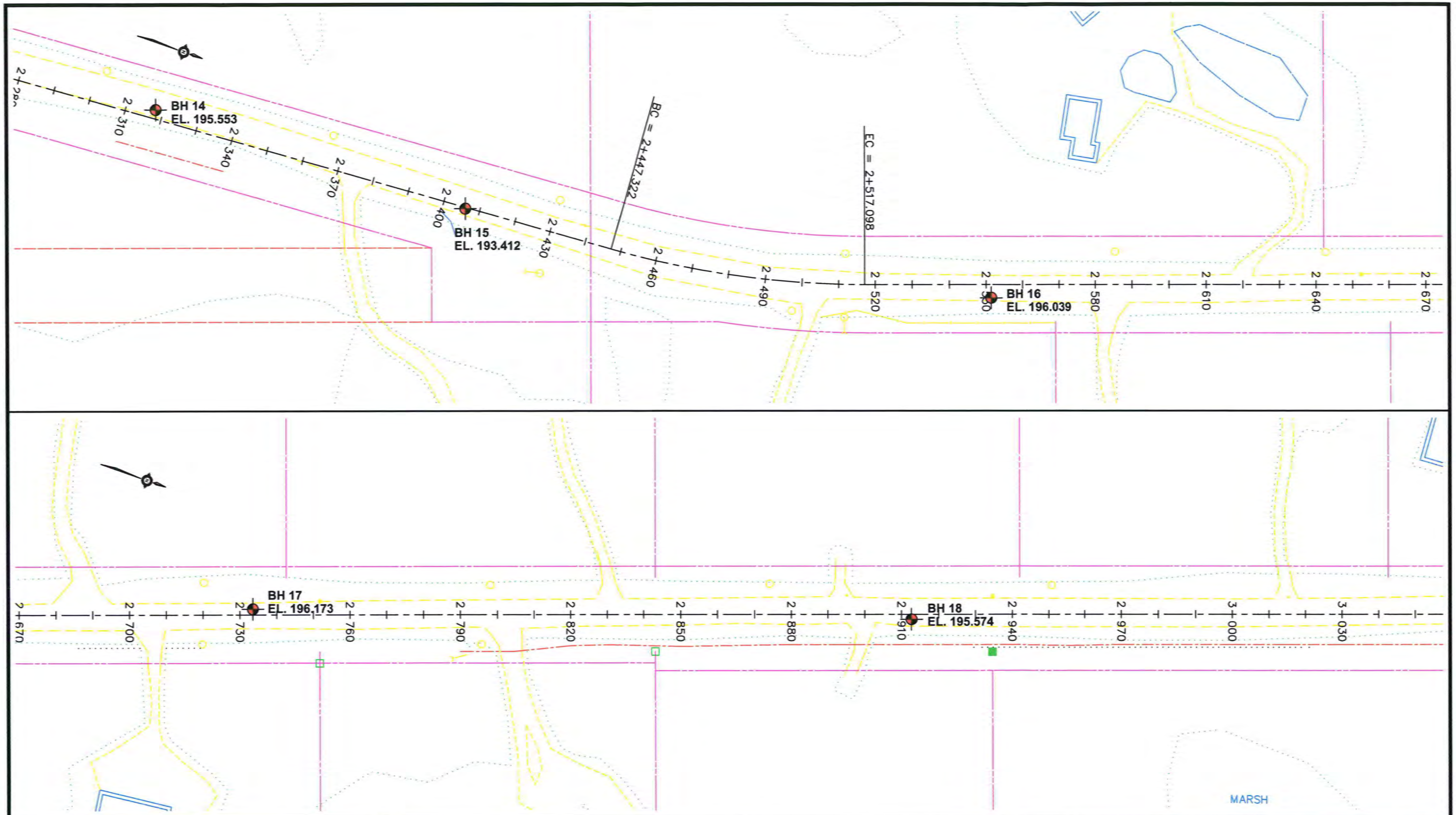
COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	DATE	SCALE	PML REF.	DWG. NO.
CHECKED	M. MOLODECKI	MARCH 2010	1:1000	10KF006	DWG. 4 1+510 - 2+280
APPROVED	M. MOLODECKI				



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LEGEND:

- ⊕ BOREHOLE
- ⊞ TEST HOLE

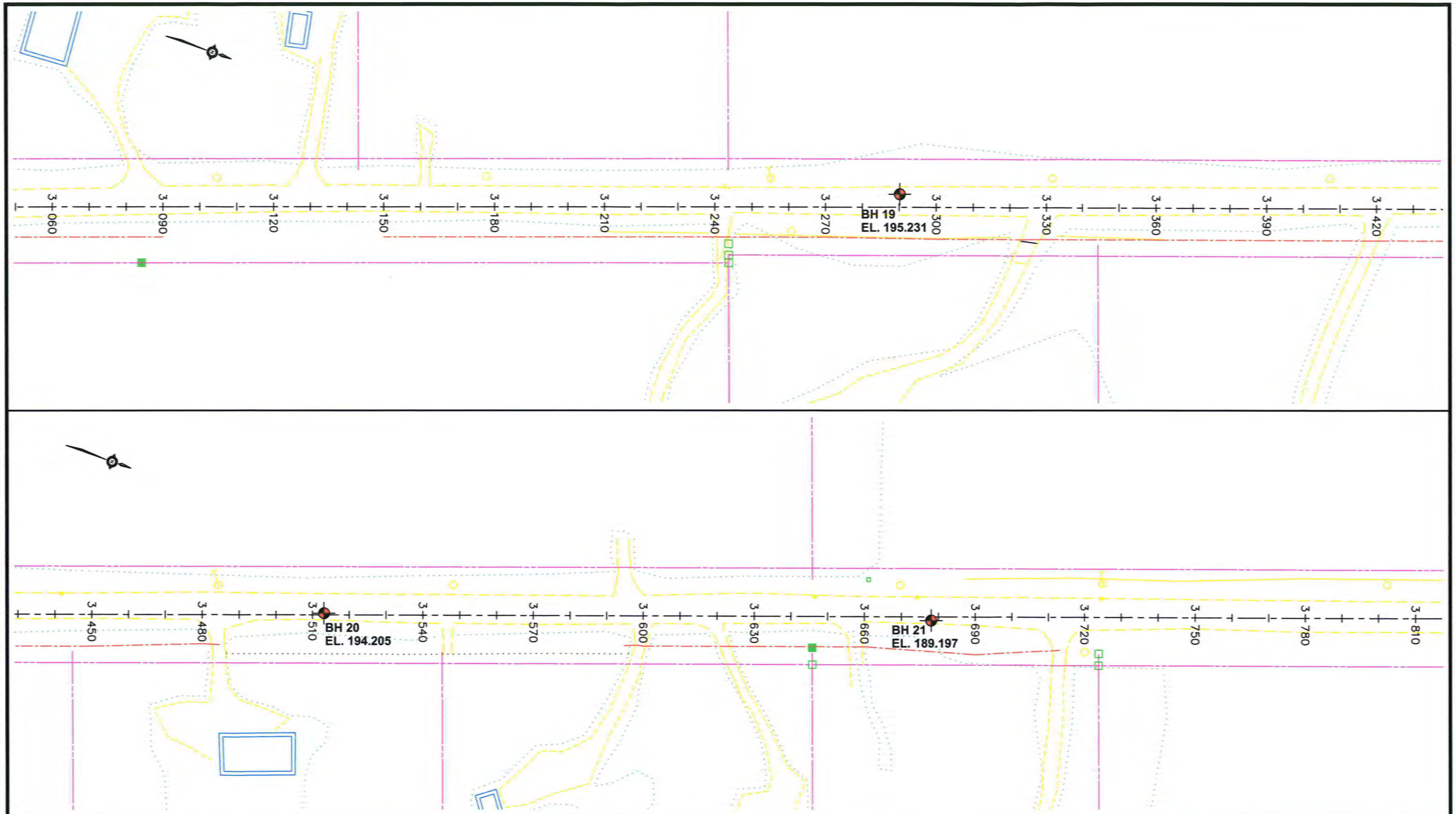
COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	DATE	SCALE	PML REF.	DWG. NO.
CHECKED	M. MOLODECKI	MARCH 2010	1:1000	10KF006	DWG. 5 2+280 - 3+050
APPROVED	M. MOLODECKI				



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LEGEND:

⊕ BOREHOLE

⊞ TEST HOLE

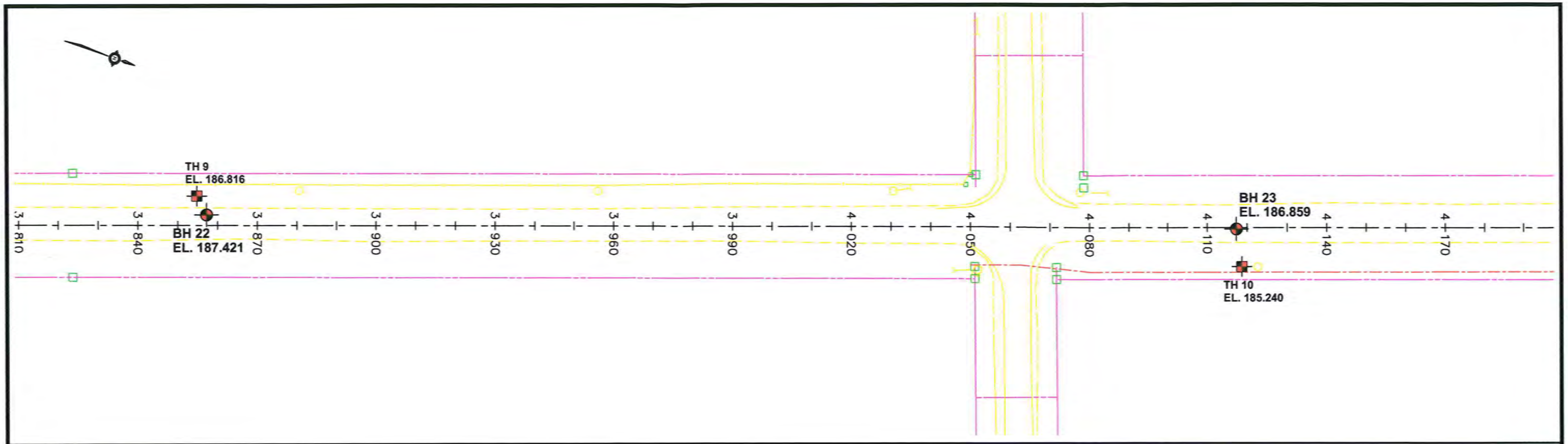
COUNTY OF BRUCE

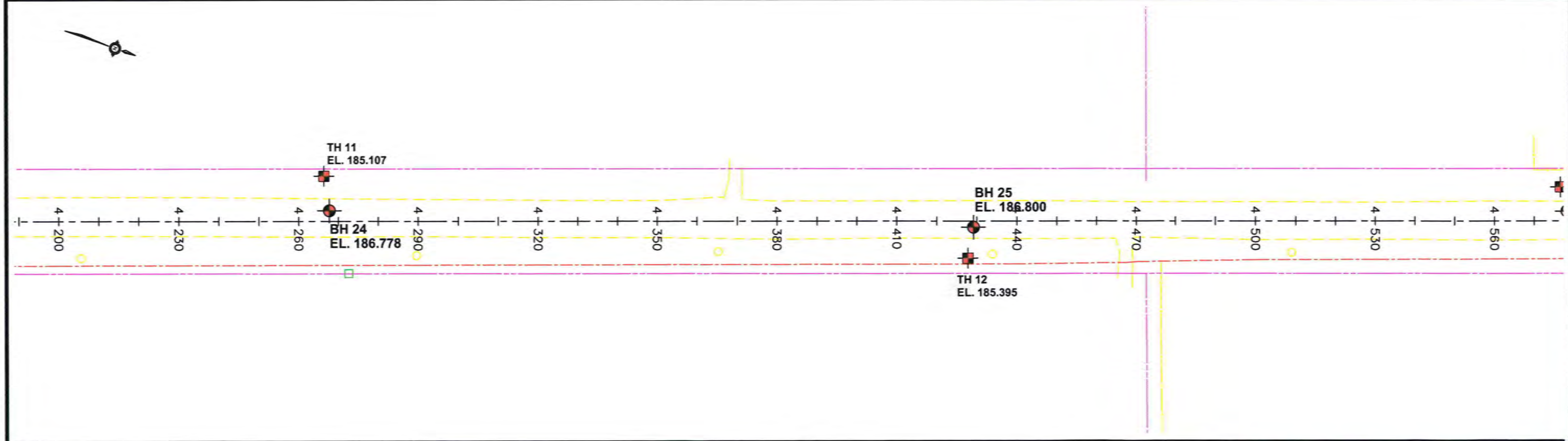
RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	**DATE**	**SCALE**	**PML REF.**	**DWG. NO.**
CHECKED	M. MOLODECKI	MARCH 2010	1:1000	10KF006	DWG. 6 3+050 - 3+810
APPROVED	M. MOLODECKI				





REFERENCE:

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LEGEND:

⊕ BOREHOLE

■ TEST HOLE

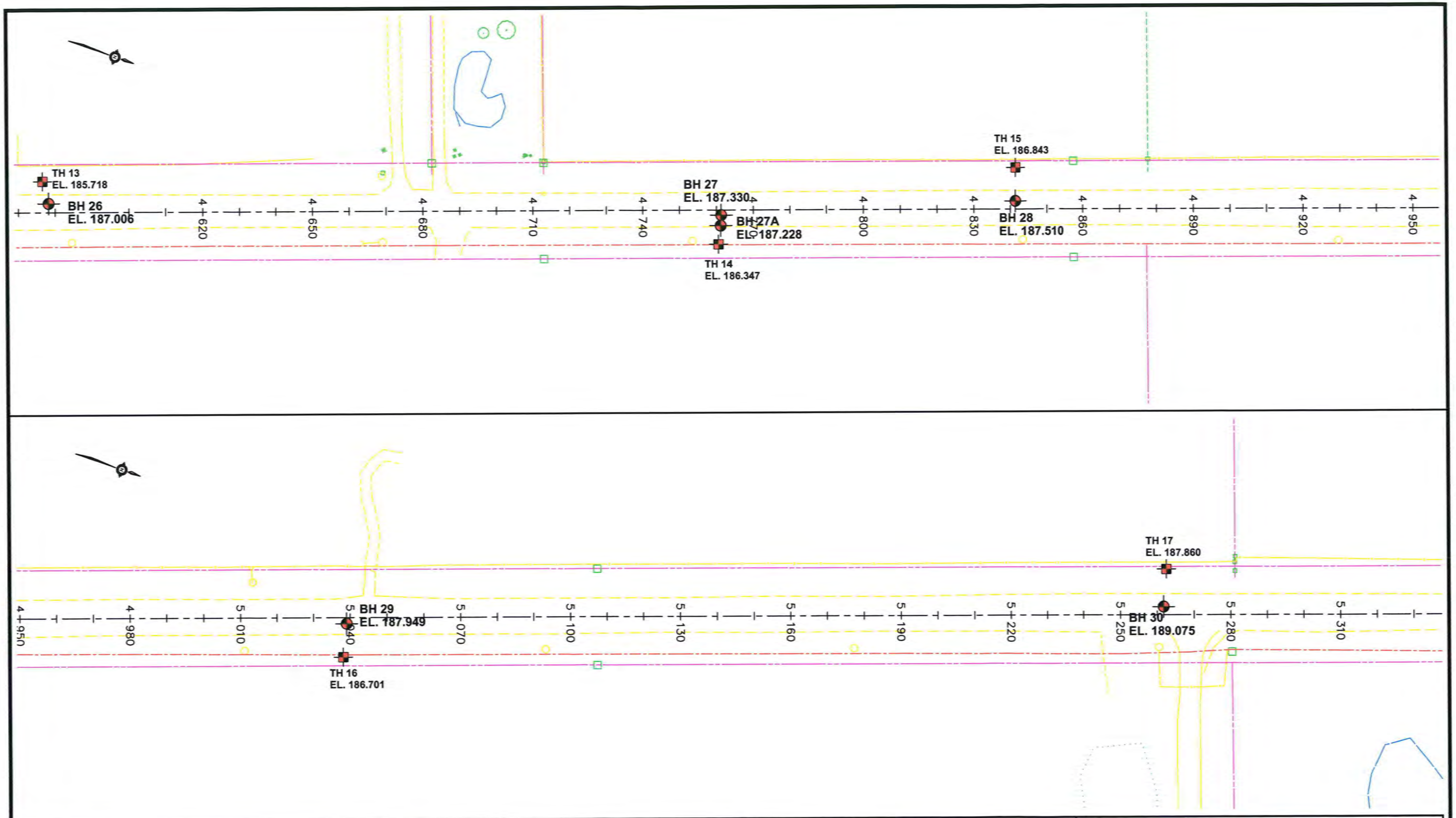
COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	DATE	SCALE	PML REF.	DWG. NO.
CHECKED	M. MOLODECKI	MARCH 2010	1:1000	10KF006	DWG. 7 3+810 - 4+570
APPROVED	M. MOLODECKI				



REFERENCE:

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NOTE:

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LEGEND:

⊕ BOREHOLE

⊞ TEST HOLE

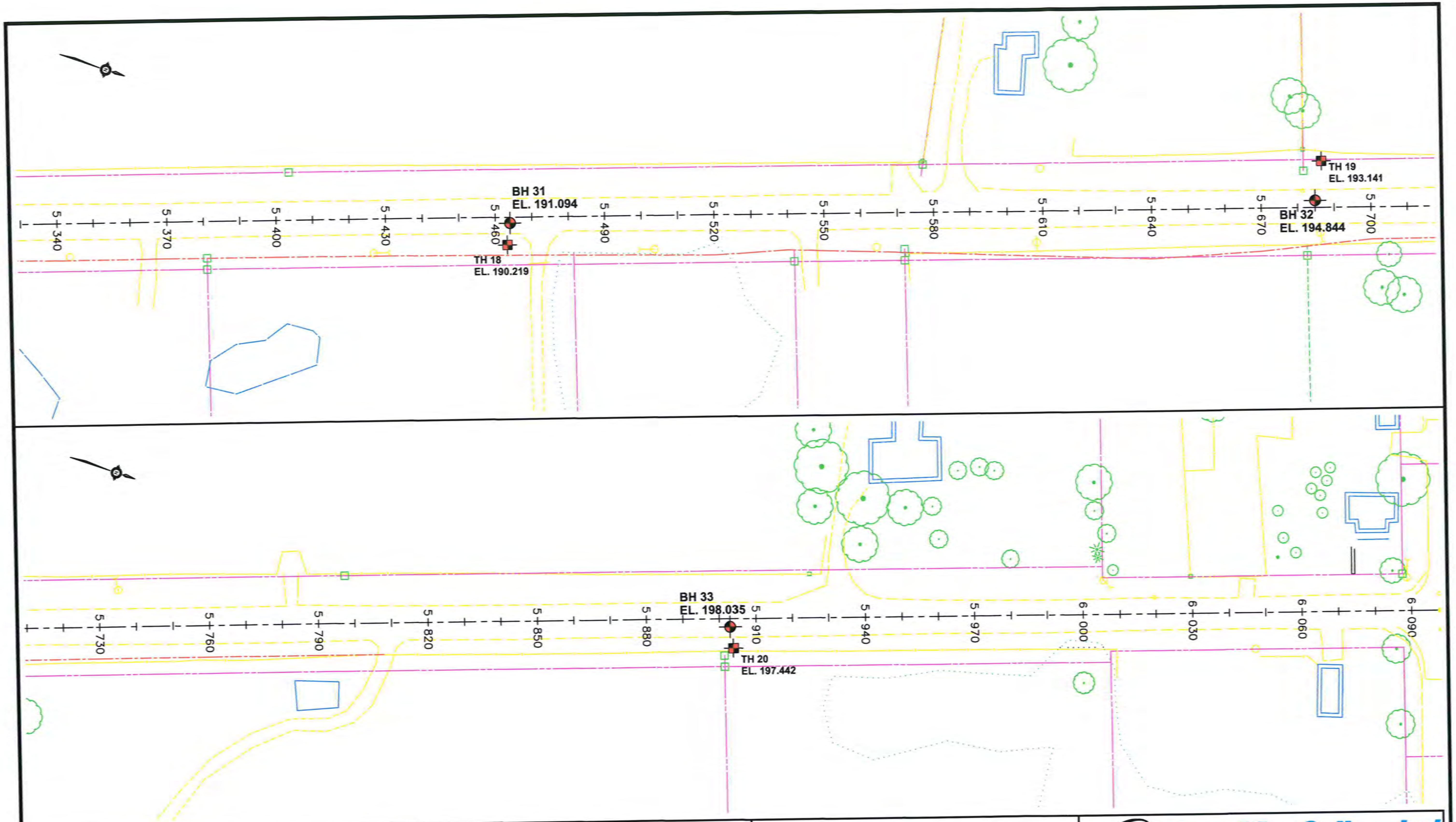
COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	DATE	SCALE	PML REF.	DWG. NO.
CHECKED	M. MOLODECKI	MARCH 2010	1:1000	10KF006	DWG. 8 4+570 - 5+330
APPROVED	M. MOLODECKI				



REFERENCE:

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NOTE:

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LEGEND:

- ● BOREHOLE
- ■ TEST HOLE

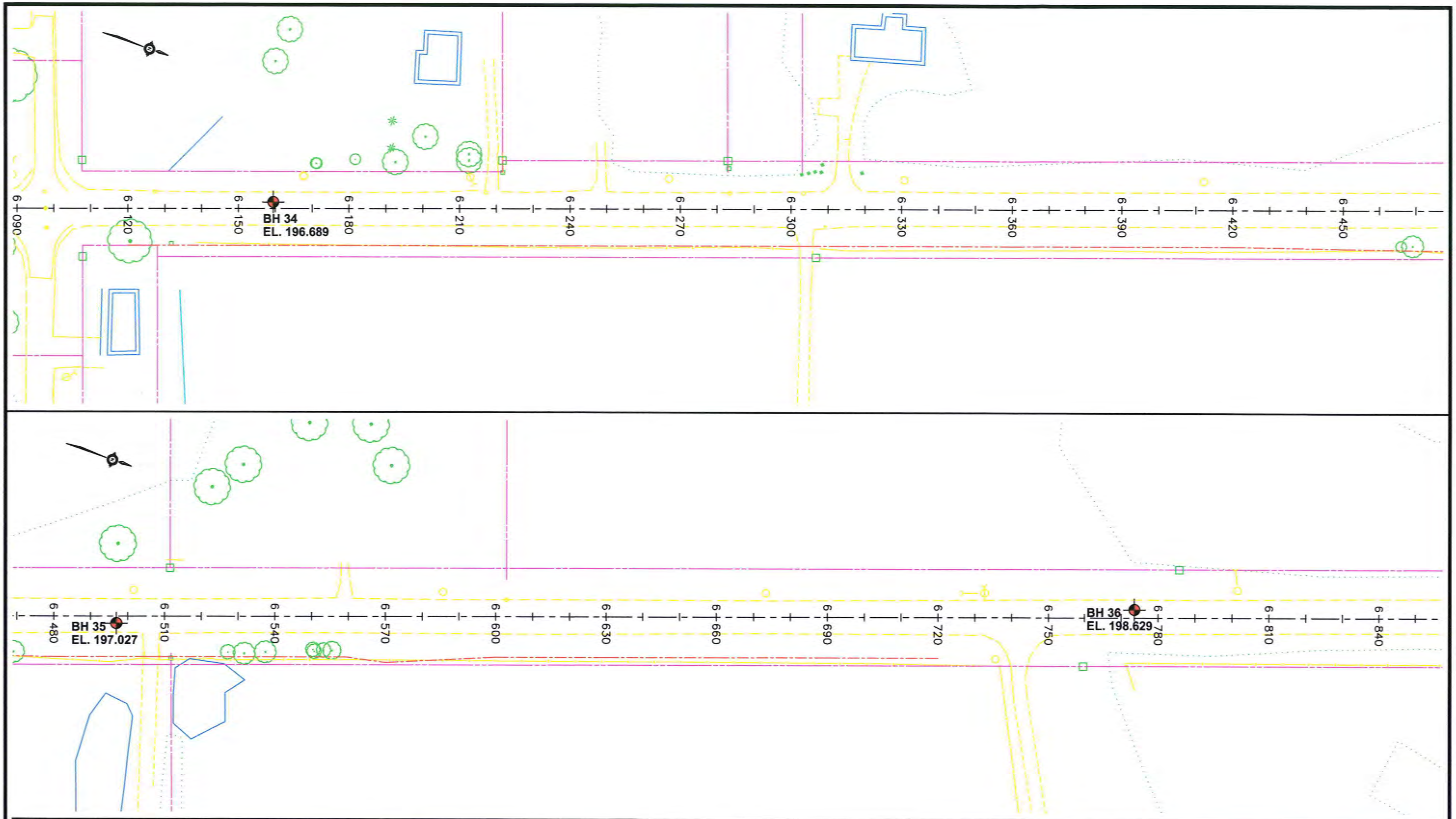
COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS

		DATE	SCALE	PML REF.	DWG. NO.
DRAWN	K. HANES	MARCH 2010	1:1000	10KF006	DWG. 9 5+330 - 6+100
CHECKED	M. MOLODECKI				
APPROVED	M. MOLODECKI				



REFERENCE:

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NOTE:

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LEGEND:

⊕	BOREHOLE
⊞	TEST HOLE

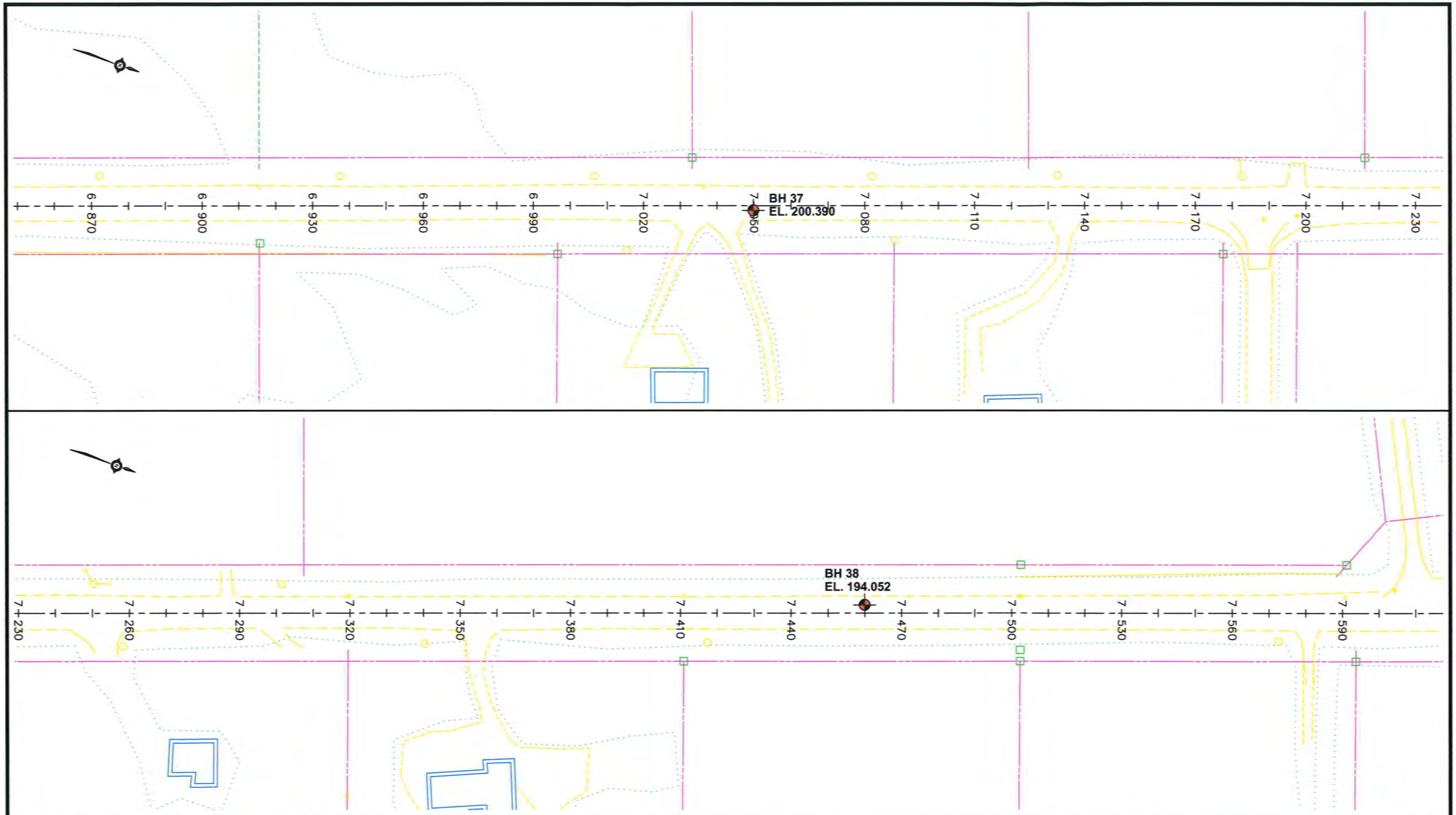
COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	**DATE**	**SCALE**	**PML REF.**	**DWG. NO.**
CHECKED	M. MOLODECKI	MARCH 2010	1:1000	10KF006	DWG. 10 6+100 - 6+850
APPROVED	M. MOLODECKI				



REFERENCE:

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LEGEND:

- ⊕ BOREHOLE
- ⊞ TEST HOLE

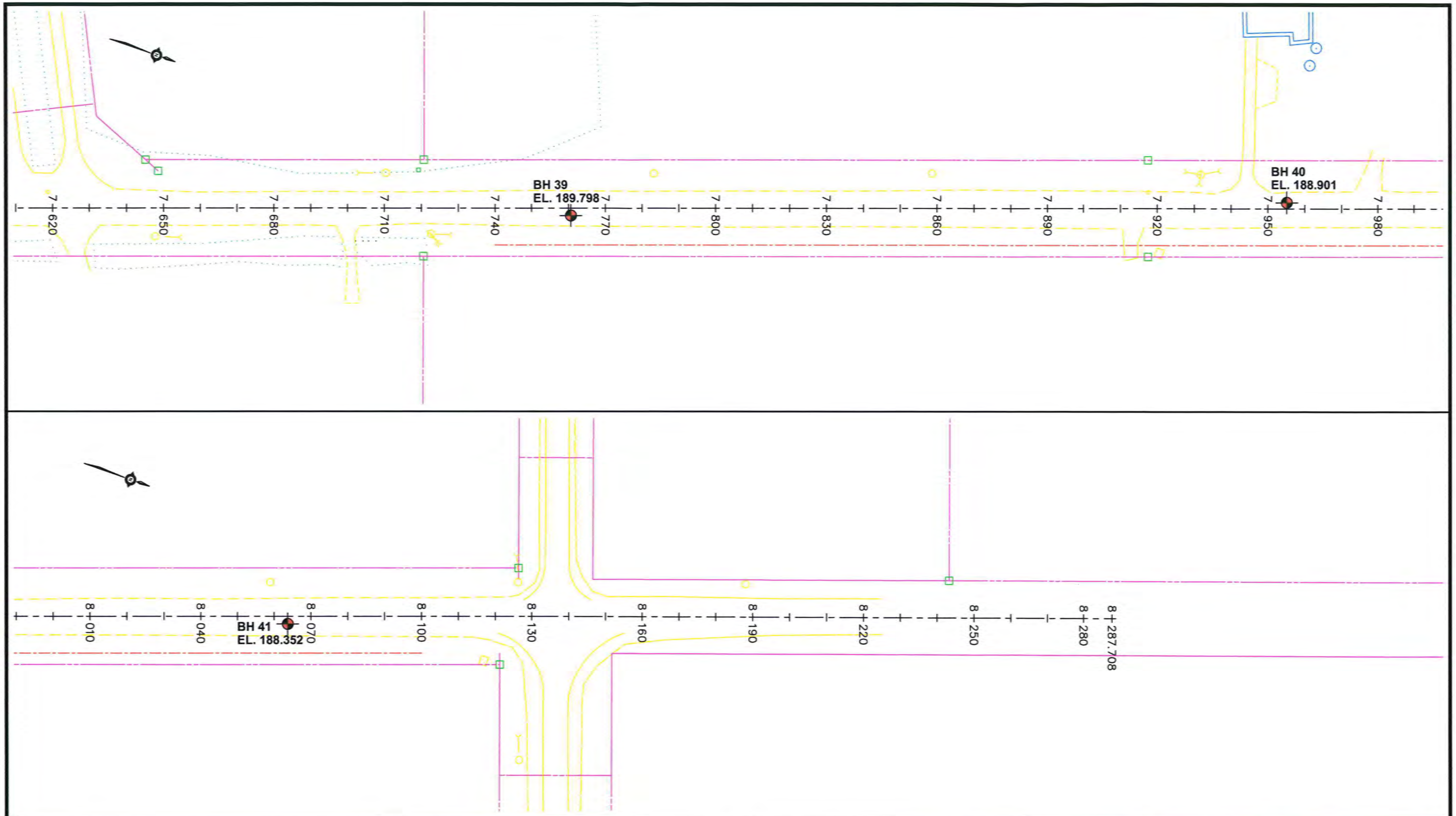
COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	**DATE**	**SCALE**	**PML REF.**	**DWG. NO.**
CHECKED	M. MOLODECKI	MARCH 2010	1:1000	10KF006	DWG. 11 6+850 - 7+610
APPROVED	M. MOLODECKI				



REFERENCE:

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NOTE:

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LEGEND:

⊕	BOREHOLE
■	TEST HOLE

COUNTY OF BRUCE

RECONSTRUCTION OF WEST ROAD
PIKE ROAD TO FERNDALE ROAD
COUNTY OF BRUCE, ONTARIO

TEST HOLE LOCATION PLAN

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	K. HANES	**DATE**	**SCALE**	**PML REF.**	**DWG. NO.**
CHECKED	M. MOLODECKI	MARCH 2010	1:1000	10KF006	DWG. 12 7+610 - 8+280
APPROVED	M. MOLODECKI				

APPENDIX A

ENGINEERED FILL

The information presented in this appendix is intended for general guidance only. Site specific conditions and prevailing weather may require modification of compaction standards, backfill type or procedures. Each site must be discussed, and procedures agreed with Peto MacCallum Ltd. prior to the start of the earthworks and must be subject to ongoing review during construction. This appendix is not intended to apply to embankments. Steeply sloping ravine residential lots require special consideration.

For fill to be classified as engineered fill suitable for supporting structural loads, a number of conditions must be satisfied, including but not necessarily limited to the following:

1. Purpose

The site specific purpose of the engineered fill must be recognized. In advance of construction, all parties should discuss the project and its requirements and agree on an appropriate set of standards and procedures.

2. Minimum Extent

The engineered fill envelope must extend beyond the footprint of the structure to be supported. The minimum extent of the envelope should be defined from a geotechnical perspective by:

- at founding level, extend a minimum 1.0 m beyond the outer edge of the foundations, greater if adequate layout has not yet been completed as noted below; and
- extend downward and outward at a slope no greater than 45° to meet the subgrade

All fill within the envelope established above must meet the requirements of engineered fill in order to support the structure safely. Other considerations such as survey control, or construction methods may require an envelope that is larger, as noted in the following sections.

Once the minimum envelope has been established, structures must not be moved or extended without consultation with Peto MacCallum Ltd. Similarly, Peto MacCallum Ltd. should be consulted prior to any excavation within the minimum envelope.

3. Survey Control

Accurate survey control is essential to the success of an engineered fill project. The boundaries of the engineered fill must be laid out by a surveyor in consultation with engineering staff from Peto MacCallum Ltd. Careful consideration of the maximum building envelope is required.

During construction it is necessary to have a qualified surveyor provide total station control on the three dimensional extent of filling.

4. Subsurface Preparation

Prior to placement of fill, the subgrade must be prepared to the satisfaction of Peto MacCallum Ltd. All deleterious material must be removed and in some cases, excavation of native mineral soils may be required.

Particular attention must be paid to wet subgrades and possible additional measures required to achieve sufficient compaction. Where fill is placed against a slope, benching may be necessary and natural drainage paths must not be blocked.

5. Suitable Fill Materials

All material to be used as fill must be approved by Peto MacCallum Ltd. Such approval will be influenced by many factors and must be site and project specific. External fill sources must be sampled, tested and approved prior to material being hauled to site.

6. Test Section

In advance of the start of construction of the engineered fill pad, the Contractor should conduct a test section. The compaction criterion will be assessed in consultation with Peto MacCallum Ltd. for the various fill material types using different lift thicknesses and number of passes for the compaction equipment proposed by the Contractor.

Additional test sections may be required throughout the course of the project to reflect changes in fill sources, natural moisture content of the material and weather conditions.

The Contractor should be particularly aware of changes in the moisture content of fill material. Site review by Peto MacCallum Ltd. is required to ensure the desired lift thickness is maintained and that each lift is systematically compacted, tested and approved before a subsequent lift is commenced.

7. Inspection and Testing

Uniform, thorough compaction is crucial to the performance of the engineered fill and the supported structure. Hence, all subgrade preparation, filling and compacting must be carried out under the full time inspection by Peto MacCallum Ltd.

All founding surfaces for all buildings and residential dwellings or any part thereof (including but not limited to footings and floor slabs) on structural fill or native soils must be inspected and approved by PML engineering personnel prior to placement of the base/subbase granular material and/or concrete. The purpose of the inspection is to ensure the subgrade soils are capable of supporting the building/house foundation and floor slab loads and to confirm the building/house envelope does not extend beyond the limits of any structural fill pads.

8. Protection of Fill

Fill is generally more susceptible to the effects of weather than natural soil. Fill placed and approved to the level at which structural support is required must be protected from excessive wetting, drying, erosion or freezing. Where adequate protection has not been provided, it may be necessary to provide deeper footings or to strip and recompact some of the fill.

9. Construction Delay Time Considerations

The integrity of the fill pad can deteriorate due to the harsh effects of our Canadian weather. Hence, particular care must be taken if the fill pad is constructed over a long time period.

It is necessary therefore, that all fill sources are tested to ensure the material compactability prior to the soil arriving at site. When there has been a lengthy delay between construction periods of the fill pad, it is necessary to conduct subgrade proof rolling, test pits or boreholes to verify the adequacy of the exposed subgrade to accept new fill material.

When the fill pad will be constructed over a lengthy period of time, a field survey should be completed at the end of each construction season to verify the areal extent and the level at which the compacted fill has been brought up to, tested and approved.

In the following spring, subexcavation may be necessary if the fill pad has been softened attributable to ponded surface water or freeze/thaw cycles.

A new survey is required at the beginning of the next construction season to verify that random dumping and/or spreading of fill has not been carried out at the site.

10. Approved Fill Pad Surveillance

It should be appreciated that once the fill pad has been brought to final grade and documented by field survey, there must be ongoing surveillance to ensure that the integrity of the fill pad is not threatened.

Grading operations adjacent to fill pads can often take place several months or years after completion of the fill pad.

It is imperative that all site management and supervision staff, the staff of Contractors and earthwork operators be fully aware of the boundaries of all approved engineered fill pads.

Excavation into an approved engineered fill pad should never be contemplated without the full knowledge, approval and documentation by the geotechnical consultant.

If the fill pad is knowingly built several years in advance of ultimate construction, the areal limits of the fill pad should be substantially overbuilt laterally to allow for changes in possible structure location and elevation and other earthwork operations and competing interests on the site. The overbuilt distance required is project and/or site specified.

Iron bars should be placed at the corner/intermediate points of the fill pad as a permanent record of the approved limits of the work for record keeping purposes.

11. Unusual Working Conditions

Construction of fill pads may at times take place at night and/or during periods of freezing weather conditions because of the requirements of the project schedule. It should be appreciated therefore, that both situations present more difficult working conditions. The Owner, Contractor, Design Consultant and Geotechnical Engineer must be willing to work together to revise site construction procedures, enhance field testing and surveillance, and incorporate design modifications as necessary to suit site conditions.

When working at night there must be sufficient artificial light to properly illuminate the fill pad and borrow areas.

Placement of material to form an engineered fill pad during winter and freezing temperatures has its own special conditions that must be addressed. It is imperative that each day prior to placement of new fill, the exposed subgrade must be inspected and any overnight snow or frozen material removed. Particular attention should be given to the borrow source inspection to ensure only nonfrozen fill is brought to the site.

The Contractor must continually assess the work program and have the necessary spreading and compacting equipment to ensure that densification of the fill material takes place in a minimum amount of time. Changes may be required to the spreading methods, lift thickness, and compaction techniques to ensure the desired compaction is achieved uniformly throughout each fill lift.

The Contractor should adequately protect the subgrade at the end of each shift to minimize frost penetration overnight. Since water cannot be added to the fill material to facilitate compaction, it is imperative that densification of the fill be achieved by additional compaction effort and an appropriate reduced lift thickness. Once the fill pad has been completed, it must be properly protected from freezing temperatures and ponding of water during the spring thaw period.

If the pad is unusually thick or if the fill thickness varies dramatically across the width or length of the fill pad, Peto MacCallum Ltd. should be consulted for additional recommendations. In this case, alternative special provisions may be recommended, such as providing a surcharge preload for a limited time or increase the degree of compaction of the fill.