GEOTECHNICAL INVESTIGATION
PROPOSED CANADIAN TIRE STORE UPGRADE
1655 - 18th STREET
BRANDON, MANITOBA

SUBMITTED TO:

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AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

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1.0 INTRODUCTION

1.1 TERMS OF REFERENCE

This report summarizes the results of a geotechnical investigation undertaken by AGRA Earth & Environmental Limited (AEE) for a proposed redevelopment of the existing Canadian Tire property in Brandon, Manitoba. The geotechnical investigation completed by AEE was to evaluate a number of options for site re-development, including possible additions to the existing store as well as a number of options for new buildings at various locations throughout the site.

The primary purpose of AEE's investigation was to determine the subsurface soil and groundwater conditions at the proposed building locations, and based on the conditions encountered, provide geotechnical recommendations for the design and construction of foundations, floor slabs and asphalt pavements. The above work was to be undertaken in accordance with AEE's proposal (WPG98299), as well as various follow up faxes and addendums. As well, the investigation was to follow the Canadian Tire investigation protocol which was forwarded to AEE with the request for proposal.

In conjunction with the geotechnical investigation, AEE also completed an environmental assessment of the site, focusing on the subsurface conditions within the footprints of the various building options. The results of the environmental assessment are presented under separate cover. While this geotechnical report references the general environmental conditions at the site, as they may impact design and construction, specific details on levels or extent of hydrocarbon contamination are not provided.

1.2 DESCRIPTION OF PROPOSED DEVELOPMENT

Based on the information supplied by Mr. Tat-Liang Cheam of Nejmark Architect, the following building options are presently being considered:

Options 1A and B: These options include renovations and additions to the existing store. The proposed additions vary in size from about 1000 m^2 to 2000 m^2. Option 1A consists of an addition primarily to the north and west of the existing store, with Option 1B extending west and south (See Figure 2).

Option 2: Option 2 consists of a new store located southeast of the current building location, adjacent the eastern edge of the existing parking lot (See Figure 3).

Options 3A, B & C: Options 3A, 3B and 3C include a new store located in the southwest corner of the Canadian Tire property, south of the current asphalt paved parking area. Options 3A and 3B have a similar size and location,

however the Option 3C footprint is located about 50 m to the east of 3A and 3B (See Figures 4 and 5).

Options 4 and 4A: Options 4 and 4A are similar in extent and include a new store located at the southeast end of the Canadian Tire property, within an area which is located well away from the current site development (See Figure 6).

For each of the new building options (i.e Options 2, 3 and 4), the proposed store is to consist of a structure approximately 7000 m^2 in area; primarily single storey with a small two storey office section. The main structure includes retail and warehouse space and an automotive center. In addition to the main building, each of the store options includes an approximate 1000 m^2 garden center.

2.0 SITE DESCRIPTION

The site is an approximately 6.8 hectare parcel of land located on the east side of 18th Street, south of Richmond Avenue in Brandon, Manitoba. At the time of AEE's investigation, the northwest portion of the site consisted of a retail store (approximately 4600 m^2), a gas bar and an asphalt paved parking lot (surrounding the store and gas bar and extending south of the store approximately 75 m). An undeveloped field (vegetated with prairie grass) occupies the southwest corner of the property, extending south from the parking lot to the south property line. The east half of the site was partly vegetated with deciduous trees, mainly around the east and west perimeters, with bullrushes within a low lying marshy area at the southeast corner of the site. Barren sandy soil exists throughout the remainder of the undeveloped area.

The site was bounded by industrial and commercial buildings to the north and east, a cemetery to the south, and a commercial mall to the west, across 18th Street.

3.0 FIELD AND LABORATORY INVESTIGATION

3.1 TEST HOLE DRILLING/SOIL SAMPLING

A total of twenty eight (29) test holes (TH1 to TH28 plus TH8A) were drilled at the site between September 28 and October 2, 1998. The test hole locations are shown on the attached site plan, Figure 1. As well, each building Option, and the test holes contained within that Option, are shown on Figures 2 to 6. The test holes were drilled by Paddock Drilling Limited of Brandon, Manitoba, using both a truck mounted CT250 drill rig and a track mounted RM30 drill rig. Both rigs were fitted with a combination of 150 mm diameter solid stem augers and 200 mm diameter hollow stem augers. Drilling was undertaken under the full time supervision of AEE's Field Engineer.

Of the 29 test holes drilled at the site, 21 were completed to an approximate depth of 4.6 m from grade using solid stem augers. The remaining eight test holes, two within each of the 4 primary building options, were drilled to depths ranging from 8.4 to 14.2 m from grade; generally using solid stem augers to about 5 m from grade and hollow stem augers thereafter. The test holes were drilled (in respect to each building option footprint) as follows:

- Building Option 1A/1B (TH1 to TH6): 6 test holes were drilled around the existing building (within the footprints of the proposed building expansion options); 4 test holes were advanced to 4.6 m and 2 test holes (east and west sides of existing building) were advanced to 11.1 m (Refer to Figure 2);

- Building Option 2 (TH7 to TH12 plus TH8A): 7 test holes were drilled within the footprint of the proposed building; 5 test holes were advanced to 4.6 m, 1 test hole (southwest corner) was advanced to 14.2 m and 1 test hole (northeast corner) was advanced to 11.1 m (Refer to Figure 3);

- Building Option 3A, 3B and 3C (TH13 to TH18): 6 test holes were drilled within the footprint of the proposed building; 4 test holes were advanced to 4.6 m, 1 test hole (northwest corner) was advanced to 14.2 m and 1 test hole (southeast corner) was advanced to 11.1 m (refer to Figures 4 and 5);

- Building Option 4 (TH23 to TH28): 6 test holes were drilled within the footprint of the proposed building; 4 test holes were advanced to 4.6 m, 1 test hole (northeast corner) was advanced to 8.4 m and 1 test hole (southwest corner) was advanced to 11.1 m (Refer to Figure 6).

TH19 to TH22 were drilled to 4.6 m from grade as part of the environmental assessment of the existing gas bar and are not referenced within this report, although the test hole logs are included for informational purposes.

Disturbed soil samples, from the auger cuttings and from a split spoon sampler, were obtained at regular intervals in each of the 29 test holes. In addition, relatively undisturbed Shelby tube samples were obtained at select depths in the eight deep test holes. The relative density and shear strength of the subsoils were determined in the field using a pocket penetrometer and by conducting standard penetration tests (SPT's). The field test results are included on the test hole logs, with the SPT results denoted by the SPT "N" number. Continuous logs of subsurface conditions, as encountered at the time of drilling, were recorded by AEE's Field Engineer and are shown on the test hole logs in Appendix A.

After completion of drilling, all test holes were visually examined for indications of sloughing and seepage conditions within the test hole, after which the test holes were backfilled to grade with auger cuttings and bentonite. At 11 locations (TH4, TH8A, TH9, TH14, TH16, TH17, TH19, TH22, TH23, TH26 and TH27), the test holes were completed with 50 mm diameter

PVC monitoring wells. The construction details of the monitoring wells are shown on the respective test hole logs.

During the week following the field investigation, the water levels within each of the monitoring wells were measured and are shown on the appropriate test hole logs.

3.2 LABORATORY TESTING

On return to AEE's Winnipeg laboratory, all of the soil samples were examined to supplement and confirm the field classifications. In addition, the following laboratory test program was conducted:

- Moisture contents were determined for all the soil samples recovered from TH1, TH3, TH6, TH8/8A, TH11, TH13, TH14, TH15, TH18, TH24, TH26, TH27 and TH28.
- Unconfined compressive strengths were determined on selected Shelby Tube samples from TH6, TH8, TH11, TH18, TH24 and TH28.
- Atterberg Limits (Liquid and plastic) were determined for samples from TH12, TH13 and TH24 to determine plasticity characteristics of the typical subsoils encountered.
- A hydrometer analysis was conducted on a sample of silt from TH13.

The laboratory results are included on the Test Hole Logs in Appendix A, except for the hydrometer result, which is shown as Figure A29.

4.0 DESCRIPTION OF THE SOIL PROFILE

Although highly variable in the upper 4 to 6 m, the soil profile at the test hole locations generally consisted of the following, as noted in descending order from the ground surface:

- Asphalt, Fill Materials or Organic Soils
- Variable low plastic silts and clays and/or silty sand
- Low to medium plastic silty clay
- Medium Plastic clay till, with interbedded deposits of sand and gravel

A perched groundwater zone was typically present between 1 and 2.5 m of grade, although at some locations seepage did not occur immediately on completion of drilling. Groundwater was also present within the clay till, generally occurring within interbedded sand or gravel layers.

The following subsections provide additional detail on the soil and groundwater conditions within each of the 4 primary building option locations.

4.1 OPTIONS 1A AND 1B

The soil profile within the areas of possible addition to the existing building (Options 1A/1B) generally consisted of about 100 mm of asphalt followed by 1 to 1.5 m of gravel and/or clay fill. At one test hole location (TH2), clay fill extended to 2.5 m from grade and contained a suspected concrete slab at 1.5 m from grade.

Underlying the gravel fill were layers of low to medium plastic, silty clay or a fine grained silty sand. Where sand was present, it typically occurred within the upper 2 m. A medium plastic clay was encountered below the upper variable zone and extended to the underlying clay till at depths ranging from 3 to 4.5 m from grade. The clay was generally brown to grey, firm to stiff and moist to very moist. The clay till was brown to grey, sandy, gravelly, stiff to very stiff, moist and medium plastic. The clay till extended to the test hole termination depth, except at TH2 where till was not encountered within the test hole (to 4.6 m from grade). With depth, layers of sand were encountered within the till; a number of thick layers of sand were present in TH6 and numerous thin sand layers (0.1 to 0.2 m) were present in TH3.

The measured water level within the monitoring well at TH4 was 1.2 m below grade.

4.2 OPTION 2

Within the building footprint of Option 2, surficial soils generally consisted of a layer of sandy, silty topsoil followed by clay fill which extended to a maximum depth of about 2 m from grade. Asphalt was encountered at the ground surface at TH7 and TH9, which are located within the existing parking area at the west end of Option 2.

Underlying the fill materials, a layer of sand or sandy silt was typically encountered, and extended to depths varying from 2.1 to 4.0 m from grade. The sand and sandy silt was brown to grey, poorly graded, fine grained and very moist to wet with depth. Underlying the sand and silt was a low to medium plastic, firm to stiff silty clay. Exceptions to the general profile were found at TH7 and TH8, located towards the north end of the Option 2 building area, where sand was not encountered and the low to medium plastic clay was present between the fill materials and the underlying clay till. Clay till underlies the clay at each test hole (except TH9, where it was not encountered to 4.6 m from grade), at depths of 3.0 to 6.5 m below grade and extends to the depths explored. The clay till was brown to grey, sandy, gravelly, stiff to very stiff, moist and medium plastic.

An elevated water table was encountered throughout this area of the site, typically rising towards the north. The measured water levels in the monitoring wells were 1.3 m from grade at TH8 and 1.1 m from grade at TH9.

4.3 OPTIONS 3A, 3B and 3C

Within Options 3A, 3B and 3C, up to 1 m of topsoil and fill materials were encountered at the ground surface, with an asphalt pavement section present at the ground surface in TH16. The upper 4 to 5 m of the soil profile generally consisted of low plastic silts and clays and fine grained sands. The upper soils were generally firm (for silts and clays) or loose to medium dense (for sand), moist to very moist and becoming softer and saturated below about 2 to 3 m from grade. The clay till was located at greater depths than at other areas of the Canadian Tire property, and was encountered in only 3 of the 6 test holes. At the remaining three locations, till was not encountered to the test hole termination depth of 4.6 m. Where present, the till was firm to stiff, moist, sandy and gravelly; becoming stiff to very stiff with depth. Although sand layers within the till were not specifically identified (due to the use of hollow stem augers), there were indications of water bearing sand or gravel layers, based on seepage conditions noted in the test hole after removal of the augers.

Measured water levels within the monitoring wells were 2.1 m from grade at TH14, 1.0 m from grade at TH16 and 2.7 m from grade at TH17.

For Option 3C, the building footprint extends to include the area covered by TH10, TH11 and TH12. The soil profile at these locations was similar to TH13 to TH18, although sand was more prevalent in the upper zone.

4.4 OPTION 4

Within the area of Option 4 (TH23 to TH28), the upper soils were generally wet and soft, with an elevated water table, as evident by the marshy low lying area located within the southeast corner of this Option. Below a layer of topsoil and fill materials, the upper soils were highly variable, consisting of silt at TH23, TH24, TH27 and TH28, sand at TH25, and gravel at TH26. The water level within this upper zone varied from 0.3 to 1.0 m from grade, with those test holes located nearer the marsh having a higher water level.

Clay till was present at relatively shallow depths in all of the six test holes, ranging from 1.8 to 4.5 m from grade. The till was stiff to very stiff, grey and moist. At TH24, a thick layer of gravel was encountered within the till, beginning at 6.1 m from grade. When the gravel layer was penetrated, heavy seepage occurred, with the water level instantly rising to 2.8 m below grade. The gravel layer extended to the base of the test hole (8.4 m), at which depth auger refusal occurred on a suspected boulder.

The measured water levels within the monitoring wells were 2.5 m from grade at TH23 (located at the furthest point from the marsh), 1.5 m from grade at TH26 and 0.6 m from grade at TH27). It should be appreciated that much higher water levels are likely within the spring and early summer, when the marsh is at its greatest extent and a water table near ground surface is likely.

5.0 DISCUSSION AND RECOMMENDATIONS

As noted previously, specific details on the environmental investigation are not provided in this report, and only general references to the general environmental status of the site are made. As such, both reports should be cross-referenced when assessing the various building options.

5.1 FOUNDATIONS - GENERAL

A number of foundation options have been considered for the site, with a general discussion on the suitability of each discussed below:

Thickened Edge Slab

A thickened edge slab foundation was utilized for the existing store and has apparently performed satisfactorily to date. Also, an addition to the original building was constructed in 1988, and there does not appear to have been substantial differential movements between the original structure and the addition. On this basis, a thickened edge slab appears to be a suitable alternative and in fact, is the preferred option for any additions which may be made to the existing store. It should be noted, however, that for Options 2 and 4, a thickened edge slab may be subject to numerous construction difficulties associated with the elevated water table and for this reason, is not the preferred option.

In addition to being technically feasible from a geotechnical perspective, a thickened slab foundation is likely the preferred option from an environmental standpoint, as it limits penetration into the contaminated zone and the potential for hydrocarbon vapours entering the store is reduced.

As the property is typically covered with a 1 to 1.5 m thick layer of fill and organic soils, substantial cut and fill will be required and this expense must be factored into the decision process. Also, at some locations, a portion of the fill which must be removed may be contaminated and disposal costs for the soil must be factored into the project costs.

Cast-in-Place Concrete Piles

Cast-in-place concrete, mechanically cleaned belled piles are feasible for each of the four potential building options. Mechanically cleaned belled piles, based in stiff to very stiff clay till at depths of 5 to 6 m from grade are expected to provide a suitable foundation system and a high level of long term performance. Casings will be required in most, if not all pile holes, to seal off seepage and sloughing zones. Although straight shaft friction piles could also be considered, they are not a recommended alternative because of the anticipated seepage and boulder conditions which are generally more prevalent with depth in the Brandon area.

Complications may arise during installation of the piles at some locations, as a result of the likely presence of wet sand and gravel layers in the till. Where saturated zones are encountered, piles will need to be extended deeper, with tight steel casings used. The potential for significant construction difficulties appears greatest at Option 4, in particular near TH24 where a thick, saturated gravel layer was encountered.

Belled piles could also be used for any additions to the existing store, although there is a potential for some slight differential movements between existing and new foundations.

It should be appreciated that any deep foundation system at this site could potentially create a preferential pathway for downward migration of dissolved and free phase hydrocarbon contaminants, and this potential should be reviewed in detail if a piled foundation is chosen as the preferred option.

Driven Precast Concrete Piles

Driven precast concrete piles have been successfully used in the Brandon area and could be utilized at this location with an anticipated high level of performance. Driven piles are suitable at each of the new building options and in fact, are the recommended alternative for Option 4. Pile installation would be expected to proceed without difficulty, however, a significant variation in refusal depths may occur across the site, and even within the respective building options.

Driven piles are not the preferred option for expansion of the existing building, as damage to existing foundations could occur during driving.

As with cast-in-place piles, the potential for downward hydrocarbon migration exists, although the potential would be considered slightly lower with a driven piled system, as opposed to a drilled pile system.

Spread Footings

Spread footings are not recommended for any of the four building options, due to the high variability in the strength and composition of the shallow soils, as well as the high water table, which would pose significant construction difficulties.

Detailed recommendations, where applicable for each of the above options, are provided in the subsequent sections of this report.

5.1.1 Building Option 1

5.1.1.1 Thickened Slab Foundation

As noted previously, a thickened edge slab is the preferred option where an expansion to the existing building is proposed. In this regard, a similar design to that originally proposed is suggested, as long term performance has proven to be successful. An allowable bearing pressure of 100 kPa may be utilized for design purposes, provided that the following recommendations are followed:

1. Excavation for the slab should be conducted to design elevation using a backhoe equipped with a smooth bucket and operating from the edge of the excavation. Excavation should be advanced to a minimum of 1 m below underside of slab, while further ensuring that all organic soils and fill materials are removed. Based on AEE's test holes, the average excavation depth is expected to be about 1 to 1.5 m below grade, with localized deeper areas expected. The excavation should extend at least 1.2 m beyond the building footprint at all locations.

2. During and subsequent to excavation, the bearing surface should not be disturbed or subject to frost, inundation or heavy equipment.

3. Once the bearing surface has been suitably prepared, it should be inspected by a geotechnical engineer to verify the suitability of the proposed bearing soils, to confirm that the soils are uniform and that the subsoils encountered are consistent with this report.

4. Any areas deemed unsuitable should be sub-excavated and replaced with suitable fill materials as directed by the Engineer.

5. Depending on whether any remedial work is completed prior to construction, the use of a hydrocarbon resistant liner may be required, and if so, should be installed at this point.

6. Fill soils should consist of a well graded granular subbase (maximum particle size of 75 mm), topped with 300 mm of granular base course. Specifications for these materials are attached. The subbase and base should be placed in maximum 150 mm thick lifts and should be compacted to a minimum of 98% and 100% of standard Proctor maximum dry density, respectively. The initial layer of fill should be placed to a maximum 300 mm thickness.

7. A seasonal water table may be present within the excavated depths, in particular where deeper excavations are required. In the event that groundwater seepage is encountered during construction, the water should be collected in sumps located outside of the building footprint.

Careful attention should be made to the areas where the addition(s) connects to the existing foundation. In this regard, care must be taken to ensure that the existing foundations are not undermined. For an area located within 1.2 m of any existing foundations (control zone), the excavation should not extend below the base of the existing slab foundation, which is expected to be located at about 0.6 m below grade. In addition, these areas should be backfilled immediately to prevent possible undermining due to erosion. Beyond the 1.2 m control zone surrounding the existing building, the excavation should be sloped at 1:1 down to the main excavation depth. Where a deep excavation is required adjacent to the existing building, the 1.2 m control zone should be expanded to a distance equal to the excavation depth. Where excavations deeper than 1.5 m are required, (i.e. depressed loading dock), shoring may be required and this office should review the drawings as part of the final design phase.

5.1.1.2 Belled Piles

Mechanically cleaned belled piles are also considered to be a feasible alternative for Options 1A and 1B. In particular, piles may be preferred where a winter construction schedule is required or where heavy concentrated loads must be supported. These piles should be based in the stiff clay till which is located at a depth varying between 3.5 and 7 m from grade. Where piles are based in stiff till, at a minimum depth of 5 m below grade, an allowable bearing pressure of 175 kPa may be utilized for design. The following additional recommendations are provided:

- The belling operation should be initiated once stiff to very stiff clay till has been identified, however, at a depth of no less than 5 m below grade. Caution should be exercised such that the pile shaft is not advanced too deep, as cobbles and boulders are more frequent and may make the belling operation difficult. As well, water bearing zones are more likely. All piles should be drilled and poured within as short a time as is practical to limit softening of the bearing soils as a result of seepage.

- Unless otherwise approved by this office, pile spacing should be a minimum of 2.5 bell diameters, measured center to center.

- The weight of the embedded portion of the pile may be neglected in design and the piles should be adequately reinforced and be of adequate structural design.

- The bell diameter should not exceed 3 times the shaft diameter.

- Pile installation should be monitored on a full time basis by qualified geotechnical personnel, to determine that the belling operation is undertaken at a suitable depth and in accordance with the recommendations presented.

- Contractors should allow for the possibility of encountering cobbles and boulders within the pile hole and should have proper equipment on site to remove such obstructions.

- Where water bearing sand or gravel layers are encountered, the pile hole must be advanced to a depth of at least 1 bell diameter beyond the water bearing layer, or further as required to seal off seepage.

5.1.2 Building Option 2

5.1.2.1 Thickened Slab Foundation

Construction of a thickened slab foundation for Option 2 could be difficult, due to the presence of an elevated water table within much of the building footprint. This would be particularly true where a spring construction schedule is proposed. In this regard, more specialized construction procedures will likely be required, such as the use of a geotextile. As an additional item, the soils at Option 2 are more variable than near the existing store and long term performance may be poor, with differential movements likely.

Where the construction and performance limitations noted above are acceptable, a thickened slab may be considered. In this regard, the recommendations outlined below should be used in conjunction with those previously provided in Section 5.1.1.1.

1. Where possible, the main floor slab elevation should be maintained at or above existing grades, thus reducing the potential for groundwater concerns.

2. Fill and organic materials should be removed as noted in 5.1.1.1. The excavation depths are expected to be up to 1.5 m within the north end of the building and in the order of 1 m or less in the south half of the building. As a minimum, excavation should be to at least 1 m below underside of slab elevation.

3. At many locations, the base of the excavation is expected to include wet, weak soil (in particular within the northern half of the building footprint). In order to allow for compaction of the granular fill materials, the use of a woven geotextile is recommended (Amoco 2016 or approved equivalent). A hydrocarbon resistant liner may also be required at this point.

4. Fill soils should be placed and compacted as outlined in Section 5.1.1.1, with the exception being that the initial layer of gravel should be 400 mm thick and should be compacted to only 95% of standard Proctor maximum dry density, to limit the potential for disturbance of the underlying weak soils.

5.1.2.2 Belled Piles

Belled piles are also suitable for Option 2 and the recommendations provided in Section 5.1.1.2 are suitable.

5.1.2.3 Driven Precast Concrete Piles

Driven precast concrete piles driven into the very stiff clay till are considered to be a feasible option at this site, although the actual refusal depth for driven piles is difficult to accurately predict and may vary substantially across the site. As a result, where driven piles are the preferred foundation option, driving a number of test piles is recommended at the project onset, to determine the pile refusal depths and to verify the achievable pile capacities. Driven piles would be expected to develop capacities through a combination of frictional resistance and end bearing.

Precast concrete piles, when driven to practical refusal using a hammer with a minimum driving energy of 30,000 ft-lbs per blow, may be assigned the capacities provided in Table 1.

TABLE 1
ALLOWABLE PILE CAPACITIES
DRIVEN PRECAST CONCRETE PILES

Size (inches)	Allowable Capacity (kN)	Final Refusal (blows/25 mm)
12	360	5
14	500	8
16	630	12

Any piles which are damaged or excessively out of plumb due to boulders in the till may need to be replaced, pending a review of their load carrying capacity and expected settlement.

The following additional recommendations are provided for the design and installation of precast concrete piles.

1. The above allowable capacities pertain to soil resistance only. The pile cross sections must be designed to withstand the design loads and the driving forces during installation.

2. Pile spacing should not be less than 2.5 pile diameters, measured center to center. All piles driven within 5 pile diameters should be monitored for heave and where heave is observed, piles should be re-driven. Piles which are re-driven should be driven to the refusal criteria outlined above (i.e. re-drive piles for 1 full set).

3. Preboring to a maximum of 4 m from grade is recommended at all pile locations, to enhance pile plumbness and alignment, and to reduce the effects of pile heave during driving of adjacent piles.

4. All piles must be driven at least 3 m beyond the prebore depth.

5. If drop hammers are used, the hammer used should have a minimum mass equivalent to three times the mass of the pile.

6. All piles should be driven continuously to their required design lengths, once driving is initiated.

7. The driving of all piles should be documented and approved by competent and knowledgeable geotechnical personnel. The capacities shown in Table 1 should be confirmed and reported after driving.

8. Allowances should be made for the selective retapping of piles to allow confirmation of pile capacity, particularly in groups, or as the need arises. The contractor should be advised that a minimum setup time of 1 day or more, after initial driving, may be requested.

9. A void space (minimum of 100 mm deep) should be constructed below all pile caps and grade beams.

The design capacity of a pile group (up to 4 piles) can be taken as the number of piles in the group multiplied by the allowable capacity per pile.

5.1.3 Building Option 3

5.1.3.1 Thickened Slab Foundation

A thickened slab foundation, as outlined in Section 5.1.1.1 is considered appropriate for Options 3A, 3B and 3C. Soil conditions for Option 3 are expected to consist of low plastic silts and sands, with minimal fill thicknesses (except for north portion of building). The following design and construction recommendations are presented:

1. Excavation for the slab should be conducted to design elevation using a backhoe equipped with a smooth bucket and operating from the edge of the excavation. Excavation should be advanced to a minimum of 0.75 m below underside of slab, while further ensuring that all organic soils and fill materials are removed.

2. During and subsequent to excavation, the bearing surface should not be disturbed or subject to frost, inundation or heavy equipment.

3. Once the bearing surface has been suitably prepared, it should be inspected by a geotechnical engineer to verify the suitability of the proposed bearing soils, to confirm that the soils are uniform and that the subsoils encountered are consistent with this report.

4. Any areas deemed unsuitable should be sub-excavated and replaced with suitable fill materials as directed by the Engineer.

5. Fill soils should consist of 450 mm of well graded granular subbase (maximum particle diameter of 75 mm), topped with 300 mm of granular base course. The subbase and base should be placed in maximum 150 mm thick lifts and should be compacted to a minimum of 98% and 100% of standard Proctor maximum dry density, respectively. Additional soils required to achieve grades should consist of additional granular subbase, compacted as noted above.

6. A seasonal water table may be present within the excavated depths. In the event that groundwater seepage is encountered during construction, the water should be collected in sumps located outside of the building footprint.

Based on the above, an allowable bearing pressure of 100 kPa may be utilized for design purposes.

5.1.3.2 Belled Piles

Belled piles are also considered to be a feasible alternative for Options 3A, 3B and 3C, although pile lengths will likely need to be somewhat greater than at Options 1 or 2, due to the depth to till. While pile lengths need not be based deeper than 5 m for design purposes, the depth to stiff till is greater at some locations and it is expected that pile lengths in the order of 6 to 7 m from grade will be required at most locations. Apart from the depth requirement, piles may be designed as outlined in Section 5.1.1.2.

As till was encountered in only 3 of the 6 test holes, additional test holes are recommended where this option is preferred, to verify the till depth and quality across the building footprint.

5.1.3.3 Driven Precast Concrete Piles

Driven precast concrete piles are suitable for Option 3 and may be designed as outlined in Section 5.1.2.3.

5.1.4 Building Option 4

In AEE's opinion, Option 4 is the least desirable location from a geotechnical standpoint, due to the following factors:

- Highly variable near surface soil conditions
- An elevated water table and associated drainage/grade problems
- the presence of a low lying marsh within the southeast 20% of the building.
- Apparently large groundwater pressures within the till

In particular, the presence of the marsh and associated high water levels, could pose substantial construction difficulties and long term performance of the building could be compromised.

However, if chosen as the preferred option, construction is possible and driven precast concrete piles are the suggested foundation alternative. These piles may be designed in accordance with the recommendations outlined in Section 5.1.2.3. Where this building locations is chosen, additional investigation within the marsh area is recommended; this work would have to be completed in the winter months using specialized drilling equipment.

5.2 FLOOR SLABS

Lightly loaded, grade supported floor main floor slabs are generally suitable at the site and would be expected to provide a satisfactory level of long term performance. An exception would be within the low lying marsh area (Option 4), where considerable construction difficulties and poor long term performance could be expected.

Due to the fill and organic thickness, substantial cut and fill will be required at most locations. Main floor slabs can be constructed in accordance with the recommendations for the thickened edge slabs, with the following exceptions.

- Except where dictated by fill thickness or organic soils, excavation within floor slabs need not extend more than 450 mm below underside of slab elevation.

- Fill should consist of a minimum of 150 mm of granular subbase topped with 150 mm of base course. Subbase and base should be compacted to 95 and 100% of standard Proctor maximum dry density, respectively.

- Additional fill materials, where required, should consist of additional granular subbase, placed in 150 mm thick lifts and compacted to 95% of standard Proctor maximum dry density. Where the fill thickness exceeds 1 m, all fill should be compacted to a minimum of 98% of standard Proctor maximum dry density.

- The use of a woven geotextile is expected to be required for floor slab construction of Option 4, and potentially may also be required within some areas of Option 2.

5.3 ASPHALT PARKING LOTS

The existing asphalt paved parking lot is considered to be in fair condition and where the new development will utilize all or part of the existing asphalt pavement, a thin asphalt overlay is considered appropriate. Prior to overlaying, some localized distressed areas will likely require repair, however, these areas would not be expected to be extensive and can be identified at the time of construction. It should be noted that if the existing monitoring wells in the parking lot are to be maintained, any asphalt upgrades will need to allow for raising and repairing the surface casings which cover the monitoring wells.

In areas of new asphalt pavement, removal of some or all of the organic and fill soils will likely be required. The subsoils vary substantially and as the majority of soils are highly frost susceptible, a substantial pavement section is recommended. Consideration was given to the use of a subdrainage system to control groundwater, however, disposal of the hydrocarbon impacted groundwater could pose significant concerns.

For Options 1, 2 and 3, the existing asphalt parking lot will likely be used, although the exact extent of new parking areas is not known. As such, generic recommendations for new pavement construction are provided below and can be modified as required once the exact extent of the parking area is known.

5.3.1 New Parking Areas

New asphalt pavements will be affected by the presence of frost susceptible soils near the existing ground surface, as well as the presence of thick fill materials. As full depth removal of the fill (which is contaminated at some locations) and frost susceptible soils is not a practical or cost effective alternative, AEE provides the following recommendations for parking lot construction, based on the assumption that some long term maintenance is acceptable:

1. Excavate to design subgrade elevation, ensuring that all topsoil and organic soils are removed. Final grades within the parking area should be maintained as high as practical, to maintain an adequate cover over the frost susceptible soils.

2. The exposed subgrade should be proof rolled with a sheepsfoot roller under the direction of qualified geotechnical personnel to identify weak or soft areas. Any weak or poor quality fill soils should be removed.

3. Fill material, if required above the final subgrade and below the pavement sections listed below, should consist of well graded granular subbase (maximum particle size of 75 mm), placed in maximum 150 mm thick lifts and uniformly compacted to 98% of standard Proctor maximum dry density.

Pavement sections recommended for conventional light-duty and heavy-duty traffic areas, and constructed on a subgrade prepared as noted above, are summarized in Table II.

TABLE II
PAVEMENT DESIGN SECTIONS

Material	Car Parking Areas	Truck Routes	Compaction Required
Asphalt	65 mm	80 mm	98% of Marshall Density
Base Course	200 mm	200 mm	100% of Standard Proctor
Sub Base	250 mm	300 mm	98% of Standard Proctor
Total Thickness	**515 mm**	**580 mm**	**NA**

It is recommended that concrete pads be placed at all locations where heavy static wheel loads may exist, such as at garbage container pickup areas. At these isolated, unheated locations, frost penetration can be significant and can cause seasonal heave and subsidence. To improve performance and minimize maintenance, consideration can be given to removal of the frost susceptible soil, localized subsurface drainage, synthetic insulation or provision for greater flexibility to accommodate frost action.

5.4 CONCRETE

Local practice in the Brandon area is to use Normal Portland cement for concrete in contact with the native soils. Based on exposure requirements, foundation concrete should have a minimum specified 28 day compressive strength of 30 MPa and a maximum water/cement ratio of 0.50, in accordance with Tables 8 and 10, CAN/CSA-A23.1-M94 Methods of Test and Construction. Concrete strength requirements, should, however be checked against the structural requirements of the project.

Concrete exposed to freezing temperatures should be air entrained to improve freeze-thaw durability.

5.5 DRAINAGE & SUBDRAINAGE

Drainage adjacent to the building should promote runoff away from the structure. A minimum gradient of about 2% should be used for both landscaped and paved areas immediately around the building.

6.0 CLOSURE

This report was prepared exclusively for Canadian Tire Real Estate and their Consultants for the proposed works described in the text. The report has been based on a general understanding of the planned facilities in addition to a number of limiting assumptions. Should these not be consistent with the project scope or revisions, this office should be contacted. The data and recommendations should not be used for any other purpose, or by any other parties, without review and advice from a qualified geotechnical engineer.

The findings and recommendations provided in this report were prepared in accordance with generally accepted professional engineering principles and practice. The findings and recommendations have been based on the results of field and laboratory investigations combined with an interpolation of soil and ground water conditions between test hole locations. If conditions encountered during construction are different from those noted above, this office should be contacted in order that the recommendations can be reviewed in light of the additional information.

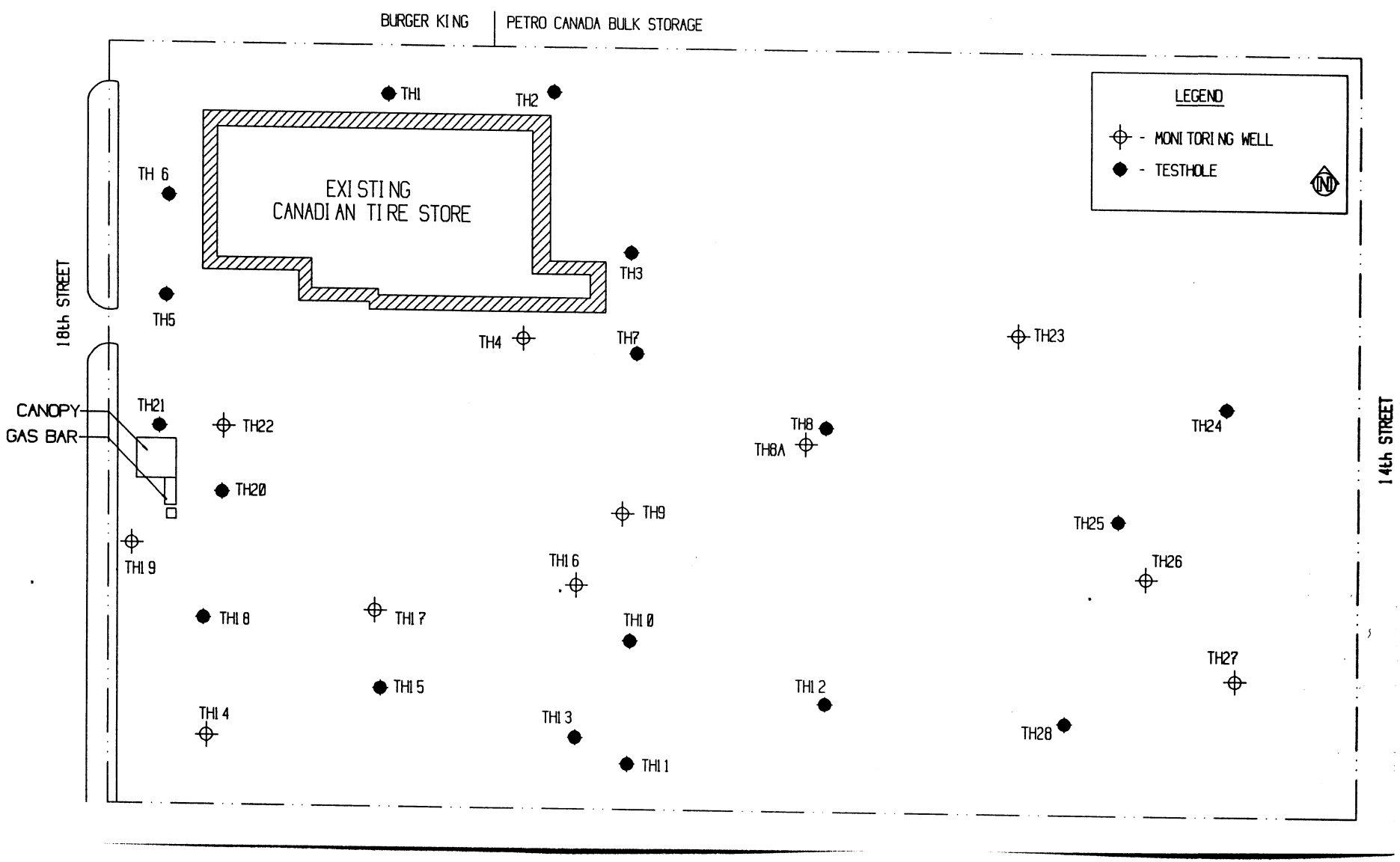
Yours truly,
AGRA Earth & Environmental Limited

Reviewed by:

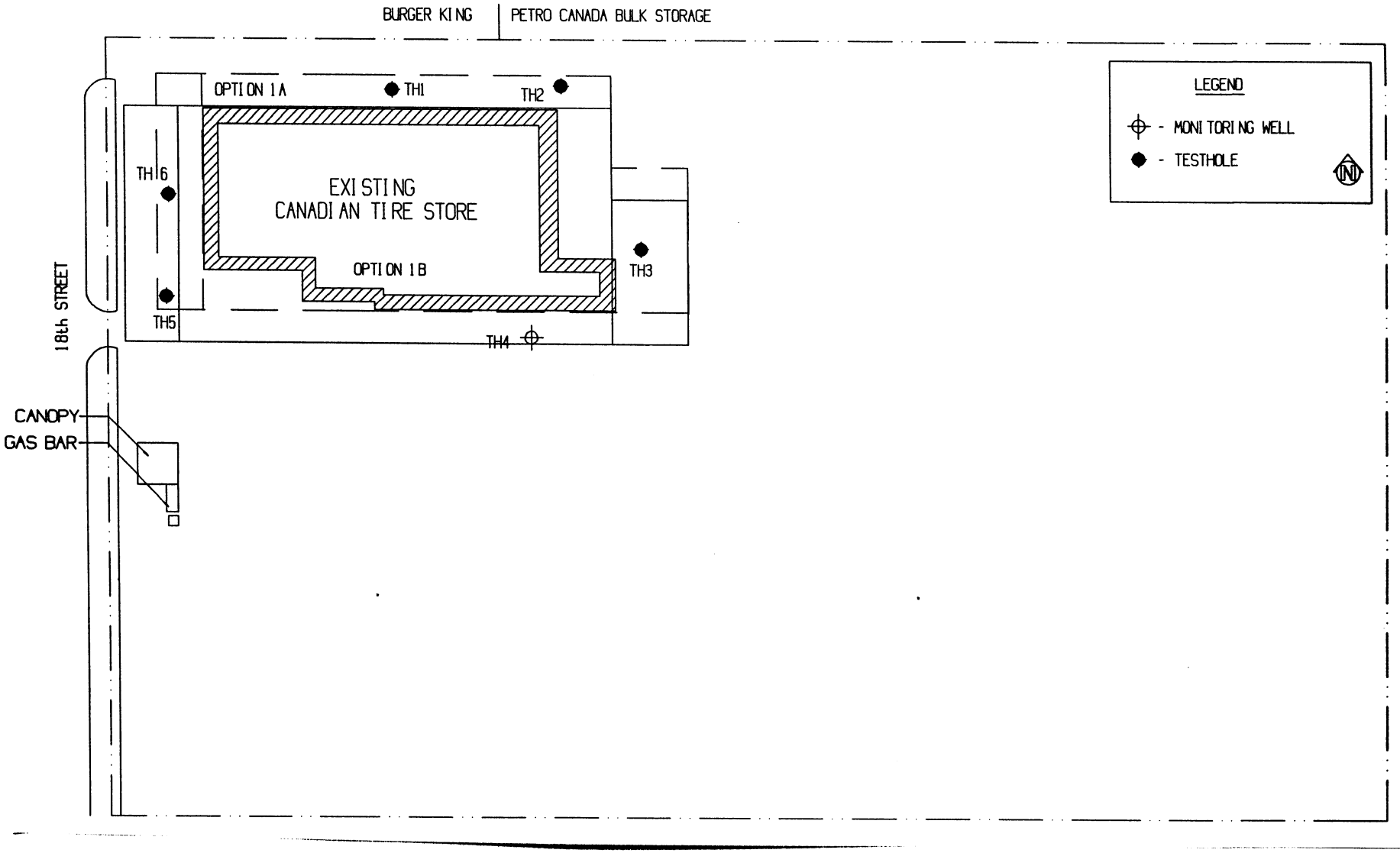
Harley Pankratz, P. Eng.

Bill Wiesner, M.Sc., P. Eng.
Senior Geotechnical Engineer

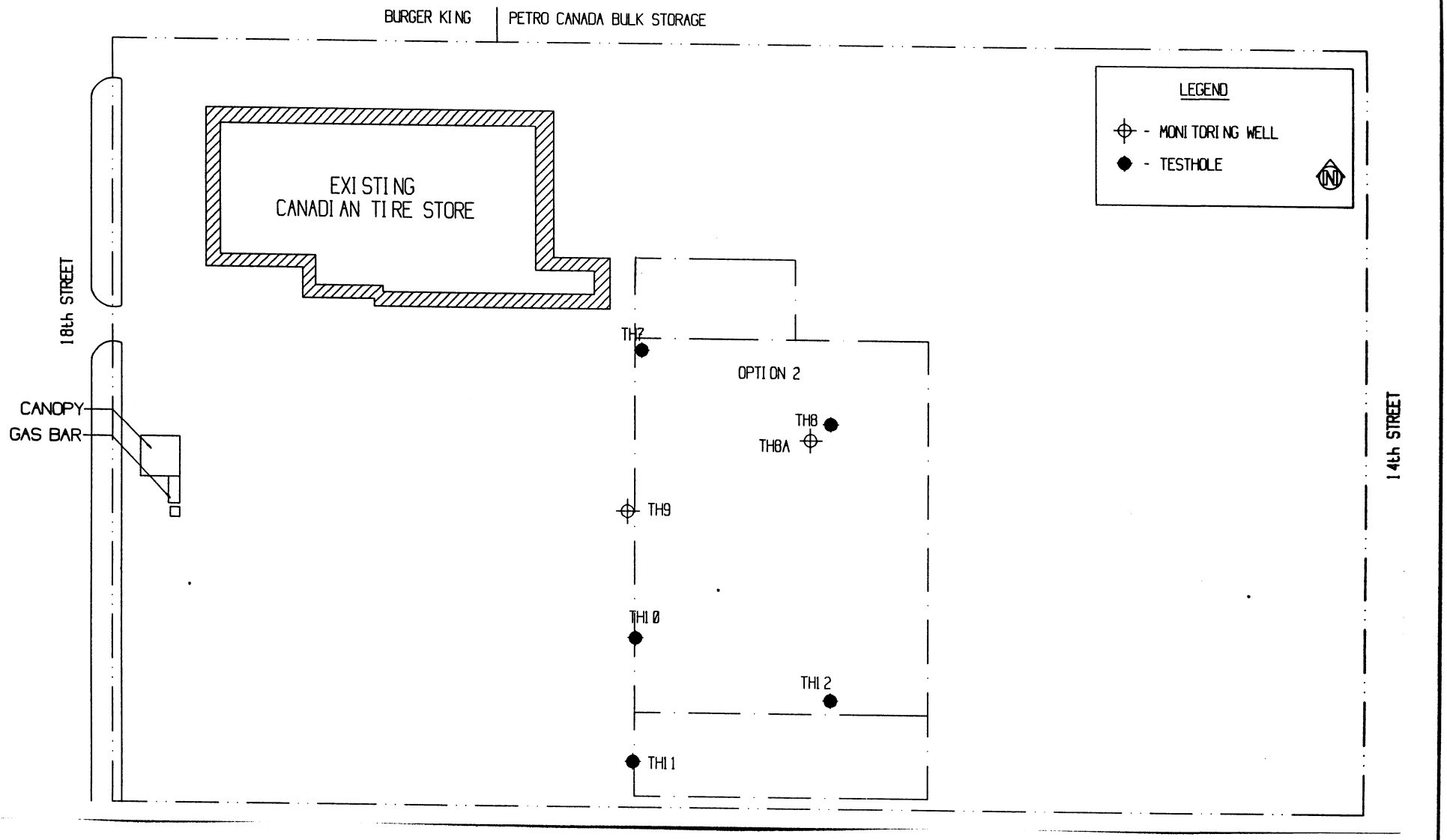
Dist: (3) Canadian Tire; c/o Mr. Tat-Liang Cheam, Nejmark Architects



AGRA *Earth & Environmental Limited*	**CANADIAN TIRE REAL ESTATE**			**TEST HOLE LOCATION PLAN CANADIAN TIRE PROPERTY** **BRANDON, MANITOBA**
Drawn: HDP	**Scale: 1:1500**	**Date: OCT 1998**	**Proposal No: WX-04528**	**Figure: 1**



AGRA *Earth & Environmental Limited*		**CANADIAN TIRE REAL ESTATE**		**TEST HOLE LOCATION PLAN OPTIONS 1A AND 1B**
Drawn: HDP	**Scale: 1:1500**	**Date: OCT 1998**	**Proposal No: WX-04528**	**Figure: 2**
				BRANDON, MANITOBA



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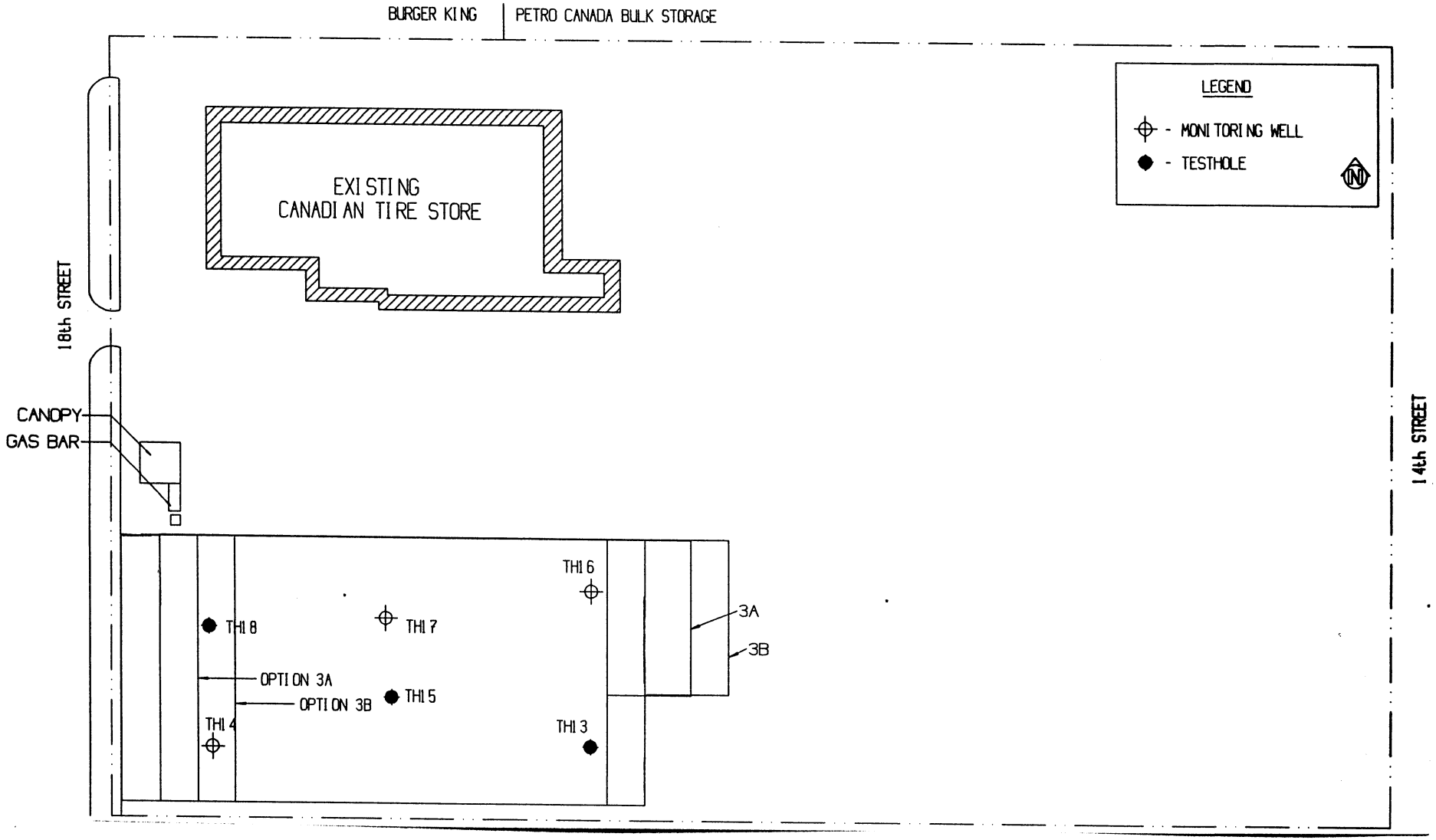
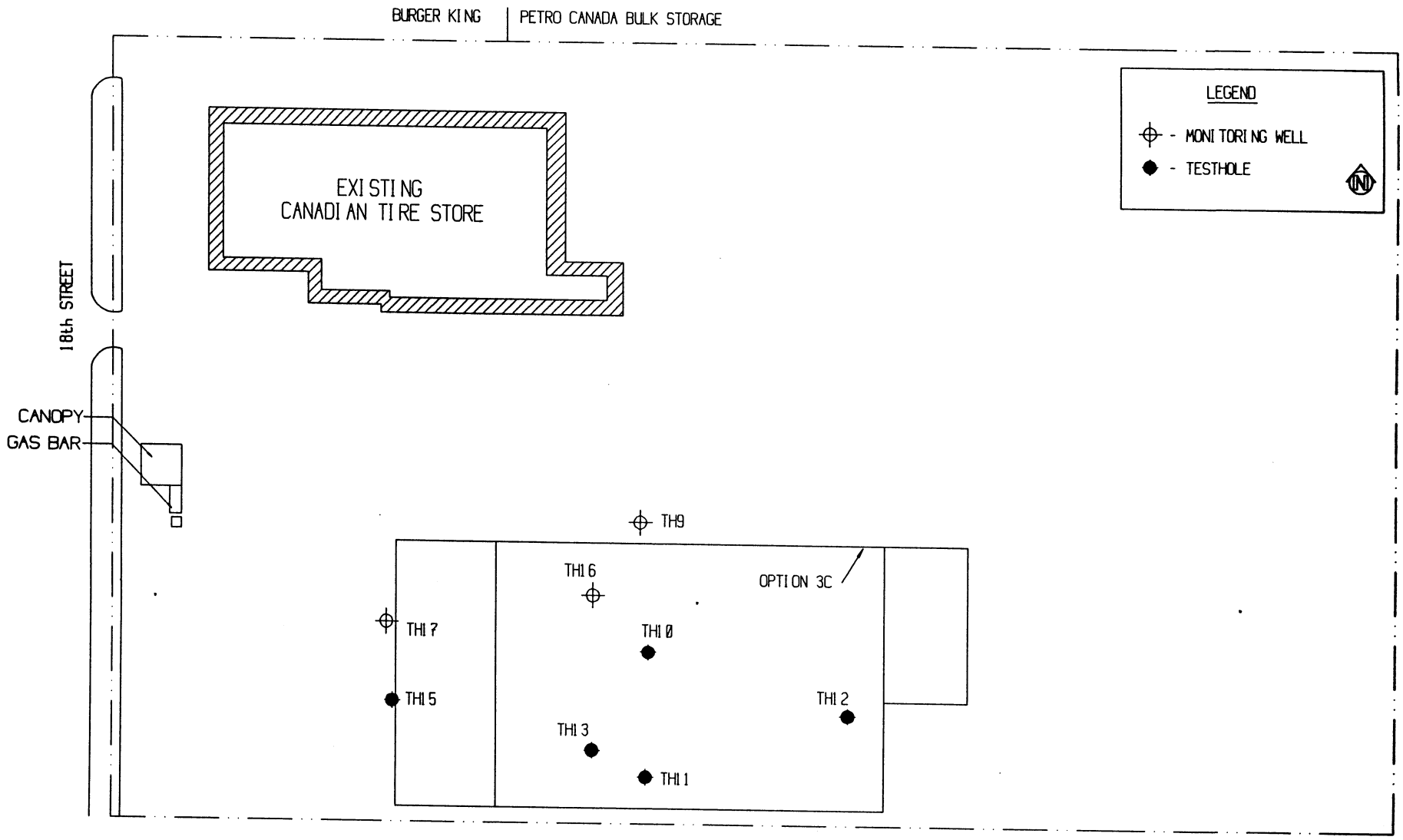
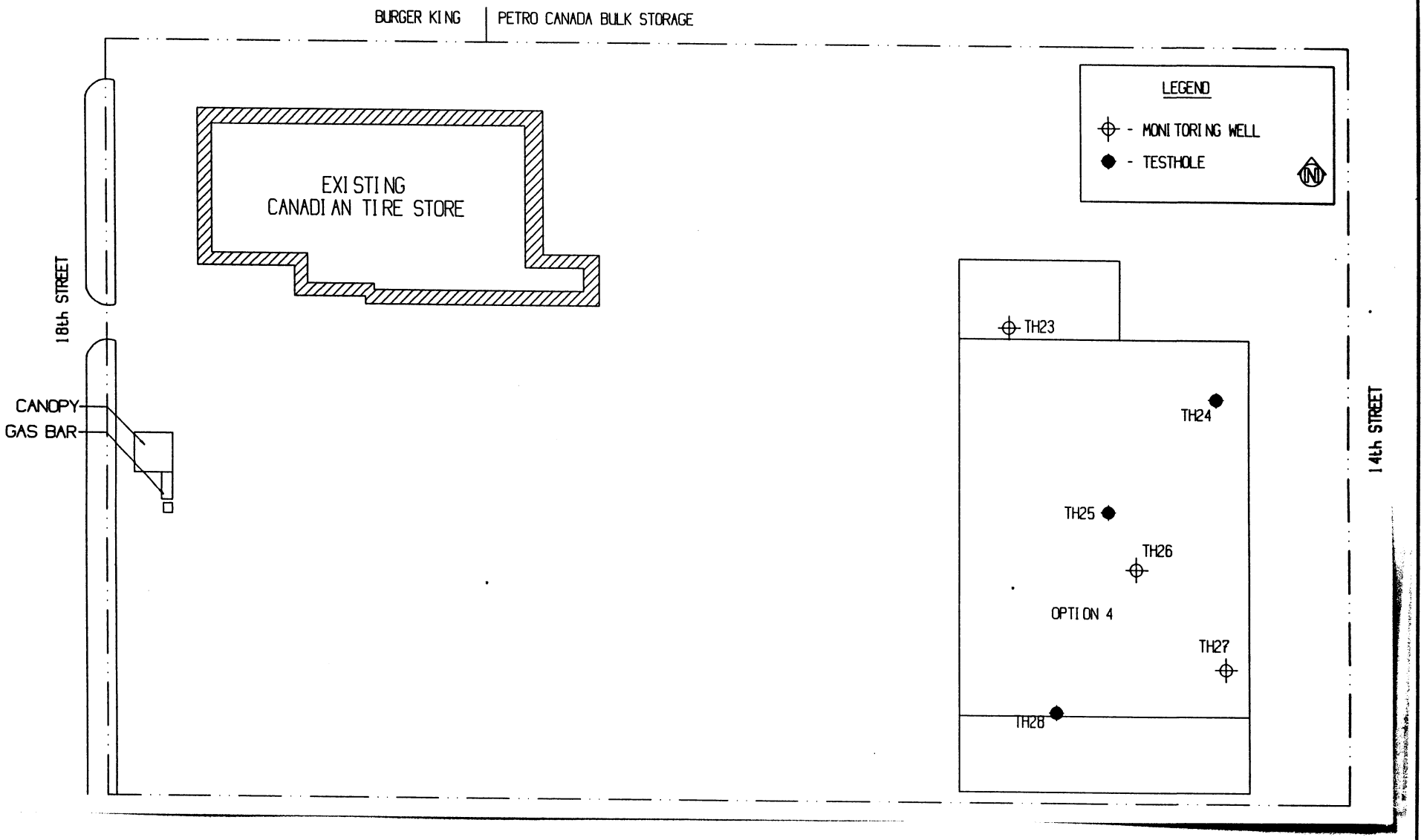


AGRA *Earth & Environmental Limited*	**CANADIAN TIRE REAL ESTATE**			**TEST HOLE LOCATION PLAN OPTIONS 3A AND 3B** **BRANDON, MANITOBA**
Drawn: HDP	**Scale: 1:1500**	**Date: OCT 1998**	**Proposal No: WX-04528**	**Figure: 4**



AGRA *Earth & Environmental Limited*	**CANADIAN TIRE REAL ESTATE**			**TEST HOLE LOCATION PLAN OPTION 3C** **BRANDON, MANITOBA**
Drawn: HDP	**Scale: 1:1500**	**Date: OCT 1998**	**Proposal No: WX-04528**	**Figure: 5**



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CANADIAN TIRE REAL ESTATE

TEST HOLE LOCATION PLAN
OPTION 4

BRANDON, MANITOBA

Drawn: HDP	Scale: 1:1500	Date: OCT 1998	Proposal No: WX-04528	Figure: 6

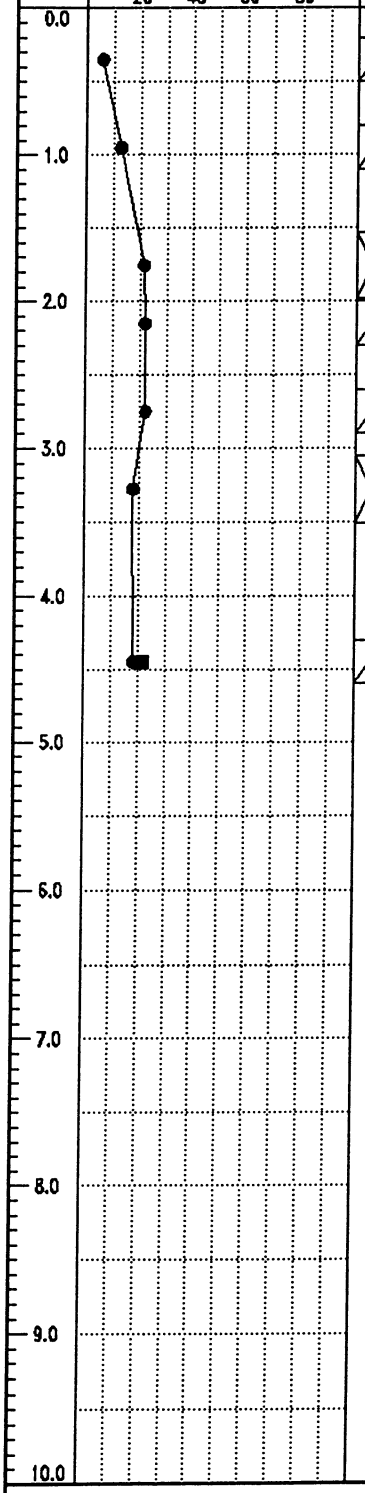
APPENDIX A

TEST HOLE LOGS

CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 1
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.78 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
					ASPHALT (100mm)			99.0
	1-1		SP		SAND (FILL) - poorly graded, fine to medium grained, loose to medium dense, silty, gravelly			
	1-2							
	1-3	6	SM		SAND - poorly graded, fine grained, moist, loose, dark brown, trace gravel Silty, clayey from 1.8 to 2.0m			98.0
	1-4				CLAY - medium plastic, moist, stiff, brown, silty, black staining			
	1-5		CI					97.0
	1-6	9						
					CLAY (TILL) - medium plastic, moist, stiff, brown, gravelly, sandy			96.0
			CI					
	1-7							95.0
					Hole ended at 4.6m No sloughing or seepage at completion of drilling. Hole filled with cuttings and plugged with bentonite at top and bottom Asphalt repaired with ready-mix concrete			94.0
								93.0
								92.0
								91.0
								90.0

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LOGGED BY: DB	COMPLETION DEPTH: 4.58 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A1	Page 1 of 1

98/10/26 09:57AM (GEO_WTD)

CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 2
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.58 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

■ POCKET PEN (kPa) ■ 100 200 300 400

▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
0.0						ASPHALT (100mm)			99.0
		2-1		SP		SAND (FILL) - poorly graded, fine to medium grained, moist, loose to medium dense, gravelly, silty			
1.0		2-2				CLAY (FILL) - low plastic, moist, firm, dark brown, very sandy, silty			98.0
				CL		Concrete and gravel from 1.5 to 1.8m			
2.0		2-4				Wet at 2.0 m			97.0
		2-5				CLAY - medium plastic, moist, firm to stiff, brown, trace sand			
3.0		2-6				Light brown below 3.0m			96.0
				CI		Low to medium plastic, very silty, firm below 4.0m			
4.0		2-7							95.0
5.0						Hole ended at 4.6m			
						Sloughing and seepage from 2.0m below grade, water to 2.0m below grade Immediately after drilling			94.0
6.0						Hole filled with cuttings and plugged with bentonite at top and bottom			
						Asphalt repaired with ready-mix concrete			93.0
7.0									
									92.0
8.0									
									91.0
9.0									
									90.0
10.0									

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Fig. No: A2	Page 1 of 1

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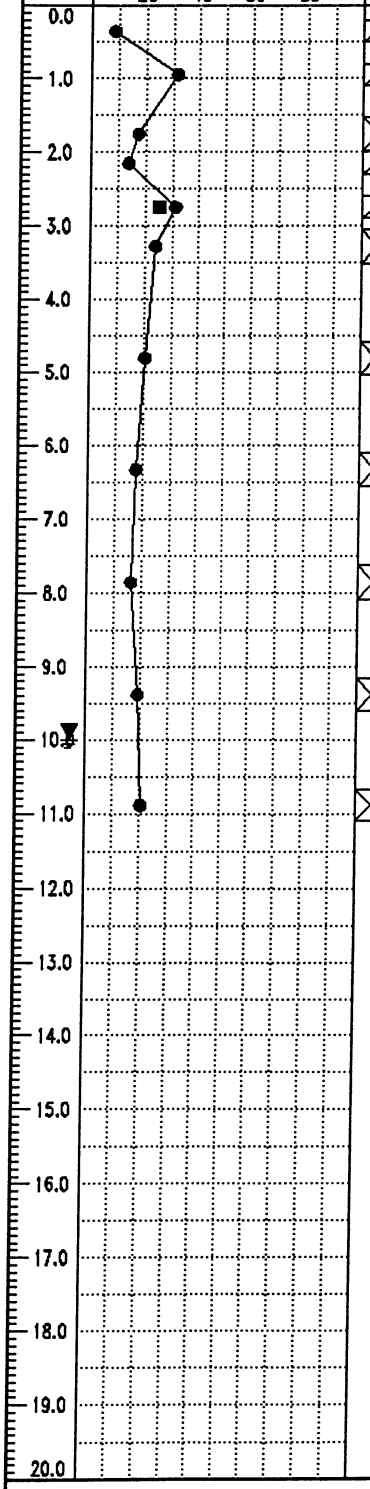
CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 3
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.44 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
0.0		3-1		SP		ASPHALT (50mm)			99.0
1.0		3-2		CL		SAND (FILL) – poorly graded, fine to medium grained, moist, loose to medium dense, gravelly, silty			98.0
2.0		3-3	6	GP		CLAY – low plastic, moist, soft to firm, black, silty			97.0
		3-4				Sandy below 1.5m			
3.0		3-5				GRAVEL – poorly graded, fine grained, moist, brown, some sand			96.0
		3-6	7			CLAY – medium plastic, moist, stiff, brown, sandy			95.0
4.0						Light brown from 2.3 to 3.4m			
5.0		3-8	10	CI		Sand intrusions, very stiff from 6.1 to 6.4m			94.0
6.0		3-9	18						93.0
7.0									92.0
8.0		3-10	19			CLAY (TILL) – medium plastic, moist, stiff, brown, gravelly, sandy			91.0
9.0						Very stiff below 6.0m			
		3-11	16	CI		Sand layer from 9.2 to 9.3m			90.0
10						Thin (0.2m thick) sand layers between 10.1 and 10.5m from grade			89.0
11.0		3-12	28						88.0
12.0						Hole ended at 11.1m			87.0
13.0						Sloughing and seepage to 10.0m below grade at completion of drilling			86.0
14.0						Hole filled with cuttings and plugged with bentonite at top, 4.6m below grade and bottom			85.0
15.0						Asphalt repaired with ready-mix concrete			84.0
16.0									83.0
17.0									82.0
18.0									81.0
19.0									80.0
20.0									

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CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 4
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.78 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

POCKET PEN (kPa) 100 200 300 400

UNCONFINED COMP. (kPa) 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	COMMENTS	ELEVATION(m)
0.0						ASPHALT (75mm)			99.78
1.0		4-1				SAND (FILL) - poorly graded, fine to medium grained, moist, loose to medium dense, gravelly, silty			98.78
		4-2		SP					
2.0		4-3				Very moist, trace gravel below 1.5m			97.78
		4-4		CL		CLAY - silty, low plastic, moist, soft to firm, grey			
3.0		4-5							96.78
		4-6	7	CI		Black, organics from 1.7 to 2.0m			
4.0						Very sandy, trace gravel at 2.8m			95.78
		4-7		CI		CLAY - medium plastic, moist, firm, brown, silty			
5.0						CLAY (TILL) - medium plastic, moist, stiff, brown, silty, sandy, some gravel			94.78
6.0						Hole ended at 4.6m			
						No sloughing or seepage at completion of drilling			93.78
7.0						Asphalt repaired with ready-mix concrete			
8.0									92.78
9.0									91.78
10.0									90.78
11.0									89.78
12.0									88.78
13.0									87.78
14.0									86.78
15.0									85.78
16.0									84.78
17.0									83.78
18.0									82.78
19.0									81.78
20.0									80.78

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REVIEWED BY: KBO		COMPLETE: 10/02/98
Fig. No: A4		Page 1 of 1

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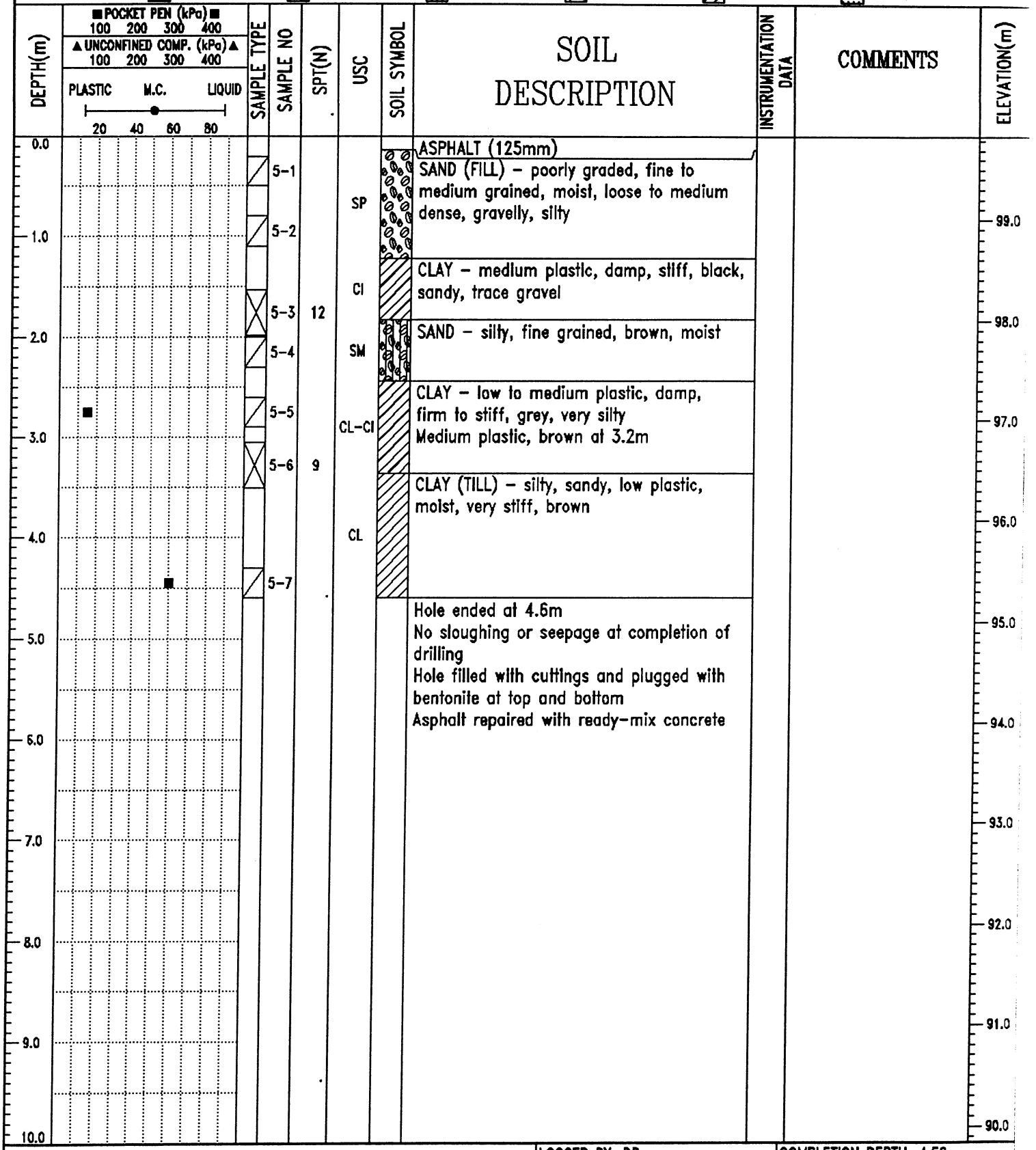
CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 5
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.84 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



AGRA Earth & Environmental Limited Winnipeg, Manitoba	LOGGED BY: DB	COMPLETION DEPTH: 4.58 m
	REVIEWED BY: KBO	COMPLETE: 10/02/98
	Fig. No: A5	Page 1 of 1

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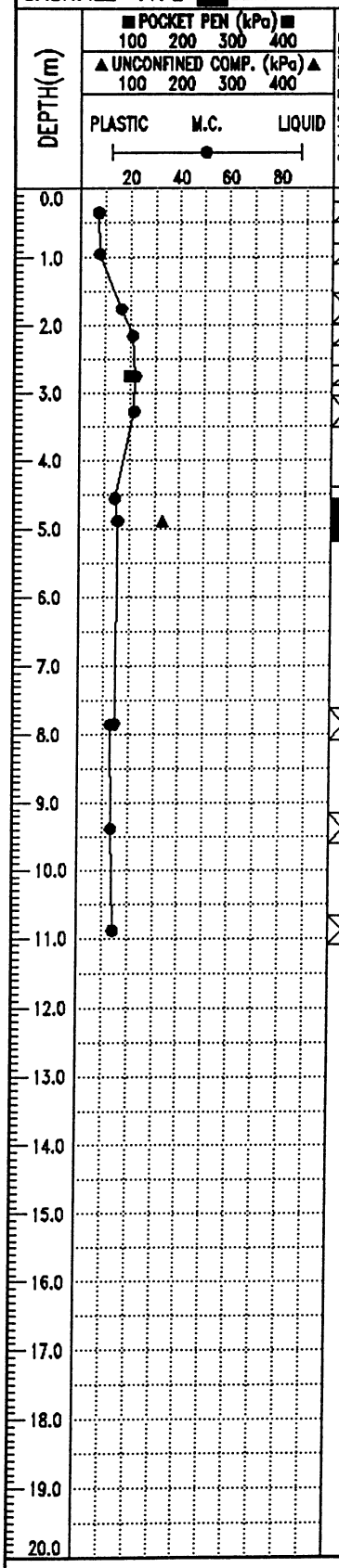
CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 6
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM SS / 150 MM HSA	ELEVATION: 99.6 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
					ASPHALT (100mm)			99.0
	6-1		SP		SAND (FILL) – poorly graded, fine to medium grained, moist, loose to medium dense, gravelly, silty			
	6-2				Very clayey, silty from 0.9 to 1.4m			98.0
	6-3	10	CL		SILT – clayey, low plastic, moist, firm to stiff, grey to black			
	6-4							97.0
	6-5							
	6-6	9	CI		CLAY – silty, medium plastic, moist, stiff, brown, oxides			96.0
	6-13	49						95.0
	6-8				CLAY (TILL) – medium plastic, moist, stiff, brown			
					Silt lenses from 3.3 to 4.5m			94.0
					Grey clay, some gravel, stiff from 6.1 to 6.4m			93.0
					Very stiff to hard below 7.0m			
					Very sandy, wet from 7.6 to 8.0m			92.0
	6-10	49	CI		Very sandy, wet from 9.2 to 9.6m			
					Grey, silty, trace sand below 10.7m			91.0
	6-11	52						90.0
	6-12	49						89.0
					Hole ended at 11.1m			88.0
					Sloughing and seepage to 7.6 m below grade at completion of drilling			
					Hole filled with cuttings and plugged with bentonite at top and bottom			87.0
					Asphalt repaired with ready-mix concrete			86.0
								85.0
								84.0
								83.0
								82.0
								81.0
								80.0

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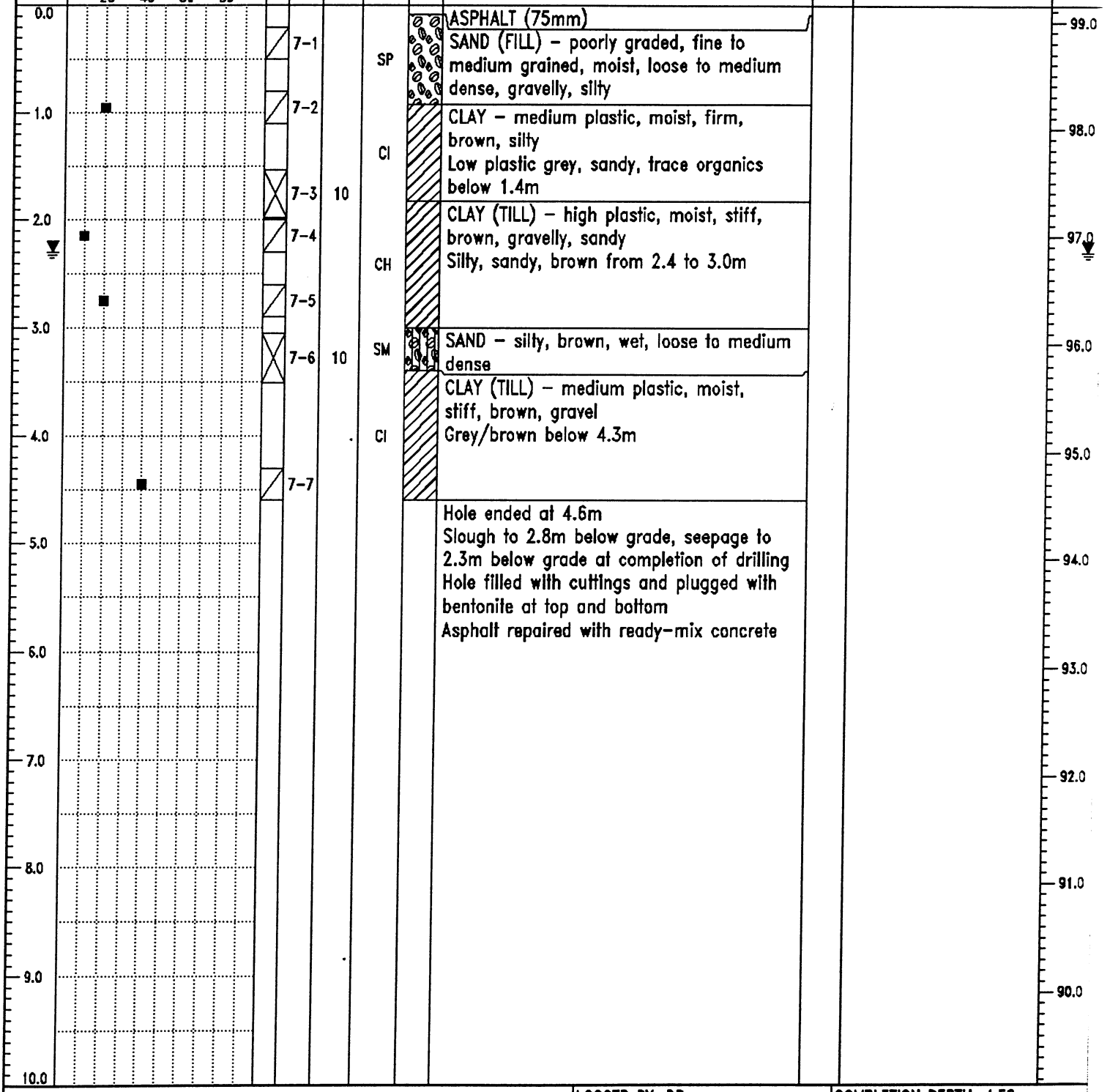
CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 7
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.15 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



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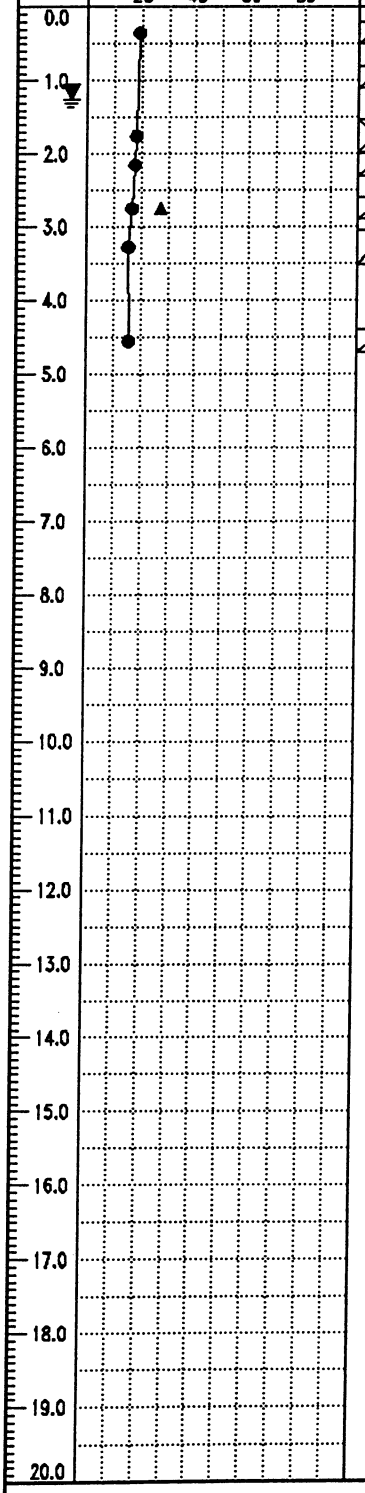
LOGGED BY: DB	COMPLETION DEPTH: 4.58 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A7	Page 1 of 1

98/10/22 09:57AM (GEO_W10)

CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 8/8A
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM SS / 150 MM HSA	ELEVATION: 100.51 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	COMMENTS	ELEVATION(m)
0.0								100.0
1.0		8-1	11	OL		TOPSOIL - loamy, black, organics, roots, moist, grass, sandy, silty, gravelly		
		8-2	12					
		8-3	11	CL		CLAY (FILL) - low plastic, very moist, firm to stiff, dark brown, gravelly		99.0
2.0		8-4	12	CL		SILT - low plastic, moist, firm, brown, silty, sandy, gravelly		
		8-5				Black, organics from 2.0 to 2.1m		98.0
3.0		8-6	17			Wet from 2.1 to 2.4m		
								97.0
4.0				CH		CLAY - high plastic, moist, firm to stiff, brown, sandy, oxides		
		8-7	17			Brown/grey from 4.0 to 4.3m		96.0
5.0						Medium plastic, moist, brown, silty, some sand from 4.3 to 5.1m		
								95.0
6.0						CLAY (TILL) - medium plastic, moist, stiff, grey, gravelly		
								94.0
7.0								
								93.0
8.0				CI				
								92.0
9.0						Very stiff below 9 m		
								91.0
10.0								
								90.0
11.0								
								89.0
12.0						The test hole was originally drilled to 4.7m with a solid stem auger, however was discontinued due to heavy seepage. Hole was completed 3.0m from original location using hollow stem augers. Sloughing and seepage to 9.2m below grade at compeltion of drilling in TH8A. TH8 was filled with bentonite TH8A completed with a monitoring well.		
								88.0
13.0								
								87.0
14.0								
								86.0
15.0								
								85.0
16.0								
								84.0
17.0								
								83.0
18.0								
								82.0
19.0								
								81.0
20.0								

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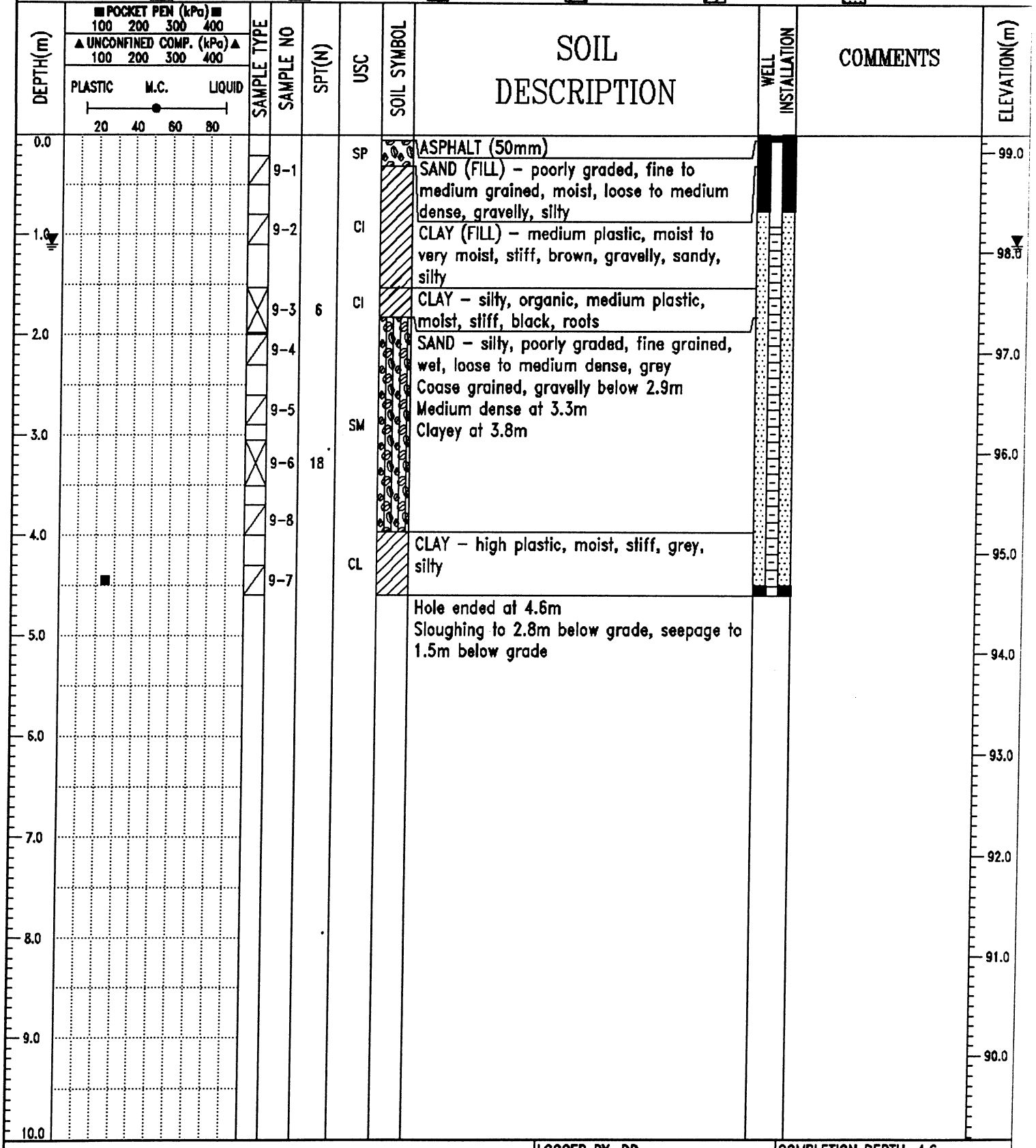
LOGGED BY: DB	COMPLETION DEPTH: 11.1 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A8	Page 1 of 1

98/10/28 04:38PM (GEO_W2D)

CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 9
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.17 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



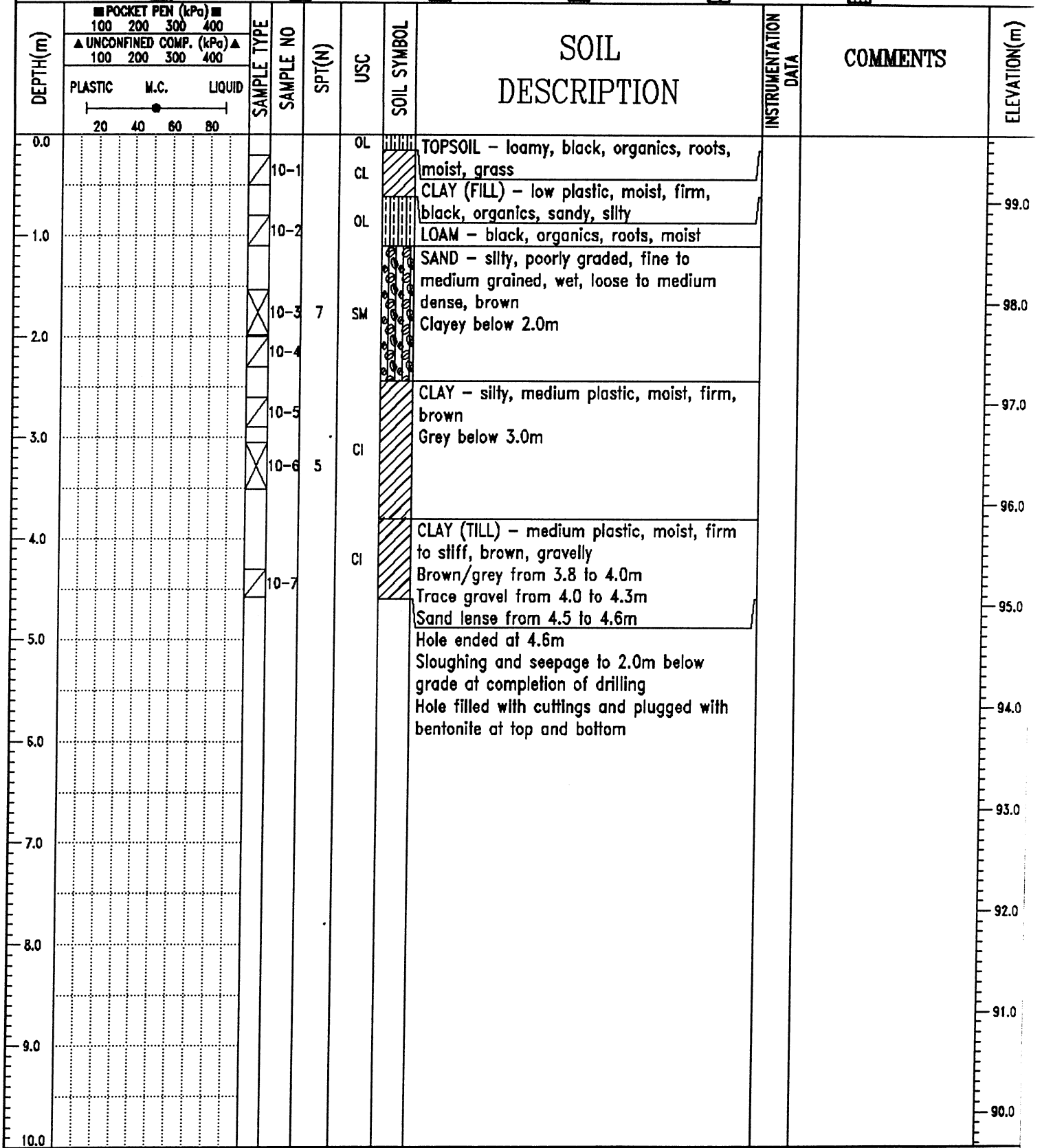
AGRA Earth & Environmental Limited Winnipeg, Manitoba	LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
	REVIEWED BY: KBO	COMPLETE: 10/02/98
	Fig. No: A9	Page 1 of 1

98/10/28 04:38PM (GEO_W10)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 10
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.66 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



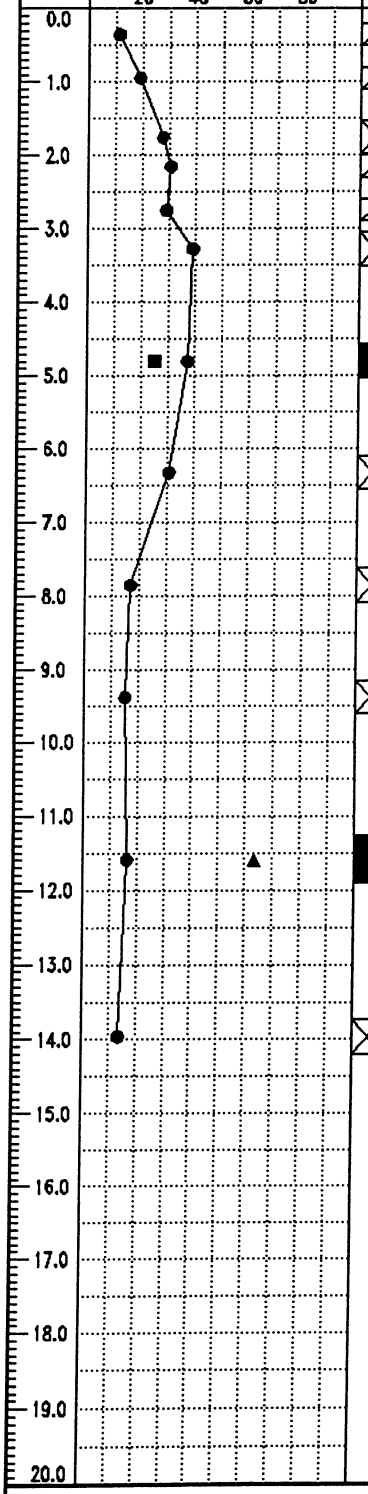
AGRA Earth & Environmental Limited Winnipeg, Manitoba	LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
	REVIEWED BY: KBO	COMPLETE: 10/02/98
	Fig. No: A10	Page 1 of 1

98/10/22 08:57AM (GEO_WTD)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 11
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM SS / 150 MM HSA	ELEVATION: 99.55 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
0.0				OL		TOPSOIL – loamy, black, organics, roots, moist, grass, sandy, silty, gravelly			99.0
1.0		11-1							
		11-2		SM		SAND – silty, poorly graded, fine grained, very moist, loose to medium dense, brown			98.0
2.0		11-3	4			Black, organics from 0.3 to 0.6m			
		11-4				Very silty from 1.4 to 1.7m			97.0
3.0		11-5				CLAY – silty, medium plastic, moist, firm to stiff, brown/grey, oxides			
		11-6	6			Some gravel from 2.8 to 3.0m			96.0
4.0				CI		Firm, grey from 6.1 to 6.6m			
5.0		11-7							95.0
6.0		11-8	7						94.0
7.0						CLAY (TILL) – medium plastic, moist, stiff to very stiff, dark grey, gravelly			93.0
8.0		11-9	13						92.0
9.0						Very stiff below 9.0 m			91.0
		11-10	18						90.0
10.0				CI					89.0
11.0									88.0
12.0		11-11							87.0
13.0									86.0
14.0		11-13				Hole ended at 14.2m			85.0
15.0						Slight sloughing and seepage from sand layer from 0.3 to 2.1 at completion of drilling			84.0
16.0						grade			83.0
17.0						Hole filled with cuttings and bentonite at bottom and 2.8m below grade			82.0
18.0									81.0
19.0									80.0
20.0									

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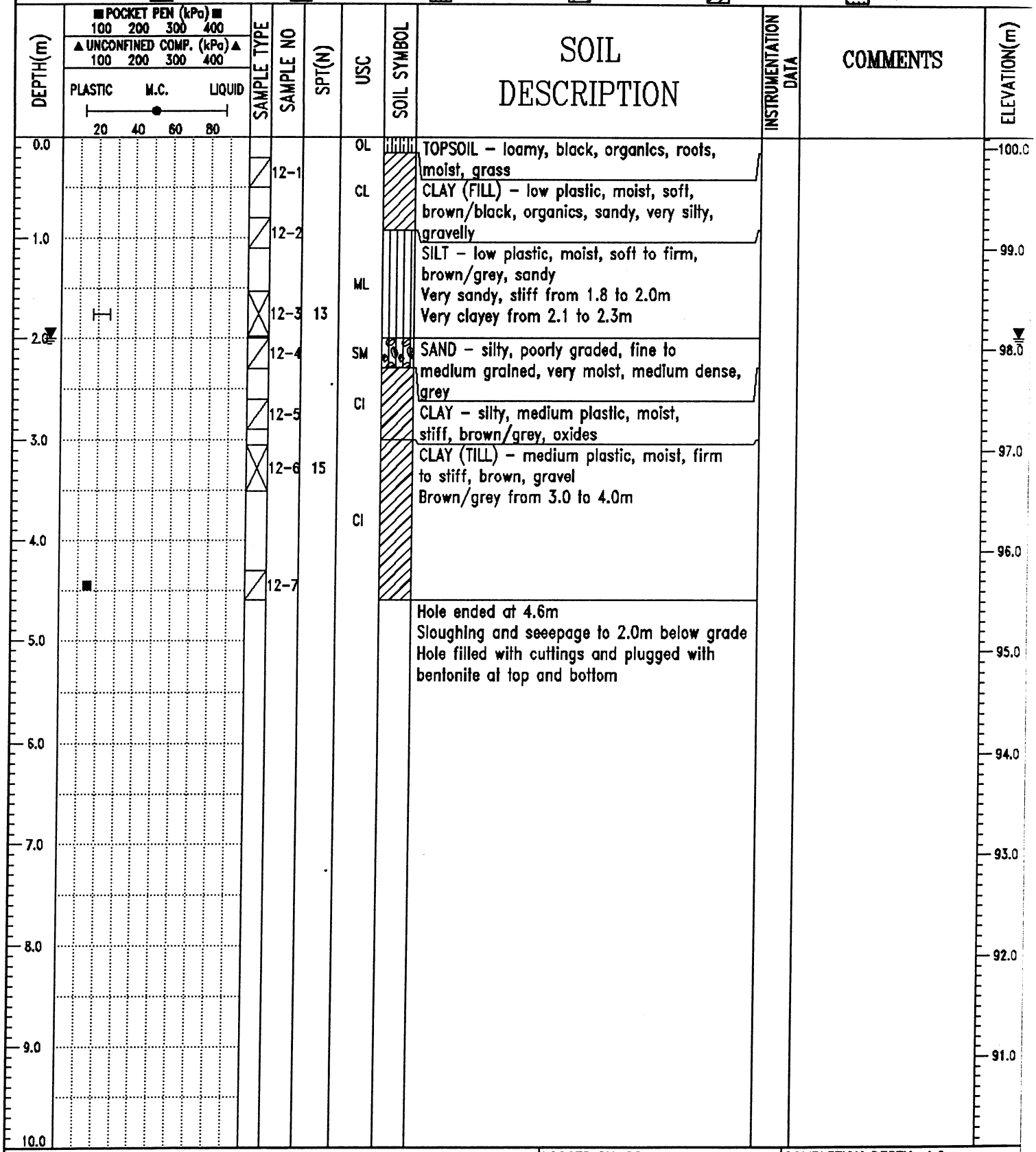
LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A11	Page 1 of 1

98/10/26 09:36AM (GEO_W2D)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 12
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 100.11 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



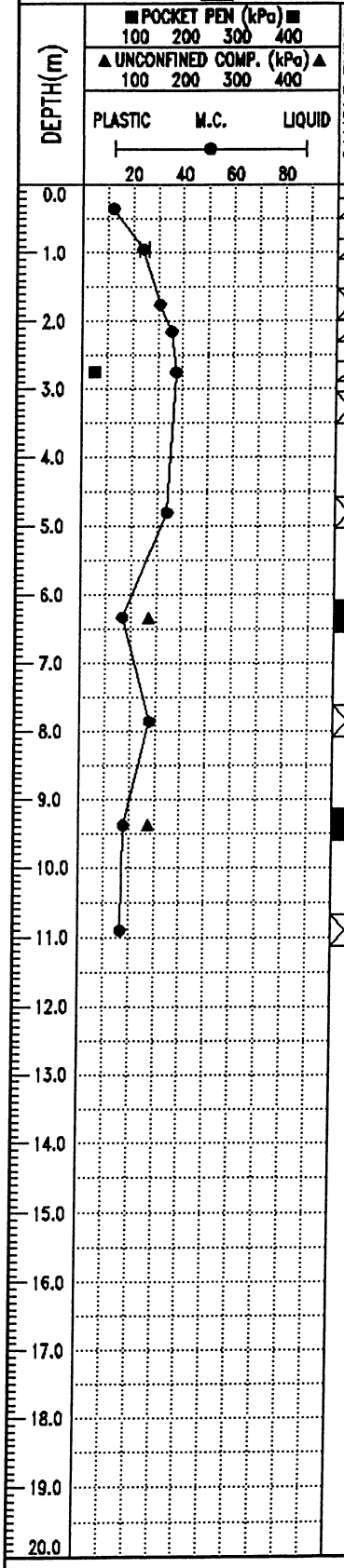
AGRA Earth & Environmental Limited Winnipeg, Manitoba	LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
	REVIEWED BY: KBO	COMPLETE: 10/02/98
	Fig. No: A12	Page 1 of 1

98/10/22 09:58AM (GEO_W10)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 13
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM SS / 150 MM HSA	ELEVATION: 99.77 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
	13-1		OL		TOPSOIL – loamy, black, organics, roots, moist, grass, sandy, silty, gravelly			99.0
	13-2				SILT – low plastic, moist to very moist, firm, brown, very sandy, oxides			
	13-3	6	ML		Trace sand, trace clay below 2.0m			98.0
	13-4							
	13-5							97.0
	13-6	7	CL-CI		CLAY – very silty, low to medium plastic, moist, firm to stiff, brown/grey, oxide Some gravel from 2.8 to 3.0m			96.0
	13-7	7						95.0
	13-8				CLAY (TILL) – medium plastic, moist, firm, grey, gravelly Stiff below 6.0m			94.0
								93.0
	13-9	14	CI					92.0
	13-10							91.0
								90.0
	13-11	18						89.0
					Hole ended at 11.1m Sloughing and seepage to 10.0m below grade at completion of drilling Hole filled with cuttings and bentonite at bottom and top			88.0
								87.0
								86.0
								85.0
								84.0
								83.0
								82.0
								81.0
								80.0

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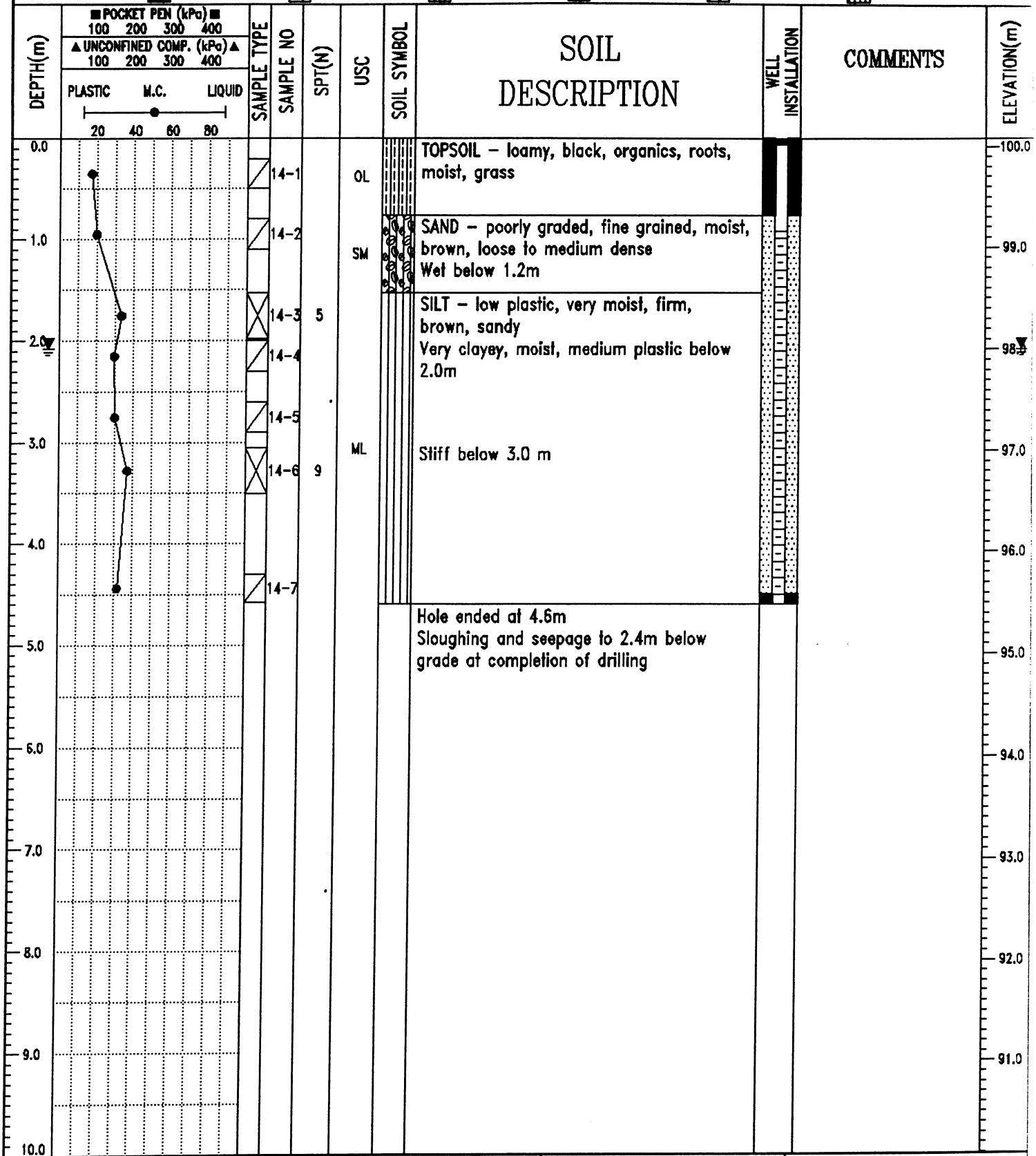
LOGGED BY: DB | COMPLETION DEPTH: 10.68 m
REVIEWED BY: KBO | COMPLETE: 10/02/98
Fig. No: C13 | Page 1 of 1

98/10/22 10:05AM (GEO_W2D)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 14
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 100.08 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



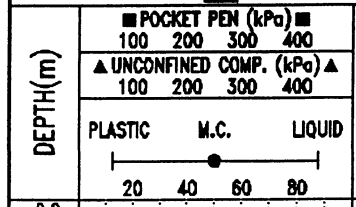
AGRA Earth & Environmental Limited Winnipeg, Manitoba	LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
	REVIEWED BY: KBO	COMPLETE: 10/02/98
	Fig. No: A14	Page 1 of 1

98/10/26 04:39PM (GEO_W10)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 15
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.3 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
0.0				OL		TOPSOIL – loamy, black, organics, roots, moist, grass			99.0
1.0		15-1				SAND – very silty, poorly graded, fine grained, moist, loose to medium dense, brown			98.0
		15-2							
		15-3	11	SM					97.0
2.0		15-4							
		15-5							
3.0		15-6	8			CLAY – low plastic, moist, stiff, brown, silty Grey below 4.0m			96.0
4.0		15-7		CL					95.0
5.0						Hole ended at 4.6m No sloughing or seepage at completion of drilling Hole filled with cuttings and plugged with bentonite at top and bottom			94.0
6.0									93.0
7.0									92.0
8.0									91.0
9.0									90.0
10.0									

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LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
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98/10/22 09:50AM (GEO_W10)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 16
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.69 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

■ POCKET PEN (kPa) ■ 100 200 300 400

▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	COMMENTS	ELEVATION(m)
0.0						ASPHALT (125mm)			99.69
		16-1		SP		SAND (FILL) – poorly graded, fine to medium grained, moist, loose to medium dense, brown, gravelly, silty			
1.0		16-2		CH		CLAY (FILL) – high plastic, moist, stiff, brown/black, sandy, gravelly, silty			99.0
		16-3	6	CL		CLAY – silty, low plastic, moist, firm, brown, sandy, clayey			98.0
2.0		16-4		SM		SAND – silty, poorly graded, fine grained, very moist, medium dense, black			
		16-5							97.0
3.0		16-6	5	CI		CLAY (TILL) – medium plastic, moist, firm to stiff, brown, gravelly Sandy silt layer from 4.1 to 4.3m			96.0
4.0		16-7							
						Hole ended at 4.6m Sloughing and seepage to 2.0m below grade at completion of drilling			95.0
5.0									94.0
6.0									93.0
7.0									92.0
8.0									91.0
9.0									90.0
10.0									

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LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A16	Page 1 of 1

98/10/26 04:36PM (GEO_WTD)

CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 17
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.24 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

■ POCKET PEN (kPa) ■ 100 200 300 400

▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	COMMENTS	ELEVATION(m)
0.0				OL		TOPSOIL – loamy, black, organics, roots, moist, grass, sandy, silty, gravelly			99.0
		17-1		SM		SAND (FILL) – poorly graded, fine grained, moist, medium dense, brown, organics			
1.0		17-2		CI		CLAY – silty, medium plastic, moist, firm to stiff, brown, sandy, oxides			98.0
		17-3	6						
2.0		17-4				SILT – low plastic, very moist, soft to firm, brown/grey, clayey, trace sand			97.0
		17-5				Very moist below 2.5 m			
3.0		17-6	5	CL					96.0
4.0		17-8							
		17-7		CL-CI		CLAY – low to medium plastic, moist, stiff, brown, trace sand and gravel			95.0
5.0						Hole ended at 4.6m No sloughing or seepage at completion of drilling			94.0
6.0									93.0
7.0									92.0
8.0									91.0
9.0									90.0
10.0									

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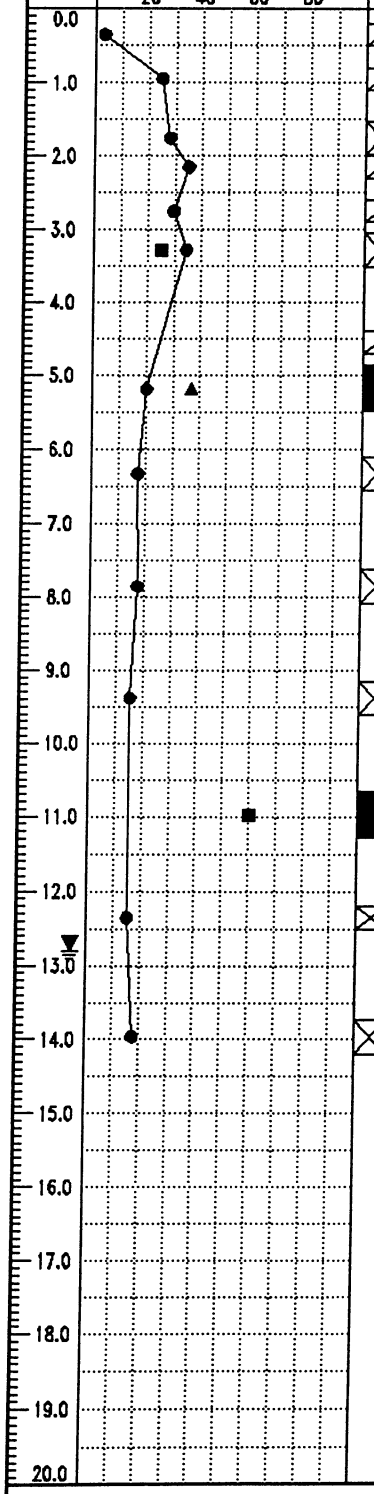
LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A17	Page 1 of 1

98/10/28 04:40PM (GEO_W1B)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 18
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM SS / 150 MM HSA	ELEVATION: 99.98 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
0.0				OL		TOPSOIL – loamy, moist, black, organics, sodded (50mm)			99.0
1.0		18-1		CI		CLAY (FILL) – very sandy, gravelly, medium plastic, moist, firm, brown			98.0
2.0		18-2							97.0
		18-3	5	SM		SAND – poorly graded, fine grained, moist, loose to medium dense, grey, silty			96.0
3.0		18-4							95.0
		18-5		CL		CLAY – low plastic, moist, soft to firm, brown, very silty Wet from 2.6 to 3.1m Stiff from 3.1 to 4.3m			94.0
4.0		18-6	9			Sand layer from 3.1 to 3.4m			93.0
		18-14							92.0
5.0		18-7		CI		CLAY – medium plastic, moist, stiff, grey/brown, silt lenses			91.0
6.0		18-8	8			CLAY (TILL) – medium plastic, moist, firm to stiff, grey, gravelly			90.0
7.0									89.0
8.0		18-9	10						88.0
9.0		18-10							87.0
10.0				CI					86.0
11.0		18-11				Very stiff below 11 m			85.0
12.0		18-12	22						84.0
13.0									83.0
14.0		18-13	18			Hole ended at 14.2m Sloughing and seepage to 12.8m below from sand layers grade at completion of drilling Hole filled with cuttings and plugged with bentonite at top and bottom			82.0
15.0									81.0
16.0									80.0
17.0									
18.0									
19.0									
20.0									

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LOGGED BY: DB	COMPLETION DEPTH: 14.2 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A18	Page 1 of 1

98/10/28 09:41AM (GEO_W2D)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 19
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 100.34 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

■ POCKET PEN (kPa) ■ 100 200 300 400

▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	COMMENTS	ELEVATION(m)
0.0						ASPHALT (125mm)			100.0
		19-1		SP		SAND (FILL) – poorly graded, fine to medium grained, moist, loose to medium dense, brown, gravelly, silty, clayey			
1.0		19-2		CL		CLAY (FILL) – low plastic, moist, firm, brown/black, organics sandy, gravelly, silty			99.0
		19-3	4			CLAY – medium plastic, moist, firm, brown, silty			
2.0		19-4				Grey/brown clay below 4.3m			98.0
		19-5							
3.0		19-6	4	CI					97.0
4.0									96.0
		19-7							
5.0						Hole ended at 4.6m No sloughing or seepage at completion of drilling			95.0
6.0									94.0
7.0									93.0
8.0									92.0
9.0									91.0
10.0									

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LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A19	Page 1 of 1

98/10/26 04:41PM (GEO_W10)

CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 20
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528.
	AUGER: 125 MM	ELEVATION: 99.72 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

■ POCKET PEN (kPa) ■ 100 200 300 400

▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
0.0						ASPHALT (100mm)			99.0
		20-1		GP		SAND (FILL) - poorly graded, fine to medium grained, moist, loose to medium dense, brown, gravelly, silty, clayey			
1.0		20-2		CL		CLAY - low plastic, moist, firm to stiff, brown/grey, very silty, sandy Black, organics from 0.8 to 0.9m Silt lenses from 1.5 to 1.7			98.0
		20-3	7			CLAY - medium plastic, moist, firm to stiff, brown/grey, trace gravel Grey/brown, silty below 4.3m			
2.0		20-4							97.0
		20-5							
3.0		20-6	6	CI					96.0
4.0		20-7							
5.0						Hole ended at 4.6m No sloughing or seepage at completion of drilling			95.0
6.0									94.0
7.0									93.0
8.0									92.0
9.0									91.0
10.0									90.0

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LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A20	Page 1 of 1

98/10/28 04:41PM (GEO_W10)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 21
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.44 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

■ POCKET PEN (kPa) ■ 100 200 300 400

▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
0.0						ASPHALT (125mm)			99.44
		21-1		SP		SAND (FILL) – poorly graded, fine to medium grained, moist, loose to medium dense, brown, gravelly, silty, clayey			
1.0		21-2		CL		CLAY – low plastic, moist, firm, brown, very silty			98.0
2.0		21-3	5	ML		SILT – low plastic, very moist, soft to firm, brown, trace sand			97.0
		21-4							
		21-5							
3.0		21-6	5	CL-CI		CLAY – low to medium plastic, moist, firm to stiff, grey			96.0
4.0 ▼									▼
		21-7							95.0
5.0						Hole ended at 4.6m Sloughing and seepage to 4.0m below grade on completion of drilling. Hole filled with cuttings and plugged with bentonite at top and bottom			
6.0									94.0
7.0									93.0
8.0									92.0
9.0									91.0
10.0									90.0

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LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A21	Page 1 of 1

98/10/26 09:43AM (GEO_W1D)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 22
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 99.2 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

■ POCKET PEN (kPa) ■ 100 200 300 400

▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	WELL INSTALLATION	COMMENTS	ELEVATION(m)
0.0						ASPHALT (75mm)			99.0
		22-1		SP		SAND (FILL) – poorly graded, fine to medium grained, moist, loose to medium dense, brown, gravelly, silty			
1.0		22-2							98.0
		22-3	7	ML		SILT – low plastic, moist, firm, grey, some clay Black, organics from 1.2 to 1.5m			
2.0		22-4				SAND – silty, poorly graded, fine grained, medium dense, brown grey, silty, wet at 2.5m			97.0
		22-5							
3.0		22-6	12	SM					96.0
4.0									95.0
		22-7							
5.0						Hole ended at 4.6m Sloughing and seepage to 2.4m below grade at completion of drilling			94.0
6.0									93.0
7.0									92.0
8.0									91.0
9.0									90.0
10.0									

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LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A22	Page 1 of 1

98/10/26 04:42PM (GEO_WTD)

CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 23
NEJMARK ARCHITECTS	DRILL RIG: RM30	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 100.1 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH(m)	POCKET PEN (kPa) 100 200 300 400 / UNCONFINED COMP. (kPa) 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	COMMENTS	ELEVATION(m)
0.0					OL		TOPSOIL - loamy, brown/black, organics, roots, moist, sandy, silty		100.0
			23-1		CL		CLAY (FILL) - low plastic, moist, soft, black/brown, roots, organics, sand, silt		
1.0			23-2				SILT - low plastic, moist, firm, brown, organics, sandy		99.0
							Clayey, soft, very moist from 1.2 to 1.5m		
			23-3	13	CL		Firm to stiff from 2.1 to 2.6m		
2.0			23-4						98.0
			23-5				CLAY - high plastic, moist, stiff, grey, silty, trace gravel		
3.0					CH				97.0
			23-6	14			CLAY (TILL) - medium plastic, damp, firm to stiff, grey, silty		
4.0					CI				96.0
			23-7						
5.0							Hole ended at 4.6m		95.0
							No sloughing or seepage at completion of drilling		
6.0									94.0
7.0									93.0
8.0									92.0
9.0									91.0
10.0									

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LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A23	Page 1 of 1

98/10/28 04:42PM (GEO_WTD)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 24
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM SS / 150 MM HSA	ELEVATION: 99.73 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

■ POCKET PEN (kPa) ■ 100 200 300 400

▲ UNCONFINED COMP. (kPa) ▲ 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
0.0		24-1		OL		TOPSOIL – loamy, moist, black, organics, sandy			99.0
1.0		24-2		CL		CLAY (FILL) – low plastic, moist, soft to firm, brown, very silty, very sandy			
2.0		24-3	11	CI		CLAY (TILL) – medium plastic, moist, stiff to very stiff, grey/brown, silt lenses			98.0
		24-4				Grey, stiff from 6.10 to 7.63m			
3.0		24-5							97
		24-6	8	ML		SILT – low plastic, moist, soft to firm, grey, sandy, clayey			
4.0						Very sandy, wet from 3.0 to 3.2m			96.0
5.0		24-7		CI		Very clayey below 4.0m CLAY (TILL) – medium plastic, moist, firm to stiff, grey, gravelly			95.0
6.0		24-8							94.0
7.0				GP		GRAVEL – poorly graded, fine to medium grained, very wet, medium dense, some sand, gravelly, stones (shale)			93.0
8.0		24-9				Water encountered at approximately 6.1m, water filled hole to 2.8m below grade immediately after drilling to 6.1m			92.0
9.0						Hole ended at 8.4m; refusal on suspected boulders			91.0
10.0						Sloughing to 6.1m below grade, water level at 2.8m below grade at completion of drilling			90.0
11.0						Hole filled with cuttings and plugged with bentonite at top and bottom			89.0
12.0									88.0
13.0									87.0
14.0									86.0
15.0									85.0
16.0									84.0
17.0									83.0
18.0									82.0
19.0									81.0
20.0									80.0

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LOGGED BY: DB	COMPLETION DEPTH: 8.39 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A24	Page 1 of 1

98/10/26 09:46AM (GEO_W2D)

CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 25
NEJMARK ARCHITECTS	DRILL RIG: RM30	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 100.16 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

DEPTH(m)	POCKET PEN (kPa) 100 200 300 400 / UNCONFINED COMP. (kPa) 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
0.0					SP		SAND (FILL) - poorly graded, fine to medium grained, damp, loose, brown, gravelly, roots, silty			100.0
			25-1		CL		CLAY (FILL) - low plastic, moist, soft, black/brown, roots, organics, sand, silt			
1.0			25-2				SAND - poorly graded, fine to medium grained, loose, very moist, brown, silty			99.0
2.0			25-3	33	SM		Wet below 1.8 m			98.0
			25-4							
3.0			25-5				CLAY - medium plastic, moist, firm to stiff, brown/grey, silty			97.0
			25-6		CI		Gravel traces below 4.1m			
4.0							CLAY TILL - high plastic, damp, firm, grey, silty			96.0
			25-7		CI					
5.0							Hole ended at 4.6m Sloughing and seepage to 2.0m Hole plugged with cuttings and bentonite at top and bottom			95.0
6.0										94.0
7.0										93.0
8.0										92.0
9.0										91.0
10.0										

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LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A25	Page 1 of 1

98/10/26 09:46AM (GEO_W10)

CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 26
NEJMARK ARCHITECTS	DRILL RIG: RM30	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 100.69 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

POCKET PEN (kPa) 100 200 300 400

UNCONFINED COMP. (kPa) 100 200 300 400

PLASTIC M.C. LIQUID 20 40 60 80

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	COMMENTS	ELEVATION(m)
0.0				OL		TOPSOIL - loamy, brown/black, organics, roots, moist, sandy, silty		100.0
1.0		26-1		CL		CLAY (FILL) - low plastic, moist, soft, black/brown, roots, organics, sand, silt		
		26-2						
2.0		26-3	35	GP		GRAVEL - poorly graded, fine to medium grain, wet, dense, brown		99.0
		26-4						
3.0		26-5		CH		CLAY - high plastic, moist, stiff, brown, some silt		98.0
		26-6						
4.0				CI		CLAY (TILL) - medium plastic, moist, stiff grey, gravelly		97.0
		26-7						
5.0						Hole ended at 4.6m Sloughing and seepage to 1.5m below grade at completion of drilling		96.0
6.0								95.0
7.0								94.0
8.0								93.0
9.0								92.0
10.0								91.0

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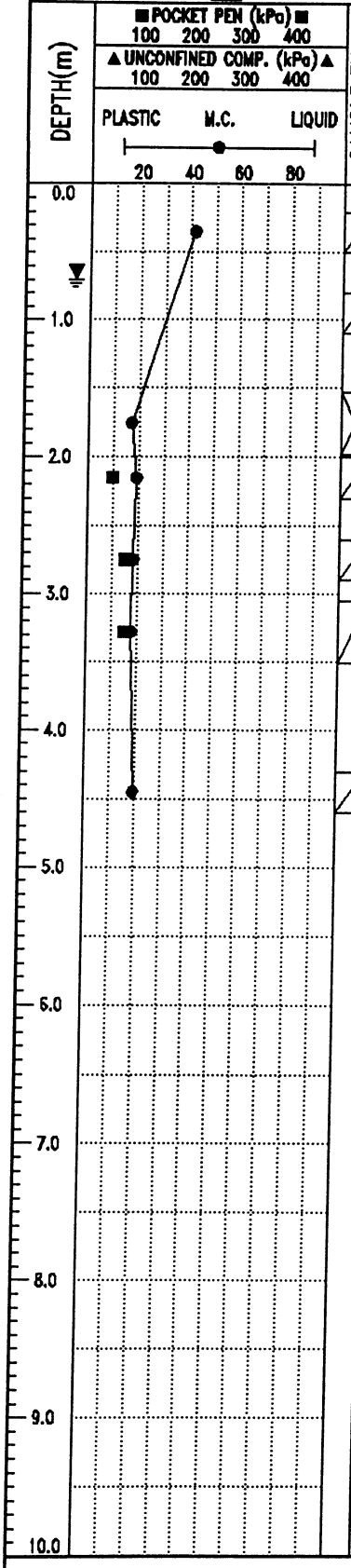
LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A26	Page 1 of 1

98/10/26 04:43PM (GEO_W10)

CANADIAN TIRE – BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 27
NEJMARK ARCHITECTS	DRILL RIG: RM30	PROJECT NO: WX04528
	AUGER: 125 MM	ELEVATION: 100.08 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	COMMENTS	ELEVATION(m)
					TOPSOIL – loamy, brown/black, organics, roots, moist, sandy, silty		100.0
	27-1		OL		SILT – low plastic, moist, soft, black/brown, roots, organics, sand, silt		
	27-2		CL		Very sandy from 0.6 to 1.1		99.0
					Silty sand from 1.1 to 1.2m		
					Wet below 0.63m		
	27-3	16			Sandy, gravelly from 1.2 to 1.5m		
	27-4				CLAY (TILL) – medium plastic, moist, firm to stiff, grey, gravelly		98.0
	27-5						
	27-6		CI				97.0
							96.0
	27-7						
					Hole ended at 4.6m		95.0
					Sloughing and seepage to 1.5m below grade at completion of drilling		
							94.0
							93.0
							92.0
							91.0

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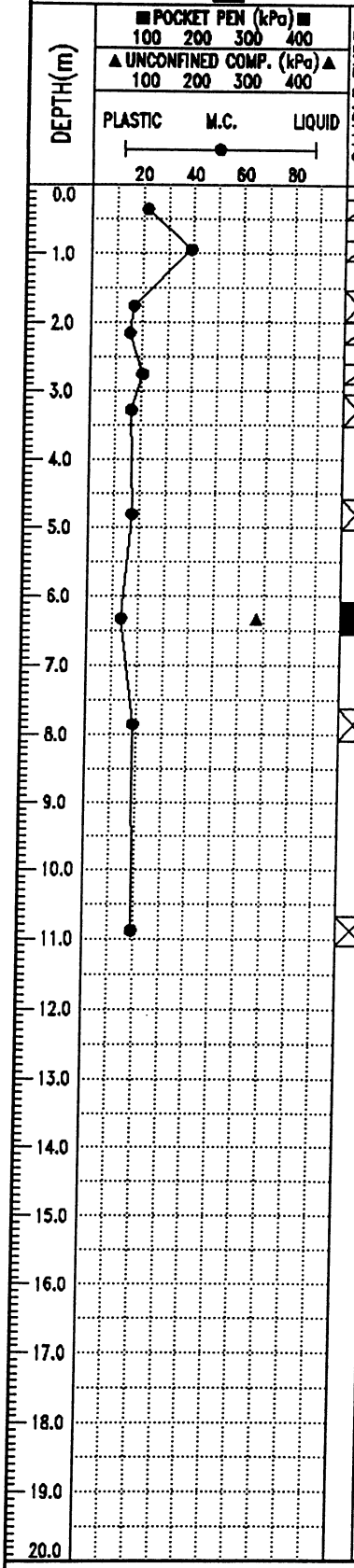
LOGGED BY: DB	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A27	Page 1 of 1

98/10/28 04:43PM (GEO_WTB)

CANADIAN TIRE - BRANDON	CONTRACTOR: PADDOCK DRILLING LTD.	TEST HOLE NO: 28
NEJMARK ARCHITECTS	DRILL RIG: CT250	PROJECT NO: WX04528
	AUGER: 125 MM SS / 150 MM HSA	ELEVATION: 99.59 m

SAMPLE TYPE: SHELBY TUBE | CUTTINGS | SPT | CORE | NO RECOVERY | CONT. SAMPLE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



SAMPLE TYPE	SAMPLE NO	SPT(N)	USC	SOIL SYMBOL	SOIL DESCRIPTION	INSTRUMENTATION DATA	COMMENTS	ELEVATION(m)
			OL					99.0
	28-1		CL		TOPSOIL - loamy, black, organics, roots, moist, grass, sandy, silty, gravelly			
	28-2		CL		CLAY (FILL)- low plastic, moist, firm, black, gravelly, silty, organics, roots			98.0
	28-3	19			CLAY - low plastic, moist to wet, stiff, grey, very silty			
	28-4		ML		SILT - low plastic, moist, stiff, grey, very sandy			97.0
	28-5				Gravel from 1.7 to 2.8m			
	28-6	10	CI		Wet from 1.8 to 2.6m			96.0
	28-7	12			CLAY - medium plastic, moist, stiff, brown, sandy			95.0
	28-8				CLAY (TILL) - medium plastic, moist, stiff grey, gravel			94.0
					Dark grey, very stiff below 6.1m			93.0
			CI					92.0
	28-9	25						91.0
								90.0
								89.0
	28-11	28						88.0
					The test hole was originally drilled to 4.6m with a solid stem auger, however was discontinued due to limitations of the drill rig. The hole was completed 1.5m from the original hole with a hollow stem auger. Little sloughing or seepage occurred in either hole. Holes were filled with cuttings and bentonite at bottom and top			87.0
								86.0
								85.0
								84.0
								83.0
								82.0
								81.0
								80.0

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LOGGED BY: DB	COMPLETION DEPTH: 11.1 m
REVIEWED BY: KBO	COMPLETE: 10/02/98
Fig. No: A28	Page 1 of 1

98/10/26 04:46PM (GEO_W2D)

AGRA
Earth & Environmental Limited

PARTICLE-SIZE ANALYSIS REPORT

TO: Canadian Tire

OFFICE: WINNIPEG
PROJECT NO: WX-04528
CLIENT:
SAMPLE NO.: TH13-2@3'

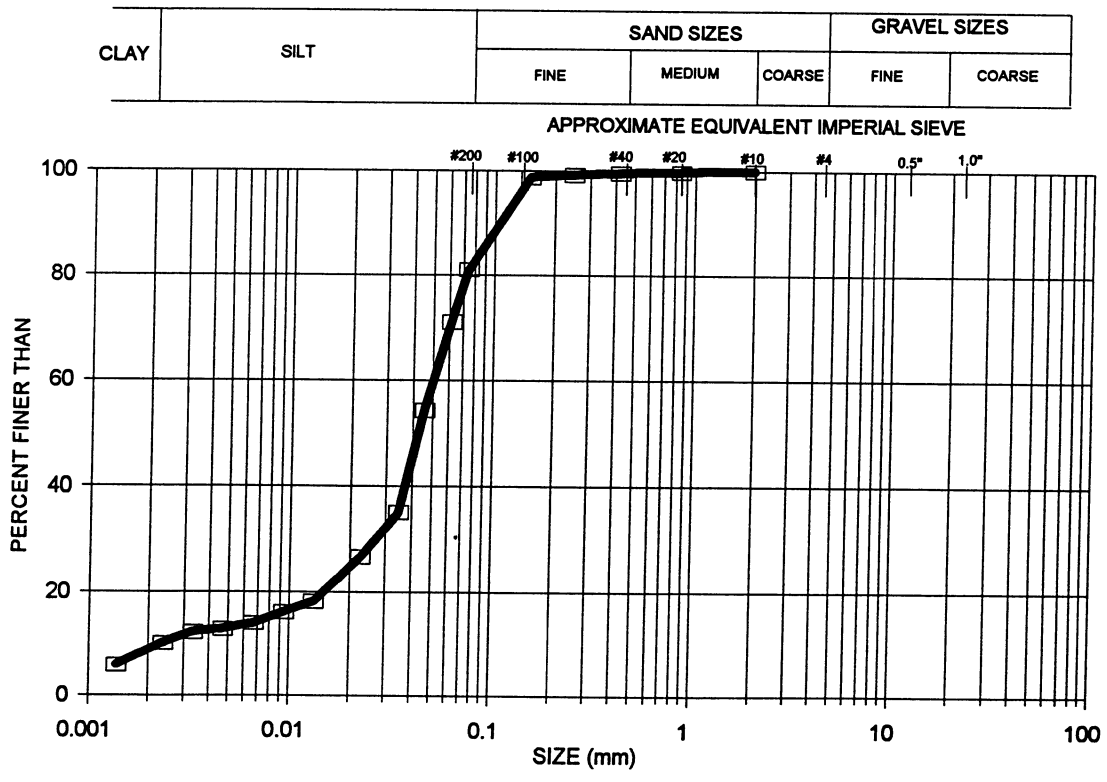
ATTN:

COPIES TO:

PROJECT: Canadian Tire Store - Proposed addition, Brandon, Mb.

TYPE OF SAMPLE: SAMPLED BY: AEE DATE SAMPLED:

DATE RECEIVED: DATE TESTED: October 8, 1998 SOURCE: TH13 @ 3'



SIEVE SIZE (mm)	PERCENT PASSING
2.0	100.0
0.85	99.8
0.425	99.6
0.250	99.2
0.150	98.7
0.075	81.0
0.0621	71.1
0.0465	54.2
0.0349	35.1
0.0225	26.7
0.0133	18.2
0.0095	16.1
0.0067	14.0
0.0048	12.9
0.0033	12.3
0.0024	10.2
0.0014	5.9

SAMPLE DESCRIPTION: Silt, very sandy, some clay
METHOD OF PREPARATION: Hydrometer method
COMMENTS:

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Figure 29

APPENDIX B

GRANULAR SPECIFICATIONS

REQUIREMENTS FOR GRANULAR BASE COURSE

Gradation

SIEVE SIZE	PERCENT PASSING (by dry mass)
3/4"	100
5/8"	80 - 100
#4	40 - 70
#10	25 - 55
#40	15 - 30
#200	5 - 15

Quality Requirements

1. The aggregate should be crushed and have a minimum CBR of 60 percent.

2. The dry material retained on the #4 sieve should have a minimum of 35 percent by dry mass with at least two fractured faces.

3. The material passing the #40 sieve should have a liquid limit of less than 25% and a maximum plasticity index of 6%.

4. The coarse fraction of the aggregate should have a percent wear by the Los Angeles abrasion test of not more than 35.

5. The aggregate should be sound, hard, durable stone or gravel free of soft, thin, elongated particles, organics or other deleterious material.

REQUIREMENTS FOR GRANULAR SUB-BASE

Gradation

SIEVE SIZE	PERCENT PASSING (by dry mass)
1.5"	100
1"	85 - 100
#4	25 - 80
#40	15 - 40
#200	8 - 18

Quality Requirements

1. The aggregate should be crushed and have a minimum CBR of 30 percent.

2. The dry material retained on the #4 sieve should have a minimum of 15 percent by dry mass with at least two fractured faces.

3. The material passing the #40 sieve should have a liquid limit of less than 25% and a maximum plasticity index of 6%.

4. The coarse fraction of the aggregate should have a percent wear by the Los Angeles abrasion test of not more than 40.

5. The aggregate should be sound, hard, durable stone or gravel free of soft, thin, elongated particles, organics or other deleterious material.