Report

Associated Engineering

GLOBAL PERSPECTIVE.
LOCAL FOCUS.

City of Yorkton

Commercial Subdivision Serviceability Study

December 2010

ASSOCIATION OF PROFESSIONAL ENGINEERS
AND GEOSCIENTISTS OF SASKATCHEWAN
CERTIFICATE OF AUTHORIZATION
ASSOCIATED ENGINEERING (SASK.) LTD.
NUMBER
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Permission to Consult Held By:

Discipline	Sask. Reg. No.	Signature
civil/mech	6614	

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF

Signature:

Date: Dec 6/06

PROFESSIONAL ENGINEER
J.H. HORNER
MEMBER 10460
10 12 06
YR. MN. DAY
SASKATCHEWAN

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1 Introduction

1.1 PURPOSE

The City of Yorkton has identified approximately 32 ha (80 acres) of land located near the south eastern city limit for potential commercial development (refer to Figure 1 in Appendix D). The City's intent is to develop the parcel of land into a commercial subdivision to accommodate the growing demand for retail and light industrial space within the city limits. Yorkton has experienced strong economic development in recent years, and is anticipating the need for additional commercial lots to meet the current and future needs of existing and new businesses.

This serviceability study is intended to determine the requirements for a number of items such as water and sanitary sewer servicing, storm water management, site design criteria, traffic impacts, geotechnical, environmental, and other site constraints.

1.2 LOCATION

The land of interest is bounded by Highway 9 to the west, Highway 16 (Queen Street) to the south, and the Canadian Pacific Railway (CPR) tracks running from the northwest to southeast. The land is located on portions of SW ¼ 36-25-4-W2M.

1.3 LAND OWNERSHIP

There are currently four separate land title holders within the land area under consideration for the commercial subdivision. The City of Yorkton is the primary title holder, holding the surface rights to the majority of the land area. The title for a small parcel of land in the south-west corner is held by the SaskPower Corporation as a CNV easement. The Yorkton Creek Watershed Association Board holds the surface land title for an irregularly shaped land parcel in the south-east corner, and an irregularly shaped parcel of land bordering the CPR tracks has a title owned by the Manitoba and North Western Railway Company of Canada. The City will be required to purchase the above parcels from the respective land owners prior to the commencement of construction activities. Given that the parcels are primarily owned by utilities agencies, we recommend beginning negotiations immediately as it could present a risk to the overall project schedule. An illustration of the land parcels included in the proposed subdivision area is included in Appendix A.

2 Existing Conditions

2.1 SITE CHARACTERISTICS

The land proposed for the commercial subdivision is currently cultivated and used for agricultural purposes, with the exception of the City of Yorkton Tourism and Chamber of Commerce Centre located on the western edge of the parcel. The site has gently rolling topography ranging in elevation from 503.0 m to 507.0 m. At the time of the most recent site visit, the south west portion of the land area owned by SaskPower was wet and marshy. Despite the unusually wet spring and summer months, vegetation present suggests this particular area is usually wet in relation to the surrounding land. This wet area will require specific consideration during the detailed design.

2.2 GEOTECHNICAL INVESTIGATION

P. Machibroda Engineering Ltd. was commissioned to complete the geotechnical investigation. The scope of the geotechnical investigation included a field drilling and sampling program, laboratory analysis, and design recommendations.

The field drilling program was conducted between August 30 and September 2, 2010. The program consisted of thirteen testholes drilled to a depth of 8.1 m to 18.0 m below the existing ground surface. Test hole logs were completed recording soil stratification, groundwater conditions, the position of unstable sloughing soils, and the depth at which boulders were encountered. Peizometers were installed at each testhole for groundwater monitoring purposes, and all testhole locations were surveyed with RTK GPS equipment providing a correlation with the topographical site survey.

The general soil profile consisted of organic topsoil overlying highly variable deposits of clay, glacial till, silt, clay shale, sand and gravel to depths of approximately 12 m to 15 m. Extensive groundwater seepage and sloughing conditions were encountered within the sand and gravel deposits during test drilling. The groundwater elevation as recorded on September 10, 2010 varies from 0.3 m to 5.5 m below the ground surface, with an average depth of 2.6 m. The groundwater geodetic elevation is measured between 501.0 m to 502.0 m.

Given the highly variable soil conditions and the relatively high water table, it is recommended that the following design considerations by followed:

- Design grades should be maintained as high as possible to minimize the potential for groundwater related issues.
- Excavation below the groundwater table should be minimized where possible. Dewatering may be required for some construction operations.
- Extensive amounts of fill material will likely be required over the entire site. The fill should be imported and have non-expansive properties.
- Fill material should be placed in maximum 150 mm lifts and compacted to 98% Standard Proctor Density.

- The use of geotextile/geogrid is recommended where soft/wet soil conditions are encountered.
- Free-draining granular aggregate should be used in the bottom of wet excavation areas to minimize the disturbance of the underlying soil.
- Buildings constructed within the development are anticipated to require pile and grade beam foundation systems and grade supported concrete floor slabs.
- Individual developers should complete additional geotechnical analysis on their parcel specific to their needs.

Additional details related to the geotechnical investigation can be found in Machibroda's final geotechnical report attached as Appendix B.

2.3 ENVIRONMENTAL AND HERITAGE SCREENING

Associated Engineering commissioned Golder Associates to complete a desktop environmental screening as part of the subdivision serviceability study. The objective of their work was to document the current environmental conditions, to summarize the regulatory contacts that will be required if the project proceeds, identify any potential environmental issues that may require additional assessment, and provide any recommended mitigation measures that could be implemented during site preparation and construction.

Although there is a large permanent wetland basin located in the southeast corner of the proposed subdivision, along with three smaller ephemeral wetland basins, none of the wetlands observed were deemed to be potential fish habitat. If the existing drainage ditch is used to transport storm water from the proposed subdivision east to Yorkton Creek, appropriate sediment and erosion control measures will be required to reduce the potential impact on fish habitat in Yorkton Creek.

A vegetation assessment was conducted in the project area on August 20, 2010 to categorize existing vegetation communities and to identify any listed plants or potential listed plant habitat, as well as any noxious weedy species listed under the Saskatchewan Noxious Weed Act. The proposed subdivision is comprised of previously disturbed (cultivated) habitat with limited parcels of native habitat types (wetlands and woody habitat) present. No federally or provincially listed plant species were observed during the field survey and habitat suitability for these species is generally limited in the area. No specific mitigation measures are required.

Although the project area has been fragmented by cultivation and influenced by urban development, the natural habitat that remains still provides nesting, breeding, foraging, and escape cover habitat for birds, small mammals, and ungulates. A visual wildlife survey was conducted on August 20, 2010 to determine if there were any rare or listed species present or if any sensitive or key wildlife habitats for these species are encountered by the proposed subdivision. No unique habitat types or features were observed in the immediate area. As the proposed subdivision is comprised primarily of previously disturbed habitat (cropland) and wildlife habitat is limited, no specific mitigation measures are required.

There are however timing restrictions that should be followed during construction. Clearing and grubbing operations should be completed prior to the spring nesting and breeding period to avoid destroying occupied nests. If construction activities are delayed into the spring/summer period April 1, pre-construction bird surveys will be required to identify wildlife nesting/breeding locations. If nesting or breeding sites are found during the surveys, additional mitigation measures may be required and the appropriate activity restrictions must be adhered to.

Although the development is entirely within the city limits, the Ministry of Environment (MOE) office in Melville should be contacted regarding any concerns they may have with the proposed project. In addition, an Aquatic Habitat Protection Permit (AHPP) will also be required from MOE prior to the commencement of construction activities associated with the wetland area in the south project limit. MOE may request compensation for the loss of wetland habitat affected by the project. This may require the submission of a wetland compensation plan.

A review of heritage resources was also completed. As per Section 66 of The Heritage Property Act, all heritage resources on privately owned land and provincial Crown land are considered to be property of the Crown. It is the responsibility of the developer to submit all proposed operations for regulatory review to the Heritage Resources Branch. The proposed project was submitted to the Heritage Resources Branch for review on August 20, 2010. The Heritage Resources Branch reviewed the project details and determined that a Heritage Resources Impact Assessment (HRIA) is not required should the project proceed as proposed. A copy of the response letter is contained in Golder's report, which is included in Appendix C. No further work related to heritage resources is required prior to construction activities.

If heritage resources are encountered during construction activities, construction shall cease immediately and the site will be documented. Consultation with Heritage Resources Branch would be required to determine the most suitable course of action (feature mapping, excavation, or avoidance).

3 Conceptual Design

3.1 POTENTIAL LAND USE

The proposed zoning by City of Yorkton has specified that this site will accommodate commercial and/or light industrial businesses. This could encompass a wide range of business types that have vastly different potable water demands, sewage production volumes, and transportation access requirements. Depending on the types of businesses that are expected for this development, the conceptual design may require modifications during the detailed design stage.

3.2 CONCEPTUAL LAYOUT

The conceptual layout developed for the serviceability study has been designed for the needs of a commercial or light industrial subdivision with very little pedestrian traffic and no on-street parking. This allows for a larger developed lot size suitable for businesses such as automobile dealerships, hotels, and large-scale retail outlets.

The City of Yorkton has developed a conceptual site layout for the proposed project. The concept provided to Associated Engineering at the beginning of the study process consisted of a total of 17 commercial lots, which incorporates the existing Tourism and Chamber of Commerce site. The proposed layout also consisted of direct access to Highway 9 located in the vicinity of the existing access, as well as direct access to Highway 16 located at approximately the halfway point along the south development boundary. The combined area of all 17 lots is 25.30 ha (62.6 acres). A copy of the original concept plan is shown on Figure 5 Appendix D.

Although the development of additional concept plans was not part of the original project scope, the City felt it was desirable to extend the existing “T” intersection at King Street, providing access to the proposed subdivision. To accommodate this change, additional roadways were required within the subdivision placed parallel to the existing CPR tracks. Other minor revisions were also completed including insertion of curves at the roadway deflection points, and a realignment of the cul-de-sac to better balance the individual lot areas in the south eastern corner of the subdivision. The final conceptual plan includes a fully directional access to Highway 16 (no change from original concept), a fully directional access to Highway 9 (extension of King Street), and a “right-in/right-out” access near the existing tourist info access.

The final conceptual plan consists of a total of 16 commercial lots ranging in size from 0.97 ha (2.4 acres) to 2.10 ha (5.2 acres) in size, with a combined saleable area of 24.04 ha (59.4 acres). This includes the lot already occupied by the Tourism and Chamber of Commerce. Figure 1 contained in Appendix D provides an illustration of the proposed lot shapes and sizes, roadway layout, access locations, and possible construction staging.

4 Transportation

4.1 SITE ACCESS

The parcel of land under consideration is bounded at the west by Highway 9 and at the south by Highway 16 (Queen Street). Currently the only access roadway is the entrance and exit for the City of Yorkton's Tourism and Chamber of Commerce Centre. Both of these access points adjoin Highway 9. Optimally, the new conceptual plan will include direct access to both Highway 9 and Highway 16. The access to Highway 9 will include a revised access in the vicinity of the existing Tourism access, and provide for a new access at the north end of the project, extending from King Street into the proposed subdivision. It is recommended that the existing Tourism access be relocated to the new subdivision roadway, or as a minimum reduce the existing dual access to a single point on Highway 9. The access to Highway 16 would be located at the approximate midpoint along the south boundary of the subdivision.

The Ministry of Highways and Infrastructure (MHI) was contacted to discuss the proposed project and access locations along Highway 9 and Highway 16. As the entire project is contained within the city limits, MHI does not have authorization to provide a determination on the suitability of the proposed access locations. All control of access decisions within the proposed project area reside with the City of Yorkton.

4.2 TRAFFIC ANALYSIS & INTERSECTION REQUIREMENTS

A traffic analysis was completed following the Institute of Transportation Engineers (ITE) methodology for Transportation Impact Analysis for Site Development. The analysis was completed at a conceptual level to determine serviceability needs for the development.

Several assumptions, including potential land uses, are noted throughout the analysis which will require confirmation as development progresses. The type of land use has a direct impact on the amount of traffic that will be generated. The traffic analysis was completed for both commercial and light industrial land use scenarios. The commercial retail category has higher trip generators than the light industrial category.

Details of the traffic analysis are provided in Appendix E. The following is a summary of the various intersection improvements required for full build-out of the development site.

King Street Intersection Improvements:

- Southbound left turn lane, 60 m taper and 45 m of storage (light industrial) or 85 m of storage (commercial).
- Northbound left turn lane to align with southbound, minimum length consisting of 15 m storage and 60 m taper.
- Northbound acceleration lane not recommended due to proximity of railway tracks.
- Northbound right turn lane not required for capacity but recommended for safety and consistency along the corridor.
- Westbound right turn lane and a shared through/left turn lane.
- Traffic Signals would be required.
- Improvements to the railway crossing warning system may be required.

South Intersection on Highway 9 Improvements:

- Southbound left turn lane, 85 m of storage length and 60 m of taper.
- Northbound right turn lane.
- Westbound right turn lane.
- Stop sign (light industrial) or potential traffic signals (commercial) on the new road for westbound traffic.

Highway 16 Intersection:

- Eastbound left turn lane is not warranted.
- Westbound right turn is not warranted.
- Reduce speed limit to 70 km/hr.
- Stop sign on the new road for southbound traffic.
- Separate southbound right turn lane and left turn lane.

Intersection improvements for the first stage of development are described below. The first stage is based on only a car dealership and a hotel being development initially, providing the City with an opportunity to test the phasing for implementing improvements on adjacent roadways.

King Street Intersection Improvements:

- Traffic Signals warranted by 2015. Would be prudent to monitor traffic volumes and install only when warranted.
- Construct all turn lanes to ultimate size requirements.
- Southbound left turn lane. The City would be required to make a decision around the storage length (ie. construct for lower or higher trip generation scenarios).
- Northbound left turn lane to align with southbound, minimum length consisting of 15 m storage and 60 m taper.
- Northbound acceleration lane not recommended due to proximity of railway tracks.
- Northbound right turn lane not required for capacity but recommended for safety and consistency along the corridor.
- Westbound right turn lane and a shared through/left turn lane.
- Improvements to the railway crossing warning system would likely not be required. Additional traffic studies would be required to provide justification to CPR.

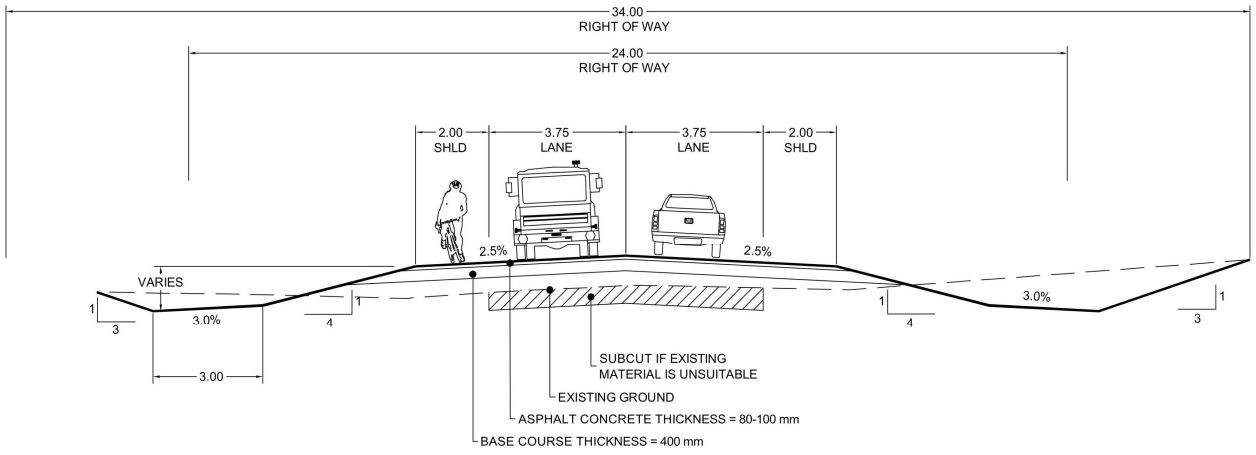
4.3 INTERNAL ROADWAY CROSS-SECTION

The roadway design criteria values used were developed primarily through discussion with the City of Yorkton, with reference to the Province of Saskatchewan Subdivision Regulations, and Transportation Association of Canada (TAC) Geometric Design Guidelines. The City had initially expressed a preference for 24.0 m road allowances; however, we recommend considering a 34.0 m road allowance to accommodate storm water routing and lot grading. Design parameters of the recommended roadway cross-section include:

- 34.0 metre right-of-way (road allowance). Additional width may be required at primary access locations to account for additional lanes.
- Maximum 60 km/hr operating speed.
- 3.75 m lane width.
- 2.0 m shoulder width.
- 2.5% cross slope.
- No sidewalks.
- No on-street parking.
- Asphalt concrete surfacing.
- Storm water drainage ditches on both sides of the roadway with surface drainage via corrugated steel pipe culverts (450 mm minimum diameter).
- Minimum 9.0 m at intersection radii.
- Asphalt concrete pavement thickness to be based on anticipated traffic volumes and axle loading.
- Street lights to be based on standards for light industrial conditions.
- Traffic signage to be based on latest standards and regulations.

It should be noted that the conceptual design (Figure 1) is based on the City's request to use a 24.0 m wide right-of-way. Changes would be required to incorporate the recommended 34.0 m right-of-way. These changes will have a minor impact on the individual parcel dimensions and areas.
The following figure illustrates a typical rural collector roadway cross-section with both 24.0 m and 34.0 m right-of-ways to identify the limitations.

COLLECTOR- COMMERCIAL



5 Utility Servicing

All new services for the proposed commercial development will be required to tie into the City's existing infrastructure. Potable water, sanitary sewer, and storm sewer connections should be designed as efficiently as possible taking advantage of the features of the existing municipal service network. In addition, consideration should be given to other future development areas within the city during the determination of servicing requirements. There may be benefits to upsizing services for the current requirements in order to account for and minimize the cost to future developments.

5.1 EARTHWORKS AND GRADING

The proposed grading plan for this commercial development is based on surface drainage with a series of drainage channels or overland ditches for storm water management. Storm water will be required to run overland through a series of ditches and will flow to one of two designated discharge points located in the east and the south-east. The following design parameters were used in developing the proposed grading plan:

- Minimum 2% surface slope, on all lots, from the ground elevation at the building to the design elevation at the front, back or side of the lot.
- Minimum 0.5 m drop, on all lots, from the ground elevation at the building to the design elevation at the front or back of the lot.
- Minimum 0.3 m drop, on all lots, from the ground elevation at the building to the design elevation at the side yard of the lot.
- Preferred minimum 0.5% surface slope for all ditches, drainage channels and easements.

Any existing feature, generally along the boundary of the proposed development site that is required to remain unchanged can be considered a design constraint. Constraints to the proposed grading plan include:

- Existing drainage ditch crossing at the south-east corner near the intersection of Highway 16 and the CPR right-of-way.
- The alignment of Highway 16 and Highway 9, and the associated highway right-of-ways.
- The naturally occurring groundwater elevation in the area.

Figure 4 in Appendix D illustrates the basic grading plan for the proposed commercial development.

In addition to the high water table, the existing site is relatively low, requiring a significant amount of imported earth fill to achieve the design elevations. The primary influence on the grading design is the minimum ditch elevations which must be achieved to ensure gravity surface drainage off the site. The initial site elevation was determined by applying these minimum ditch elevations along with minimum ditch gradients, and minimum ditch depths.

It is reasonable to expect that some unsuitable material will be encountered near the existing wetland basin. An estimate of unsuitable material has been made and is included in the cost estimate. This material will

be removed and disposed of offsite, and replaced with suitable imported earth fill. Additional comments specific to the earth embankment procedures and construction techniques in the low wetland area are included in the geotechnical report located in Appendix B.

The availability of earth fill material in the nearby area has the potential to significantly impact the project costs. It may be desirable to investigate adjacent properties for potential borrow sources. The cost to purchase a borrow source in nearby cultivated land would likely be offset by the savings associated with trucking earth material from a further location. The challenge will be to find a source which is not impacted by a high water table. Alternatively, the City may wish to explore the option of trucking earth fill material from the future residential subdivision located north of York Road and east of Highway 9. Although there would be trucking costs associated with this haul, it would provide the City with the opportunity to complete rough grading at the residential site at minimal cost.

5.2 STORM WATER SYSTEM

The proposed commercial development will use overland drainage to manage storm water flows. Collection of storm water and the use of drainage channels or ditches to divert the water to a discharge point is widely accepted and effective. The proposed storm water drainage ditch system is composed of main collecting ditches that will run parallel to roadways and smaller drainage ditches between each of the lots and along the back edges of the properties. The individual lot developers will be required to maintain these elevations to ensure proper drainage and reduce conflicts.

The conceptual design has the storm water collection system discharging at two separate points; one to the east into a drainage ditch along the CPR right-of-way and through an existing culvert under the railway, and one at the south-east corner of the land parcel intersecting with an existing drainage ditch. This concept retains the natural drainage patterns thereby reducing the concerns from Saskatchewan Watershed Authority. However, additional analysis is required at the detailed design stage to estimate the differences between pre-development and post-development storm water flows, and to develop mitigation techniques to reduce the impact to downstream users.

We understand that the existing low lying area located between Highway 9 and Wal-Mart serves as storm water storage and that the City does not intend to develop this area. This area may require expansion to account for the additional flows that will be experienced from the north portion of the subdivision, minimizing the impact on the City's Dracup storm water system.

Bordering the southern edge of the proposed development is a drainage ditch owned by the Yorkton Creek Watershed Association (YCWA). This ditch conveys water east approximately 2.5 km (1.5 miles) before discharging into Yorkton Creek. Our understanding based on discussion with Saskatchewan Watershed Authority, is that this ditch was constructed in the 1970's as part of a regional water project intended to divert water from Willowcreek to fill a number of wetland areas before discharging the excess water into Yorkton Creek. Given the nature of the regional project, the interconnection of a number of wetland areas by constructed drainage ditches should result in a flat hydrograph and would not typically be expected to coincide with storm water run-off from the proposed subdivision.

Discussions with the YCWA are required to determine if this ditch can be used by the City for conveyance of storm water east to Yorkton Creek. No costs for improvements to this ditch, or the construction of a new ditch, have been included in our cost estimate.

The conceptual design for the storm water system does not include the construction of an on-site storm water holding pond. Storm water holding ponds have become a popular method of collecting large volumes of storm water for a short period of time, allowing it time to move through the drainage system at a more manageable pace and avoiding back-ups and localized flooding. The design elevations required to meet drainage requirements are not favourable for the construction of a storm water holding pond at this site. If the City wishes to investigate the addition of a storm water holding pond it is recommended that it be located outside the subdivision boundary. In addition, a storm water pond may be required by MOE as compensation for the loss of wetland habituated affected by the project.

Further storm water analysis is required at the detailed design stage. Additionally, communication should take place with CPR, MOE and the YCWA as their requirements could have a significant impact on the final storm water design.

Figure 3 in Appendix D includes the basic design layout of the storm water collection system.

5.3 SANITARY SEWER SYSTEM

The City of Yorkton currently operates a gravity flow sanitary sewer system with a number of sewage lift stations. Sanitary sewer connections are required between the proposed subdivision and the nearby existing sanitary network. The nearest suitable main for connection is a 300 mm diameter polyvinylchloride (PVC) sanitary sewage main that is buried in the east ditch of Highway 9. This sewage main has an approximate gradient of 0.20% with a calculated maximum flowrate of 0.056 m3/s.

To determine the sanitary sewer requirements for the proposed subdivision, a conceptual design layout was developed using the following parameters:

- Minimum pipe bury depth of 3.0 m from existing ground surface.
- Maximum 110 m spacing between manholes.
- Standard 1050 mm diameter precast concrete manholes.
- PVC – DR 35 sewer pipe.
- Minimum 0.20% slope on 300 mm diameter pipe.
- Assume pipe flowing full.
- Minimum flow velocity of 0.6 m/s.
- Estimated sewage production of 22.2 l/s including inflow and infiltration. This value represents typical flows that can be expected for commercial or light industrial land use of this size.

The conceptual layout of the sanitary sewer system is shown in Figure 2 in Appendix D.

One outstanding task related to the sanitary sewer design is the confirmation of downstream capacity. It is our understanding that the City does have accurate record information containing the pipe material, size, slope, and elevation for the area between the proposed subdivision and the waste water treatment plant. From this record information we are able to calculate the maximum capacity of individual pipe segments. However, we are unable to calculate or comment on the estimated flows that are presently experienced within these pipes as they are interconnected to other areas of the City's sanitary sewer system. We require the City's input to estimate the current flow rates, allowing us to calculate the available capacity in the system, and identify any downstream bottlenecks that require upgrading to support the additional flows from the proposed subdivision.

5.4 WATER DISTRIBUTION SYSTEM

Although the City of Yorkton does not have documented fire flow standards, other City's such as Regina have standards which state that light commercial development require approximately 150 L/s of fire flow. This minimum allowable watermain pressure to achieve this fire flow is 150 kPa (21.75 psi) according to the Fire Underwriters. Several options were investigated in order to provide the required 150 L/s fire flow.

The single existing 200 mm diameter distribution main running south along Highway No. 9 is inadequate to support a 150 L/s fire flow due to pressure loss during high flows. In addition to significant pressure loss, a single supply to a subdivision is risky and multiple supply sources are recommended to ensure a secure supply to residents. As such, a second connection from the Queen Street Water Treatment Plant is recommended. In addition to providing a second supply source to the subdivision, connecting to the dead-end watermain at Highway No. 9 will strengthen the entire distribution system in the southeast.

A minimum 250 mm diameter supply main is required from the water treatment plant to the subdivision. However, based on long term water distribution planning efforts completed by Associated Engineering and City of Yorkton staff in 2008, a 400 mm diameter water main is recommended to support further development east of Highway No. 9 and south of Queen Street.

Refer to Figure 2 in Appendix D for the proposed water distribution system layout, diameters and connection points. The proposed water distribution for the commercial subdivision was added to the City's existing computerized water model. The system was modeled under the current average day, peak hour and maximum day plus fire flow demands.

To determine the water costs for the proposed subdivision, a conceptual design layout was developed using the following parameters:

- Minimum pipe bury depth of 3.0 m.
- Minimum hydrant spacing of 100 m.
- Water pipe PVC DR-18 to AWWA C900 standard.
- Gate valves to AWWA C509 standard.

According to water modeling simulations, the proposed water distribution system under current demands is capable of providing in the order of 250 L/s of fire flow to the subdivision, well above the fire flow of

approximately 150 L/s required for commercial development. Average day and peak hour pressures are expected to range between 510 to 545 kPa (74 to 79 psi) and 505 to 540 kPa (73 to 78 psi) respectively, well above the City of Yorkton's desired minimum pressure of 310 kPa (45 psi).

5.5 OTHER UTILITIES

CPR was contacted to discuss the potential impact on their existing railway crossing at Highway 9. They did confirm that a new warning system complete with gates would be required at the crossing if it was likely that southbound traffic would queue past the tracks. To avoid the upgrades at the railway crossing the City is required to complete a traffic study illustrating that traffic is not expect to queue past the tracks.

Given the number of growth scenarios that are possible with the new subdivison, it is difficult to determine the immediate impact the project will have on the existing railway crossing. It is our recommendation that the City complete further traffic studies to determine an approximate timeframe of when southbound traffic waiting to enter the subdivision may queue beyond the railway tracks, and therefore requiring upgrading. It is our belief that a staged construction approach to the project could defer costly expenditures related to the upgrading of the railway crossing and warning system.

Although information requests have been sent to SaskEnergy, SaskPower, and SaskTel, we have not received any formal responses to date. We will continue to communicate with the above utility agencies and include their information for the final report.

It should be noted that the utility costs included in this report are estimates only and could change based on the actual response received from the respective agencies.

6 Cost Analysis

A conceptual level cost estimate has been prepared for the proposed commercial subdivision based on the following assumptions:

- GST and other applicable taxes have not been included.
- Estimate values based on 2010 dollars.
- Estimate values could vary ± 20%.

The conceptual cost estimate for the development of a commercial subdivision in this location totals $10,600,000. This value assumes the project is completed as a single phase construction. The following table summarizes the capital costs associated with the conceptual design.
The option to stage the project and distribute the capital costs involved has also been developed. This approach divides the project construction into three distinct stages, with the first phase being the most costly due to some off-site servicing (new water main) that is required at the beginning of construction. The total conceptual cost using a staged approach is slightly higher than that of a single contract due to the additional costs of mobilization and demobilization multiple times. The following table summarizes the capital costs associated with each of the three construction stages.

Table 6-1
Conceptual Cost Estimate Summary

ITEM	DESCRIPTION	COST
1.0	Mobilization and Demobilization	$ 150,000
2.0	Site Preparation	$ 3,980,000
3.0	Roadwork	$ 1,020,000
4.0	Traffic Signal Controls	$ 500,000
5.0	Sanitary Sewer	$ 530,000
6.0	Potable Water	$ 1,040,000
7.0	Water Treatment Plant Upgrades	$ 100,000
8.0	Land Purchase	$ 50,000
9.0	Crown Utilities	$ 500,000
	Construction Subtotal	**$ 7,870,000**
	Contingency (20%)	$ 1,590,000
	Engineering and Professional Services (12%)	$ 1,140,000
	TOTAL (EXCLUDING GST)	**$ 10,600,000**

Table 6-2
Conceptual Cost Estimate Summary – Stages Construction

ITEM	DESCRIPTION	STAGE 1	STAGE 2	STAGE 3	PROJECT TOTAL
1.0	Mobilization and Demobilization	$ 50,000	$ 50,000	$ 50,000	$ 150,000
2.0	Site Preparation	$ 950,000	$ 1,830,000	$ 1,200,000	$ 3,980,000
3.0	Roadwork	$ 510,000	$ 390,000	$ 120,000	$ 1,020,000
4.0	Traffic Signal Controls	$ 250,000	$ 250,000	$ -	$ 500,000
5.0	Sanitary Sewer	$ 330,000	$ 160,000	$ 40,000	$ 530,000
6.0	Potable Water	$ 780,000	$ 210,000	$ 50,000	$ 1,040,000
7.0	Water Treatment Plant Upgrades	$ 100,000	$ -	$ -	$ 100,000
8.0	Land Purchase	$ 50,000	$ -	$ -	$ 50,000
9.0	Crown Utilities	$ 350,000	$ 100,000	$ 50,000	$ 500,000
	Construction Subtotal	**$ 3,370,000**	**$ 2,990,000**	**$ 1,510,000**	**$ 7,870,000**
	Contingency (20%)	$ 680,000	$ 600,000	$ 310,000	$ 1,590,000
	Engineering and Professional Services (12%)	$ 490,000	$ 430,000	$ 220,000	$ 1,140,000
	TOTAL (EXCLUDING GST)	**$ 4,540,000**	**$ 4,020,000**	**$ 2,040,000**	**$ 10,600,000**

7 Conclusion and Recommendations

The primary objective of this study was to assess the feasibility of a commercial subdivision considering a number of factors. After assessing these factors it is our opinion that this site is well suited to the City's proposed commercial subdivision. It has excellent highway frontage which should be attractive to potential businesses, the location is relatively close to the new water treatment plant providing easy water supply, it is located on the edge of the city limits which accommodates storm water drainage, and does not present any significant environmental or heritage concerns. The most significant drawback of this site is the high groundwater elevation resulting in a large amount of earth fill required to be imported to the site. There are some other risks associated with the high groundwater elevation which include the higher amounts of unsuitable material, potential construction difficulties, and future settlement. However, based on the recommendations in the geotechnical report, these risks can be minimized by following a number of mitigation techniques.

The following is a list of recommendations if the City wishes to move ahead with the project:

- Immediately begin land negotiations with property owners who have land within the proposed subdivision area (CPR, SaskPower, Yorkton Creek Watershed Association).
- Begin communication with the Yorkton Creek Watershed Association (YCWA) to assess the possibility of using their drainage ditch to convey storm water.
- Finalize a storm water management plan.
- Investigate and confirm possible sources of fill material for site grading.
- Discuss final storm water management plan with CPR, MOE, and YCWA .
- Confirm the downstream capacity of the existing sanitary sewage collection system.
- Contact the Ministry of Environment Melville office for project review.
- Review the proposed staged construction approach and modify as necessary to fit the City's budget and development requirements.
- Complete additional traffic analysis based on the final construction staging plan to determine timing of signal requirements and the need for railway crossing improvements.
- Begin work on the detailed design and contract documents for the first stage of construction.
- Continue communication with utility agencies to reduce risk to the project schedule.
- Develop an agreement for lot purchases/developers which would outline site requirements such as:
    - Site specific geotechnical investigation required for all structures.
    - Site and building grade requirements and maintenance of site grades.
    - Site access requirements.
    - Plan approvals.

A Appendix A – Legal Land Title Registry Descriptions

P:\20104734\00_COY_Com_Sub_Stdy\Working_Dwgs\100_Civil\FIG\REPORT\4734-00-FG-05.dwg
DATE: 2010-10-26, Jonathan Zapski

PROJECT No.	20104734
DATE:	2010/10/19
APPROVED:	J.H.
SCALE:	1:2500
DWG. No.	4734-00-FG-05

Associated Engineering

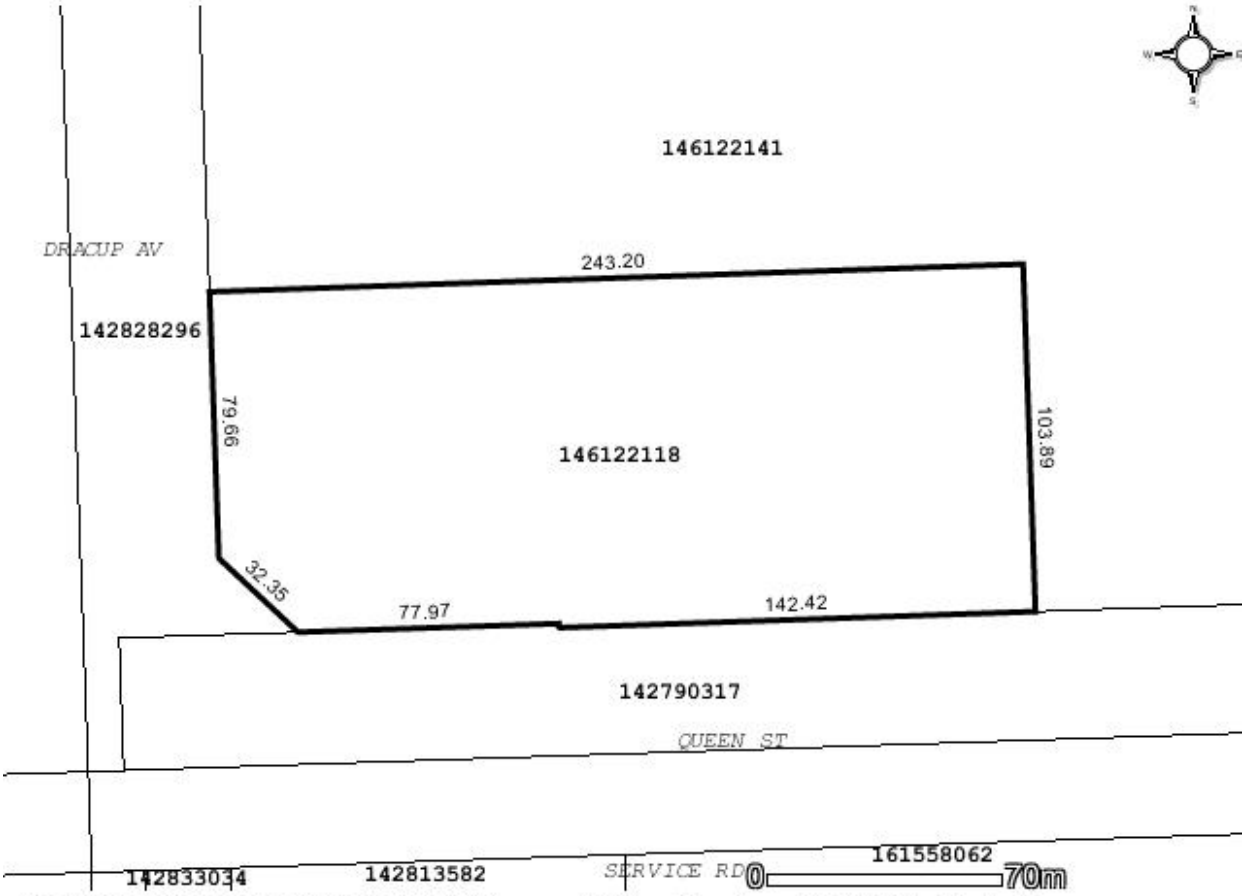
CITY OF YORKTON

COMMERCIAL SUBDIVISION STUDY

LAND TITLEMENT

Information Services Corporation of Saskatchewan

Surface Parcel Number: 146122118
LLD: (Parcel: B)Plan 101726850 Ext 22
Parcel Class Code: Parcel (Generic)
Area: 2.487 hectares (6.15 acres)
Request Date: 15-Oct-2010 10:54:38 o'clock AM CST



DISCLAIMER: THIS IS NOT A PLAN OF SURVEY. It is a consolidation of plans to assist in identifying the location, size and shape of a parcel in relation to other parcels. Parcel boundaries and area may have been adjusted to fit with adjacent parcels. To determine actual boundaries, dimensions, or area of any parcel, refer to the plan, or consult a surveyor.

Related Information

Parcel	Land Description
142828296	SW 36-25-04-2Plan 71Y08466 Ext 1
142790317	SW 36-25-04-2Plan 68Y07040 Ext 1
146122118	(Parcel: B)Plan 101726850 Ext 22
146122141	(Parcel: C)Plan 101726827 Ext 18

4 Records

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Province of Saskatchewan
Land Titles Registry
Title

Title #: 113813210
Title Status: Active
Parcel Type: Surface
Parcel Value: N/A
Title Value: *N/A*
Converted Title: 71Y08440
Previous Title and/or Abstract #: 71Y08440

As of: 15 Oct 2010 10:42:08.424
Last Amendment Date: 17 Jul 2003 19:27:56.397
Issued: 19 Sep 2002 19:57:11.323
Municipality: CITY OF YORKTON

Her Majesty The Queen in Right of Saskatchewan is the registered owner of Surface Parcel #146122118

Reference Land Description: Blk/Par BPlan No 101726850 Extension 22
As described on Certificate of Title 71Y08440, description 22.

This title is subject to any registered interests set out below and the exceptions, reservations and interests mentioned in section 14 of *The Land Titles Act, 2000.*

Registered Interests:

Interest #: 113056950 CNV Easement

Value:
Reg'd: 15 Jul 1960 00:07:32
Interest Register Amendment Date: N/A
Interest Assignment Date: N/A
Expiry Date: N/A

Holder:
Saskatchewan Power Corporation
N/A, Saskatchewan, Canada
Client #: 100869880
Int. Register #: 105138187
Converted Instrument #: 60Y04525

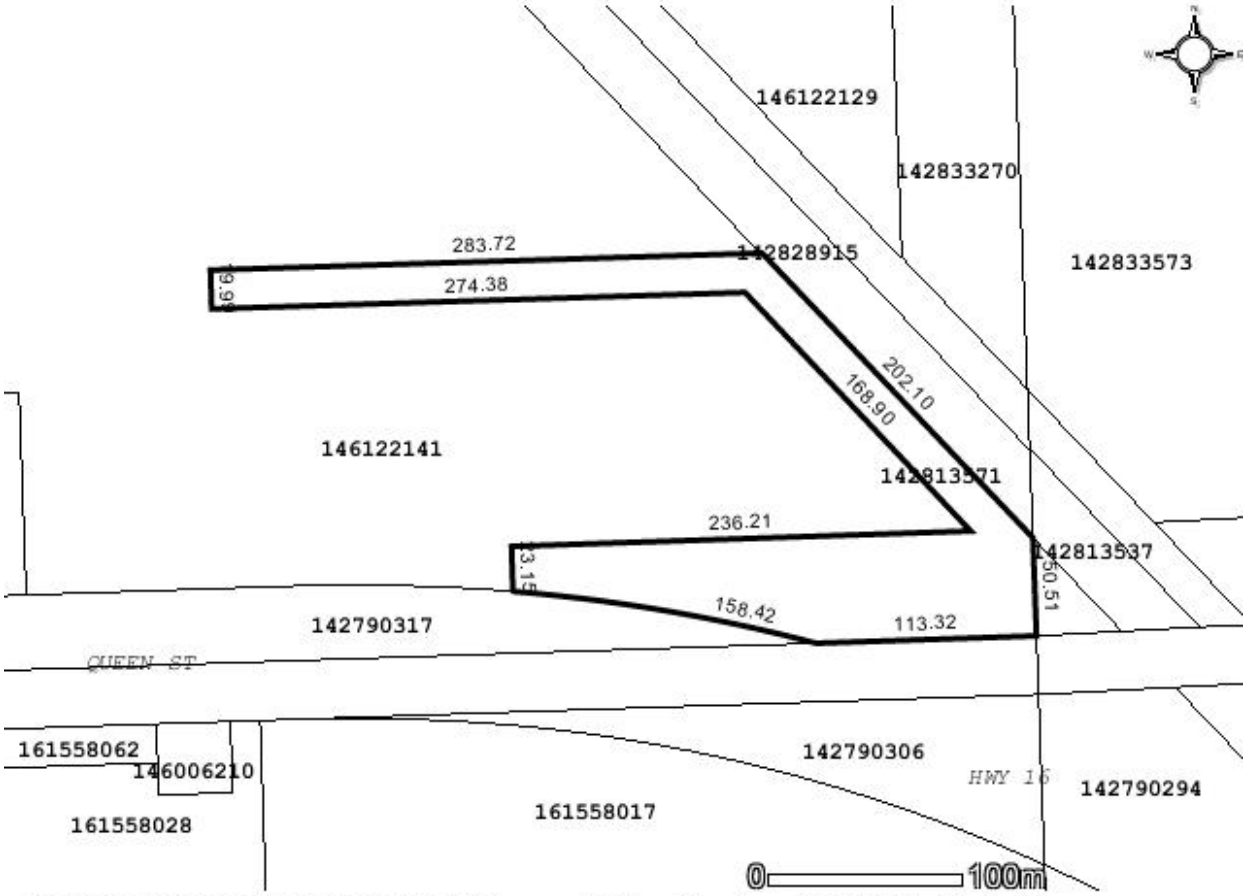
Addresses for Service:

Name	Address
Owner:	
Her Majesty The Queen in Right of Saskatchewan	Saskatchewan Highways & Infrastructure, Land Branch 900 - 1855 Victoria Avenue Regina, Saskatchewan, Canada S4P 3T2

Client #: 100942792

Information Services Corporation of Saskatchewan

Surface Parcel Number: 142813571
LLD: SW 36-25-04-2Plan 82Y01235 Ext 1
Parcel Class Code: Parcel (Generic)
Area: 2.124 hectares (5.25 acres)
Request Date: 15-Oct-2010 10:44:48 o'clock AM CST



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Related Information

Parcel	Land Description
142790317	SW 36-25-04-2Plan 68Y07040 Ext 1
142833573	SE 36-25-04-2 Ext 0
142790294	NE 25-25-04-2Plan 68Y07040 Ext 1
161558062	(Parcel: S4)Plan 101882640 Ext 0
142790306	NW 25-25-04-2Plan 68Y07040 Ext 1
142813537	SE 36-25-04-2Plan AF157 Ext 1
161558028	(Parcel: C)Plan 101882640 Ext 0
142813571	SW 36-25-04-2Plan 82Y01235 Ext 1
142813526	NE 25-25-04-2Plan AF157 Ext 1
142833270	(Parcel: A)Plan 85Y00421 Ext 0

Search Results

Search By: Current Title Details
With Criteria: As Of Date = 15-Oct-2010 10:46:00
Title Number = 113566271

Audit: **History:**

Printer-Friendly Version

Province of Saskatchewan
Land Titles Registry
Title

Title #: 113566271
Title Status: Active
Parcel Type: Surface
Parcel Value: N/A
Title Value: *N/A*
Converted Title: 82Y05566
Previous Title and/or Abstract #: 82Y05566

As of: 15 Oct 2010 10:46:00.464
Last Amendment Date: 13 Sep 2002 22:41:11.097
Issued: 13 Sep 2002 22:41:11.033
Municipality: CITY OF YORKTON

The Yorkton Creek Watershed Association Board is the registered owner of Surface Parcel #142813571

Reference Land Description: SW Sec 36 Twp 25 Rge 04 W2 Plan No 82Y01235 Extension 1
As described on Certificate of Title 82Y05566.

This title is subject to any registered interests set out below and the exceptions, reservations and interests mentioned in section 14 of *The Land Titles Act, 2000.*

Registered Interests:

None

Addresses for Service:

Name	Address
Owner:	
The Yorkton Creek Watershed Association Board	26 Fifth Ave N Yorkton, Saskatchewan, Canada S3N 0Y8
Client #: 108685064	

Notes:

Parcel Class Code: Parcel (Generic)

To request a copy, click here

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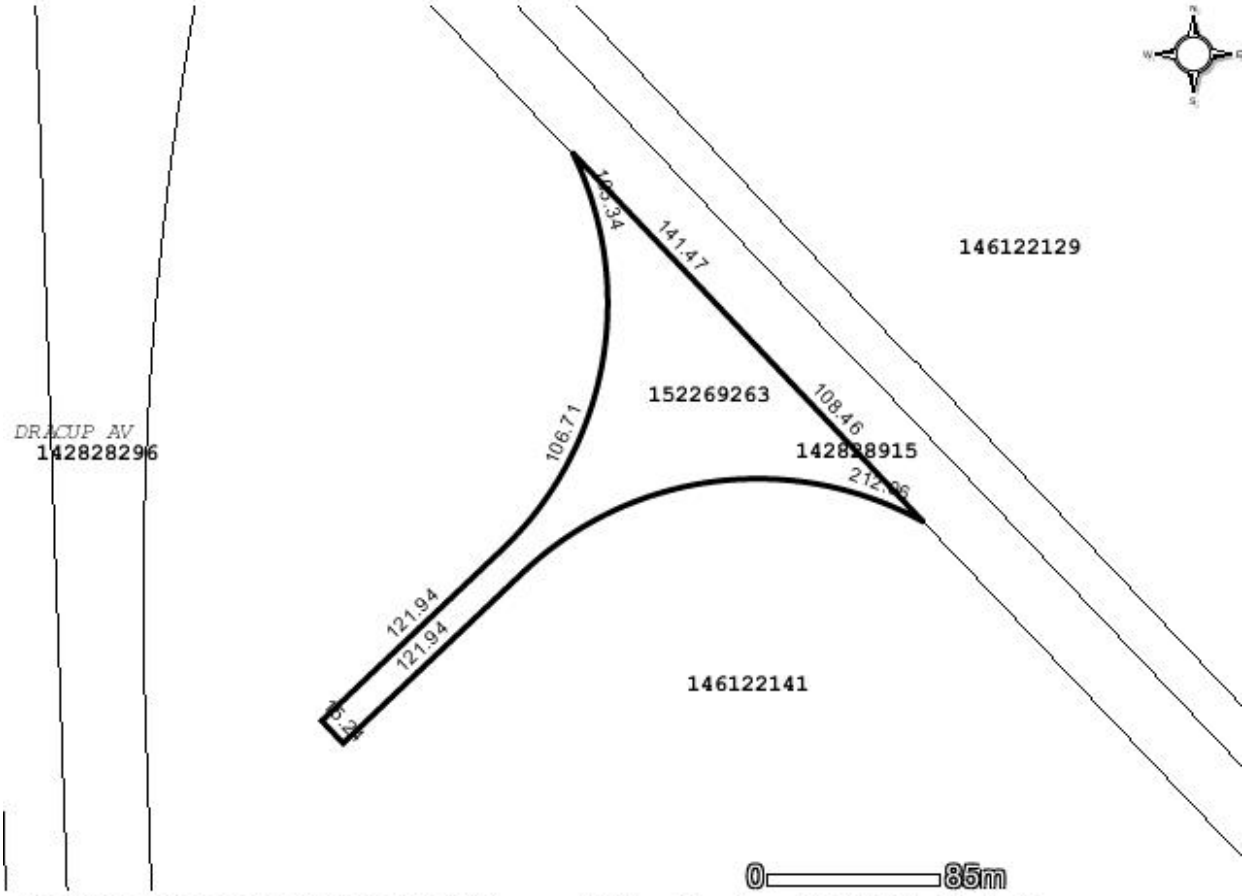
Information Services Corporation of Saskatchewan

Surface Parcel Number: 152269263
LLD: SW 36-25-04-2Plan AE1433 Ext 1
Parcel Class Code: Parcel (Generic)
Area: 1.426 hectares (3.52 acres)
Request Date: 15-Oct-2010 10:51:44 o'clock AM CST



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Related Information

Parcel	Land Description
142828296	SW 36-25-04-2Plan 71Y08466 Ext 1
146122129	(Parcel: A)Plan 101726816 Ext 15
142828915	SW 36-25-04-2Plan AF157 Ext 1
152269263	SW 36-25-04-2Plan AE1433 Ext 1
146122141	(Parcel: C)Plan 101726827 Ext 18

5 Records

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Search Results

Search By: Current Title Details
With Criteria: As Of Date = 15-Oct-2010 10:52:56
Title Number = 124871384

Audit: **History:**

Printer-Friendly Version

Province of Saskatchewan
Land Titles Registry
Title

Title #: 124871384
Title Status: Active
Parcel Type: Surface
Parcel Value: N/A
Title Value: *N/A*
Converted Title: 80Y13950
Previous Title and/or Abstract #: 80Y13950

As of: 15 Oct 2010 10:52:56.525
Last Amendment Date: 17 Jul 2003 20:02:58.067
Issued: 09 Apr 2003 21:43:06.570
Municipality: CITY OF YORKTON

Manitoba and North Western Railway Company of Canada is the registered owner of Surface Parcel #152269263

Reference Land Description: SW Sec 36 Twp 25 Rge 04 W2 Plan No AE1433 Extension 1
As described on Certificate of Title 80Y13950, description 1.

This title is subject to any registered interests set out below and the exceptions, reservations and interests mentioned in section 14 of *The Land Titles Act, 2000.*

Registered Interests:

None

Addresses for Service:

Name	Address
Owner:	
Manitoba and North Western Railway Company of Canada	Marathon Realty Co. Ltd. Suite 873 125-9th Ave SE Calgary, Alberta, Canada T2G 0P8
Client #: 113481075	

Notes:

Parcel Class Code: Parcel (Generic)

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B Appendix B – Geotechnical Assessment Report (P.Machibroda)

P. MACHIBRODA ENGINEERING LTD.

CONSULTING
GEOTECHNICAL
GEOENVIRONMENTAL
ENGINEERS AND
GEOSCIENTISTS

SASKATOON
806 – 48TH STREET EAST
SASKATOON, SK
S7K 3Y4

PHONE:
(306) 665-8444
FAX:
(306) 652-2092
E-MAIL:
pmel.sk@machibroda.com
WEB:
www.machibroda.com

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- Hydrogeological Studies
- Environmental Site Assessments
- Site Decommissioning and Clean-up
- Test Drilling Services
- Piezocone (CPTu) Testing
- Soils Testing
- Concrete Testing
- Asphalt Testing

PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
SW¼-36-25-4-W2M
HWY. 9 / QUEEN STREET (HWY. NO. 16) / CP RAILWAY
YORKTON, SASKATCHEWAN
PMEL FILE NO. S10-7447
SEPTEMBER 24, 2010

PREPARED FOR:

ASSOCIATED ENGINEERING
#1 – 2225 NORTHRIDGE DRIVE
SASKATOON, SASKATCHEWAN
S7L 6X6

ATTENTION: MR. JASON HORNER, P. ENG.
INFRASTRUCTURE MANAGER

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LIST OF DRAWINGS

LIST OF DRAWINGS (continued)

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S10-7447-18	Grain Size Distribution Analysis
S10-7447-19	Grain Size Distribution Analysis
S10-7447-20	Grain Size Distribution Analysis
S10-7447-21	Grain Size Distribution Analysis
S10-7447-22	Grain Size Distribution Analysis
S10-7447-23	Grain Size Distribution Analysis
S10-7447-24	Grain Size Distribution Analysis
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Appendix A	Explanation of Terms on Test Hole Logs
Appendix B	Piezocone Penetration Test Plots
Appendix C	Topsoil, Organic Matter and Organics

1.0 INTRODUCTION

The following report has been prepared on the results of a preliminary geotechnical investigation conducted for the proposed Commercial Development to be constructed within SW¼-36-25-4-W2M in Yorkton, Saskatchewan. The subject site is bordered by Highway No. 9, Queen Street (Highway No. 16) and a CP Railway.

The Terms of Reference for this investigation were presented in P. Machibroda Engineering Ltd. (PMEL) Proposal No. 0707-6197, dated July 7, 2010. The field test drilling and soil sampling were conducted between August 30 and September 2, 2010.

This report has been prepared to provide preliminary, general geotechnical information for the subject site. Subsequent, detailed geotechnical investigations will be required once further details and building locations have been finalized.

2.0 FIELD INVESTIGATION

2.1 Field Drilling Program

Thirteen test holes, located as shown on the Site Plan, Drawing No. S10-7447-1, were dry drilled using our truck-mounted, continuous flight, solid stem auger drill rig. The test holes were 150 mm in diameter and extended to depths of 8.1 to 18 metres below the existing ground surface.

Test hole drill logs were compiled during test drilling to record the soil stratification, the groundwater conditions, the position of unstable sloughing soils and the depths at which cobblestones and/or boulders were encountered.

Disturbed samples of auger cuttings were collected during test drilling and sealed in plastic bags to minimize moisture loss. The soil samples were taken to our laboratory for analysis.

Standard penetration tests (N-index), utilizing a safety hammer with automatic trip, were performed during test drilling.

Piezometers (slotted, 50 mm diameter PVC pipe) were installed in each Test Hole for groundwater monitoring purposes.

2.2 Piezocone Penetration Testing

Five piezocone penetration tests (CPTu) were conducted during the field investigation. The CPTu tests were extended to depths of 3.6 to 9.1 metres below ground surface, at which point penetration became very difficult. The CPTu test locations have been shown on the Site Plan, Drawing No. S10-7447-1.

The piezocone penetration tests consisted of pushing a cone, on the end of a series of rods, into the ground at a constant rate and continuous measurements were made of the resistance to penetration of the cone. Local side friction resistance measurements were also made on a friction sleeve during penetration. Pore-water pressure response generated from the advancement of the cone into the soil was measured via a pore pressure filter located directly behind the cone tip. The piezocone tip had an apex angle of 60° and a 15 cm^2 base area. The friction sleeve had a perimeter area of 225 cm^2.

The equipment and procedures for conducting the cone penetration testing were undertaken in accordance with ASTM D-5778, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Testing of Soils".

The test plots recorded during the cone soundings have been presented in Appendix B.

3.0 FIELD DRILL LOGS

The field drill logs recorded during test drilling have been shown plotted on Drawing Nos. S10-7447-2 through 14, inclusive.

The ground surface elevation and plan location of the Test Holes was provided by Associated Engineering.

3.1 Soil Profile

The general soil profile consisted of organic topsoil overlying highly variable deposits of clay, glacial till, silt, clay shale, sand and gravel (to depths of about 12 to 15 metres), followed by clay shale, which extended to a depth of at least 18 metres below existing ground surface, the maximum depth penetrated by our test holes at this site.

3.2 Groundwater Conditions, Sloughing

Extensive groundwater seepage and sloughing conditions were encountered within the sand/gravel deposits during test drilling. The depths at which groundwater seepage and sloughing conditions were encountered have been shown on the Field Drill Logs, Drawing Nos. S10-7447-2 to 14, inclusive.

A summary of the groundwater levels recorded in the piezometers installed during this investigation has been presented in Table I.

TABLE I. RECORDED GROUNDWATER LEVELS

Test Hole No.	Piezometer Rim Elevation (metres)	Ground Surface Elevation (metres)	*Recorded Groundwater Elevation (metres)	
			September 3, 2010	September 10, 2010
10-1	504.3	503.1	501.5	501.6
10-2	503.9	502.7	501.4	501.6
10-3	503.6	502.3	501.5	502.0
10-4	504.4	503.3	502.2	502.0
10-5	505.3	504.2	501.8	502.0
10-6	505.2	504.1	501.6	501.7
10-7	505.4	504.0	501.0	501.2
10-8	507.8	506.7	501.1	501.2
10-9	505.3	504.2	501.1	501.5
10-10	504.9	503.8	501.4	501.8
10-11	506.3	504.9	500.9	500.6
10-12	506.6	505.4	500.6	500.9
10-13	506.0	504.8	500.8	501.0

The groundwater levels may not have stabilized. Higher static water levels could be encountered, particularly during or following spring snowmelt and periods of precipitation.

3.3 Cobblestones and Boulders

Cobblestones and/or boulders were encountered during test drilling. The depths at which cobblestones and/or boulders were encountered have been shown on Drawing Nos. S10-7447-2 to 14, inclusive.

The glacial till consisted of a heterogeneous mixture of gravel, sand, silt and clay-sized particles. The glacial till strata also contained sorted deposits of the above particle sizes. In addition to the sorted deposits, a random distribution of larger particle sizes in the cobblestone range (60 to 200 mm) and boulder-sized range (larger than 200 mm) should be expected at the subject site.

It should be recognized that the statistical probability of encountering cobblestones and/or boulders in the eighteen small diameter test locations at this large site was low. Intertill deposits of cobblestones, boulders, boulder pavements and isolated deposits of saturated sand or gravel should be anticipated. The frequency of encountering such deposits will increase proportionately with the number of piles installed or volume of soil excavated.

4.0 LABORATORY ANALYSIS

The soil classification and index tests performed during this investigation consisted of a visual classification of the soil, water contents, Atterberg limits, unit weights, grain size distribution analysis and water-soluble sulphate contents.

The results of the soil classification and index tests conducted on representative samples of soil from this site have been plotted on the drill logs alongside the corresponding depths at which the samples were recovered as shown on Drawing Nos. S10-7447-2 through 14, inclusive.

The results of the grain size distribution analyses have been plotted on Drawing Nos. S10-7447-15 through 25, inclusive.

5.0 DESIGN RECOMMENDATIONS

The purpose of this investigation was to evaluate the existing subsurface soil and groundwater conditions for potential site development. Site specific geotechnical investigations are recommended once the nature and location of proposed structures have been finalized.

Based on the foregoing outline of soil test results, the following preliminary foundation design considerations and recommendations have been presented.

5.1 Design Considerations

The subsurface soil conditions consisted of organic topsoil overlying highly variable deposits of clay, glacial till, clay shale, silt, sand and gravel, followed by clay shale. Extensive groundwater seepage and sloughing conditions were encountered within the sand/gravel deposits during test drilling. The groundwater table was situated at a geodetic elevation of about 501 to 502 metres at the time of our field investigation. Cobblestones and/or boulders were encountered during test drilling.

Considering the relatively high groundwater table at the subject site, design grades should be maintained as high as practical to minimize the potential for groundwater related issues (i.e., soft/wet soil conditions, water infiltration, etc.). It is understood that extensive site filling (in the order of 1 to 3 metres of fill) will be conducted over the majority of the site during site development. Excavation below the groundwater table should be minimized as much as possible. Construction dewatering will be required for excavations extending below the groundwater table (i.e., large diameter wells and/or well point pumping systems).

It is anticipated that construction within the proposed Commercial/Industrial Development would consist of pile/grade beam foundation systems (at-grade buildings) and grade-supported concrete floor slabs. Considering this, the variable soil conditions and the presence of a high groundwater table, footing foundations are not considered to be feasible or economical and are not recommended at this site.

A deep foundation system consisting of drilled CFA, cast-in-place concrete piles would perform satisfactorily at this site and is considered to be the best suited foundation alternative. Some construction difficulties may be encountered due to the presence of cobbles/boulders. Conventional drilled piles are not considered practical due to extensive groundwater seepage and sloughing conditions. Driven piles (steel-H piles or open end pipe piles) or helical screw piles could also be considered and could be feasible at some locations within the subject site. However, installation difficulties (and potentially premature termination) should be expected at some locations due to the presence of cobbles/boulders and the dense/hard nature of the subgrade soils.

As previously discussed, extensive site filling will be conducted over the majority of the subject site. As such, grade-supported floor slabs will be supported predominantly on fill. All fill materials should be approved by the Geotechnical Consultant prior to use. Imported granular fill or non-expansive (i.e., low plastic), fine grained soils are recommended. The fill should be placed in thin lifts and compacted to a uniform density condition. Adequate compaction testing will be required to confirm the uniformity and density of the fill during placement. A layer of crushed, granular base course material should be provided below all grade-supported concrete slabs to provide a level working surface and uniform subgrade support.

Preliminary design recommendations have been prepared for site preparation; groundwater considerations; excavations and dewatering; pipeline construction; buoyancy forces; CFA, cast-in-place concrete piles; helical screw piles; driven, steel H-piles; driven, open-end steel pipe piles; floor slabs; grade beams; foundation concrete and surfacing structures.

5.2 Site Preparation

All organic topsoil should be removed from the building footprint, walkway and parking areas. Staining and root intrusion from the overlying organic material and roots may be encountered during excavation within the subsurface mineral soils. If these conditions are suspected, a representative of the geotechnical consultant should inspect the site during excavation to verify the depth of organic topsoil which should be removed in preparation of the site for construction. In addition to organic topsoil, all loose fill and other deleterious materials should also be removed. See Appendix C for further information in regards to topsoil composition and soil structure.

The surface of the subgrade should be levelled and compacted to the following minimum density requirements.

Building Areas	-	96 percent of standard Proctor density at optimum moisture content;
Roadway and Parking Areas	-	96 percent of standard Proctor density at optimum moisture content;
Landscape Areas	-	90 percent of standard Proctor density at optimum moisture content.

It is understood that extensive site filling operations will be conducted during site development. The fill should preferably consist of imported granular material or non-expansive (i.e., low plastic), fine grained soils (such as glacial till soils, which are common in the Yorkton area). All proposed subgrade fill should be approved by the Geotechnical Consultant prior to placement. The fill should be placed in thin lifts (maximum 150 mm loose) and compacted to a uniform density (98 percent of standard Proctor density at optimum moisture content). Regular compaction testing should be conducted to confirm the uniformity of the fill materials and to ensure adequate compaction is being obtained.

The site should be graded to ensure positive site drainage away from all structures. Roof runoff downspouts should extend well away from all structures.

Soft/wet soil conditions were encountered at the subject site. The use of high-strength geotextile/geogrid is recommended where soft/wet soil conditions are encountered to provide soil stabilization and separation. Depending on the design subgrade elevations, over-excavation and replacement with granular fill may be required. It is anticipated that the soft/wet near-surface soils will be easily disturbed. Due to the anticipated poor trafficability, Gradall or track/backhoe equipment is recommended. The geotextile/geogrid should be placed over the levelled subgrade prior to placing granular fill. It is recommended that the first lift of fill should consist of free-draining granular drainage aggregate placed over the geotextile/geogrid by end-dump and spread methods in a single, thicker lift. The initial lift should be lightly compacted with static compaction equipment to minimize disturbance of the underlying soil.

5.3 Groundwater Considerations

The groundwater table was situated at an elevation of about 501 to 502 metres at the time of our field investigation. The groundwater elevation may be situated at or near ground surface at some locations (i.e., low areas of the site). It is recommended that site grades be maintained as high as possible to limit the potential for excavation or construction near the groundwater table (i.e., construction difficulties due to groundwater seepage and sloughing conditions). De-watering will likely be required during site development.

5.4 Excavations and Dewatering

It is anticipated that the majority of shallow excavations at this site may be accomplished with conventional excavation equipment. The recommended minimum sideslopes for the excavations at this site have been presented in Table II.

TABLE II. EXCAVATION SIDESLOPES

Soil Type	*Minimum Recommended Sideslope	
	Horizontal	Vertical
Clay (moist)	2	1
Clay (wet)	4	1
Glacial Till (moist)	1	1
Glacial Till (wet)	4	1
Silt/Sand/Gravel (moist)	2	1
Silt/Sand/Gravel (wet)	4	1

* Slopes should be flattened where groundwater seepage and sloughing conditions are encountered.

De-watering of the excavations will be required during construction below the groundwater table. De-watering should be conducted on an "as required" basis over the time period for which the excavations are left open. A sump (or multiple sumps, if required) should be set up at the deepest excavation points and the floor of the excavation sloped to the sump(s) to handle groundwater seepage and precipitation runoff. A self-actuated sump pump(s) should be operated on a continuous basis and should be discharged well away from the excavations. Dewatering wells/well-points will be required if conventional dewatering techniques are inadequate.

5.5 Pipeline Construction

The following design considerations and recommendations should be incorporated into the design and construction of the proposed pipeline.

1. A minimum soil cover of 3 metres is recommended for pipeline construction (to provide protection against frost penetration). Rigid polystyrene insulation could be utilized to reduce the required depth (if this is more feasible). In this case, the Geotechnical Consultant should review the proposed insulation details.

2. It should be feasible to construct the majority of the proposed pipeline by open cutting the necessary trenches using conventional earth moving equipment. If some ravelling and earth slides can be tolerated, then the sideslopes for trench excavations should be excavated in accordance with the sideslopes presented in Table II. If potential ravelling and shallow localized caving cannot be tolerated, then the sideslopes would have to be flattened. Alternately, a combination of sloped excavation and temporary shoring could be utilized to minimize the aerial extent of the excavations. The stability of the slope will, to a large extent, be time and weather dependent. Hence, prudent scheduling of the length of the trench open at any time is recommended.

3. Where excavations extend below the groundwater table, the subgrade soils will be wet above the pipeline invert and will drain, slough and cave into an open excavation. Dewatering may be required, and should be performed on an "as required" basis using surface drainage ditches drained to sump pits equipped with sump pumps.

4. An examination of the field drill logs revealed that the proposed pipelines would be founded on highly variable deposits of glacial till, clay, silt, clay shale, sand and gravel. Any soft, compressible soils encountered at the founding elevation should be over-excavated to a minimum depth of 400 mm below the founding elevation and replaced with clean, free-draining, non-frost susceptible, compacted granular material. Pipeline bedding should be specified in accordance with the manufacturer's recommendations for the particular pipe material being utilized.

5. All backfill above the pipeline should be placed in thin lifts not exceeding 300 mm and compacted to a minimum of 96 percent of standard Proctor density. For backfill compacted in accordance with the above, it is recommended that the pipelines be designed on the basis of a soil overburden weight of 2,000 kg/m^3 for the compacted subgrade soils. Landscape fill should be placed and compacted to a minimum of 90 percent of standard Proctor density.

6. Thrust blocks will be required along the length of the pipeline where realignment or changes in direction are required. The lateral earth pressure distribution for thrust blocks is assumed to be a triangular distribution with the resultant acting at a point one third (1/3) of the height up from the bottom of the thrust block.

   The resultant force may be calculated as:

$$P = \frac{(K_p - K_a)\,\gamma\,H^2}{2}$$

   Where:

   K = Coefficient of soil pressure
   γ = Unit weight of soil
   H = Height of thrust block

The soil parameters presented in Table III may be utilized for design of the thrust blocks.

For pipes installed by directional drilling (boring) techniques, the total vertical and lateral pressure on the pipe is equivalent to the total unit weight of the overburden soil multiplied by the depth below ground surface. The submerged unit weight of the soil should be utilized below the groundwater table. The overburden pressure on the pipe should be calculated on the basis of the soil unit weights presented in Table III. Grouting of the annular space between the pipe and the surrounding soil will be required to provide uniform transference of the soil loading to the pipeline wall.

TABLE III. SOIL PARAMETERS FOR DESIGN

Soil Type	Effective Angle of Internal Friction	Earth Pressure Coefficients		Unit Weight (kN/m^3)	Submerged Unit Weight (kN/m^3)	Ultimate Coefficient of Friction*
		Active (K_a)	Passive (K_p)			
Clay/Silt	20°	0.5	2.0	19.0	9.0	0.25
Glacial Till	25°	0.4	2.5	21.5	11.5	0.35
Sand/Gravel	30°	0.3	3.0	20.0	10.0	0.40

*For concrete cast directly against the soil.

5.6 Buoyancy Forces

The groundwater level at the subject site was situated at a geodetic elevation of about 501 to 502 metres at the time of our field investigation. Higher groundwater levels could develop, particularly during or after spring thaw or during or after extended periods of precipitation. Foundation elements which are constructed below the groundwater table should be designed to resist uplift forces due to buoyancy. The uplift hydrostatic pressure acting on the base of the foundation element would be equal to the depth of the foundation element extending below the groundwater table.

5.7 Continuous Flight Auger, Cast-In-Place Concrete Piles

Continuous flight auger (CFA), cast-in-place concrete piles should perform satisfactorily and are considered to be the best suited pile alternative at this site. Construction difficulties are anticipated in some pile holes due to cobbles/boulders. CFA, cast-in-place, straight shaft concrete piles may be designed on the basis of skin friction and end bearing capacity. The allowable skin friction bearing pressures of the subgrade soils would be in the order of 15 to 20 kPa for the clay/silt soils, 25 to 35 kPa for the glacial till, sand and gravel soils, and, 35 to 50 kPa for clay shale soils. The allowable end bearing pressure for CFA piles would be in the order of 250 to 500 kPa for the variable clay/silt/glacial till soils and 500 to 1,500 kPa for the sand/gravel and clay shale soils.

5.8 Helical Screw Piles

Helical screw piles could be a practical foundation alternative at some locations within the subject site. Construction difficulties (and potentially premature termination) are anticipated at some locations due to cobbles/boulders and the hard/dense nature of the subgrade soils. Helical screw piles may be designed on the basis of skin friction and end bearing capacity. The allowable skin friction bearing pressures of the subgrade soils would be in the order of 15 to 20 kPa for the clay/silt soils, 20 to 30 kPa for the glacial till, sand and gravel soils, and, 35 to 50 kPa for clay shale soils. The allowable end bearing pressure for screw piles would be in the order of 250 to 500 kPa for the variable clay/silt/glacial till soils and 500 to 1,500 kPa for the sand/gravel and clay shale soils. Penetration depth into dense/hard soils would be limited and would depend on the pile size/geometry, pile material strength and installation equipment (i.e., torque) capacity.

5.9 Driven Piles

Driven piles (steel H-piles or open-end steel pipe piles) could perform satisfactorily at some locations within the subject site. Construction difficulties (and potentially premature termination) are anticipated in some pile holes due to cobbles/boulders and the hard/dense nature of the subgrade soils. Driven piles may be designed on the basis of skin friction and end bearing capacity. The allowable skin friction bearing pressures of the subgrade soils would be in the order of 15 to 20 kPa for the clay/silt soils, 25 to 40 kPa for the glacial till, sand and gravel soils, and, 35 to 50 kPa for clay shale soils. The allowable end bearing pressure for driven piles would be in the order of 250 to 600 kPa for the variable clay/silt/glacial till soils and 600 to 2,000 kPa for the sand/gravel and clay shale soils. Penetration depth into dense/hard soils would be limited and would depend on the pile size/diameter and the installation equipment (i.e., hammer capacity/type/efficiency). In general, steel H-piles would tend to penetrate deeper than open-end steel pipe piles.

5.10 Floor Slabs

It is understood that fill, in the order of 1 to 3 metres, will be placed over the majority of the subject site during development. The type of fill, placement and compaction of the fill materials has been discussed in Section 5.2, Site Preparation. The performance of grade-supported slabs on the fill deposits will depend on the uniformity and compaction of the fill. Long term settlement of grade-supported floors bearing on extensive deposits of fill should be expected. As such, adequate quality control (i.e., compaction testing) should be conducted throughout placement of the fill.

Heated, reinforced grade-supported floor slabs based on well compacted structural fill should perform satisfactorily if some floor slab movement and cracking can be tolerated. A layer of compacted, granular base course material (150 to 300 mm in thickness) should be provided between the subgrade soil and the underside of the floor slab.

Providing adequate site drainage adjacent to the buildings will minimize the potential for moisture/volume changes of the supporting fill soils and the potential for differential floor slab movements. Measures should be taken to accommodate potential differential movements by constructing structural elements such as partition walls, staircases, grade beams, columns, etc. independent of the slab. Partition walls, staircases and any other structural elements resting on the floor slabs should be designed to accommodate differential movements without imparting stresses on the upper levels of the Buildings. If some differential movements/floor cracking cannot be tolerated, then a structural floor should be constructed.

Grade-supported concrete slabs exposed to freezing conditions (i.e., exterior slabs/sidewalks, etc.) will be subject to differential movements associated with frost action. The potential for differential movements associated with frost action can be minimized by placing sub-horizontal rigid polystyrene insulation below the slabs/sidewalks. If differential movements cannot be tolerated, the slabs/sidewalks could be constructed as structural slabs (i.e., pile supported).

5.11 Grade Beams

Grade beams should be reinforced both top and bottom throughout their length. Grade beams should be constructed to allow for a minimum of 100 mm of net void space between the underside of the grade beam and the subgrade soil.

5.12 Foundation Concrete

Water-soluble sulphate tests were conducted on samples of glacial till and clay taken from depths of 1 to 4.5 metres in Test Hole Nos. 10-2, 10-4, 10-7 and 10-9. The sulphate concentration of the tested soils was 0.02 to 0.07 percent, which is considered negligible in terms of potential degree of sulphate attack. Based on the test results, General Use cement (CSA Designation GU) would be considered suitable for foundation concrete in contact with the soil. However, sulphate testing was recently conducted by PMEL for the proposed City of Yorkton Riverside Meadows Subdivision Phase II (located near the north end of Yorkton, similar subgrade soils), yielding sulphate concentrations of 0.05 to 2.2 percent, which is considered negligible to very severe in terms of potential sulphate attack. Additionally, concentrations of water soluble sulphates (i.e., gypsum crystals) were encountered during test drilling at the subject site. It is probable that higher sulphate concentrations could be encountered at different depths/locations of the subject site. For these reasons, sulphate resistant cement is recommended for all foundation concrete in contact with the soil. All concrete at this site should be manufactured in accordance with current CSA standards.

5.13 Surfacing Structures

Asphalt concrete pavement structures required at this site would be in the order of 300 to 450 mm in thickness for light wheel loading and 500 to 750 mm in thickness for heavy wheel loading. Geogrid/geotextile will be required where soft/loose/wet soil conditions are encountered or near the groundwater table.

6.0 LIMITATIONS

The presentation of the summary of the field drill logs and preliminary design recommendations has been completed as authorized. Thirteen, 150 mm diameter test holes were dry drilled using our continuous flight solid stem auger drill rigs. Field drill logs were compiled for the Test Holes during test drilling which, we believe, were representative of the subsurface conditions at the Test Hole locations at the time of test drilling.

Five CPTu piezocone penetration tests were conducted during the field investigation. The inferred subsoil stratigraphy has been shown on the attached CPTu plots. Variations in the subsurface conditions from that shown on the drill logs and CPTu plots at locations other than the exact test locations should be anticipated. If conditions should differ from those reported here, then we should be notified immediately in order that we may examine the conditions in the field and reassess our recommendations in the light of any new findings.

The Terms of Reference for this geotechnical investigation did not include any environmental assessment of the site. No detectable evidence (odour or staining) of environmentally sensitive materials such as hydrocarbon odour was detected during the actual time of the field test drilling program. If, on the basis of any knowledge, other than that formally communicated to us, there is reason to suspect that environmentally sensitive materials may exist, then additional test holes should be drilled and samples recovered for chemical analysis.

The subsurface investigation necessitated the drilling of deep test holes. Please be advised that some settlement of the backfill materials will occur which may leave a depression or an open hole. It is the responsibility of the client to inspect the site and backfill, as required, to ensure that the ground surface at each Test Hole location is maintained level with the existing grade.

This report has been prepared for the exclusive use of Associated Engineering and their agents for specific application to the proposed Commercial Development to be constructed within SW¼-36-25-4-W2M in Yorkton, Saskatchewan. It has been prepared in accordance with generally accepted geotechnical engineering practices and no other warranty, express or implied, is made.

Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. P. Machibroda Engineering Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

The acceptance of responsibility for the design/construction recommendations presented in this report are contingent on adequate and/or full time inspection (as required, based on site conditions at the time of construction) by a representative of the Geotechnical Consultant. PMEL will not accept any responsibility on this project for any unsatisfactory performance if adequate and/or full time inspection is not performed by a representative of PMEL.

If this report has been transmitted electronically, it has been digitally signed and secured with personal passwords to lock the document. Due to the possibility of digital modification, only originally signed reports and those reports sent directly by PMEL can be relied upon without fault.

We trust that this report fulfills your requirements for this project. Should you require additional information, please contact us.

P. MACHIBRODA ENGINEERING LTD.

Cory Zubrowski, P. Eng.

Kelly Pardoski, P. Eng.

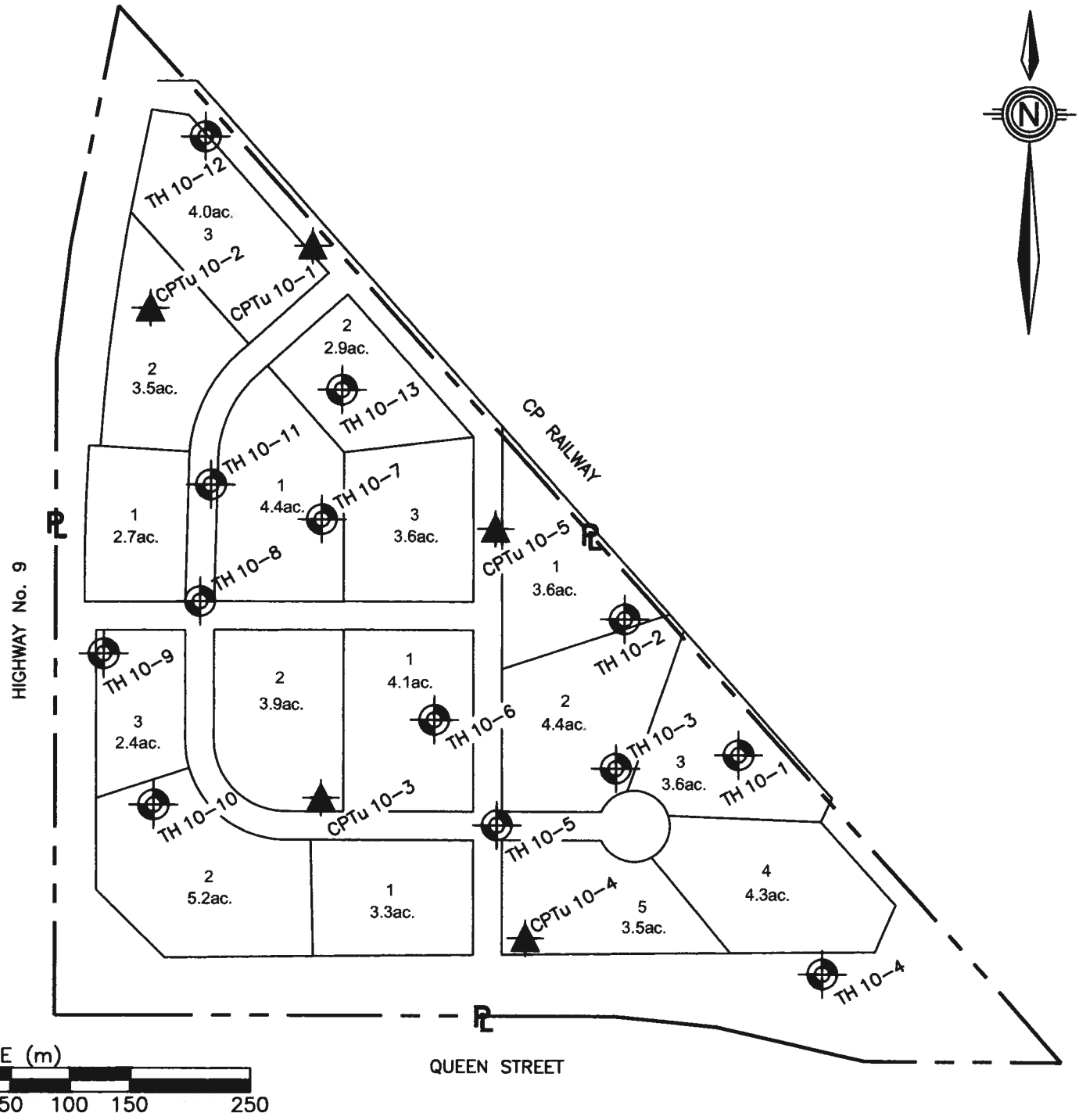
CZ/KP/clb

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
P. MACHIBRODA ENGINEERING LTD.
Number 172
Permission to Consult held by:

Discipline	Sk. Reg. No.	Signature
Geotechnical	12138	10-09-27

P. MACHIBRODA
ENGINEERING LTD.
CONSULTING
GEOTECHNICAL/GEOENVIRONMENTAL
ENGINEERS

DRAWINGS



NOTE:
1. THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.
2. THIS DRAWING WAS COMPILED USING LOCATION PLAN PROVIDED BY ASSOCIATED ENGINEERING. –PROJECT #20104734, DRAWING #4734-00-FG-01, (2010/ 08/ 06).

LEGEND	–PMEL TEST HOLE (PIEZOMETER INSTALLED)	–PMEL PIEZOCONE PENETRATION TEST	–PROPERTY LINE

CONSULTING GEOENVIRONMENTAL GEOTECHNICAL ENGINEERS

P. MACHIBRODA ENGINEERING LTD.

806 – 48th STREET EAST
SASKATOON, SK
S7K 3Y4

DRAWING TITLE:
SITE PLAN - TEST HOLE AND PIEZOCONE LOCATIONS

PROJECT:
PROPOSED COMMERCIAL DEVELOPMENT
HIGHWAY No. 9/QUEEN STREET/CP RAILWAY, YORKTON, SK

APPROVED BY:	DRAWN BY:	DRAWING NUMBER:
CZ	RO	S10-7447-1
DATE: SEPTEMBER, 2010	SCALE: 1:5000	

PIEZO. ELEV.= 504.3 m

TEST HOLE 10-1

ELEV: 503.1 m

DEPTH (m)	N	U	γ_w	Pw	Lw	w	pp
0						20.4	CUTTINGS
				14	33	17.4	
1						15.1	
	9		21.3			14.0	501.6 m SEPT 10/10
2							BENTONITE SEAL
3						13.3	
4							50 mm diam. SCH 40, PVC RISER PIPE
5	19		19.8			22.6	
6						24.7	
7						27.5	
8							50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
9						26.6	
10						13.8	SLOUGH
11						13.5	

TOPSOIL, organic, brown, rootlets.

GLACIAL TILL, clay, sandy, some silt, trace gravel, firm, medium plastic, moist, brown, oxide stained.
–P200 = 66.9% at 600 mm.
–stiff below 800 mm.

AT 600 mm:
GROUP INDEX = 4.8
CONVERTED CBR = 6 to 9

–silt stones at 2.5 m.

–cobbles/boulders 3.1 to 4.0 m.

GLACIAL TILL, silt, sandy, some clay, stiff, low to medium plastic, moist, mottled brown/grey, silt stones.

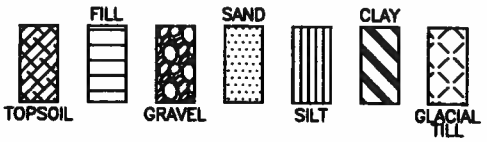
SILT AND SAND, some clay, very stiff, non to low plastic, wet, mottled brown/grey, seepage, sloughing.

–grey below 8.2 m.

SAND AND GRAVEL, trace silt, dense, well graded, fine to coarse grained, wet, brown, seepage, sloughing.

NOTE:
1. Test Hole sloughed to 3.1 m I.A.D.

LEGEND:



w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

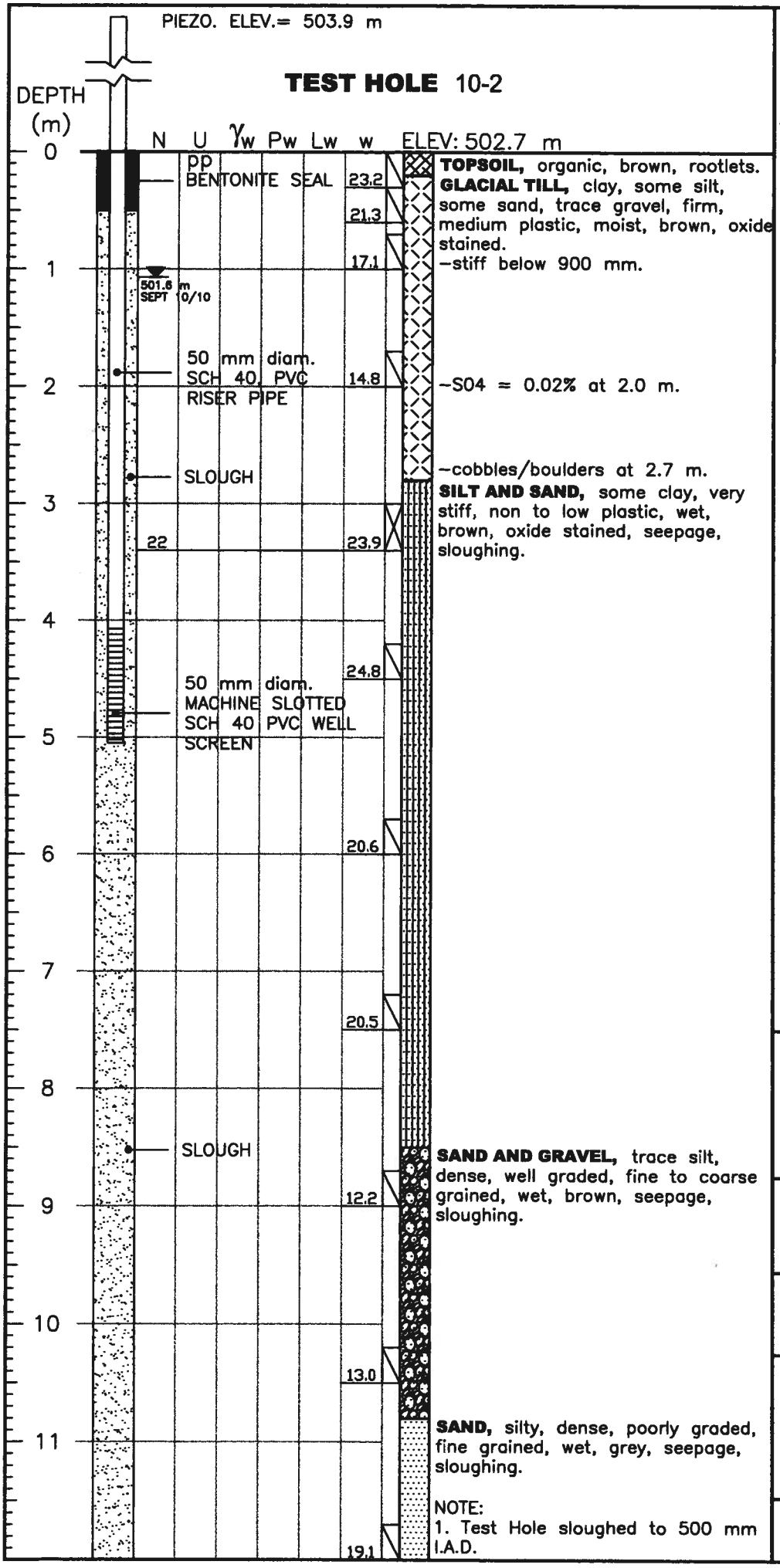
NORTHING: **EASTING:**

DATE DRILLED:	DRAWING NUMBER:
AUG 30/10	S10-7447-2

PIEZO. ELEV.= 503.9 m

TEST HOLE 10-2

ELEV: 502.7 m



TOPSOIL, organic, brown, rootlets.
GLACIAL TILL, clay, some silt, some sand, trace gravel, firm, medium plastic, moist, brown, oxide stained.
–stiff below 900 mm.

–SO4 = 0.02% at 2.0 m.

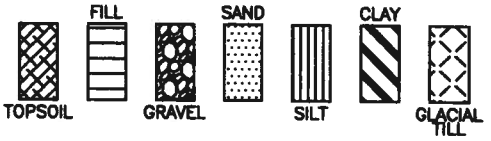
–cobbles/boulders at 2.7 m.
SILT AND SAND, some clay, very stiff, non to low plastic, wet, brown, oxide stained, seepage, sloughing.

SAND AND GRAVEL, trace silt, dense, well graded, fine to coarse grained, wet, brown, seepage, sloughing.

SAND, silty, dense, poorly graded, fine grained, wet, grey, seepage, sloughing.

NOTE:
1. Test Hole sloughed to 500 mm I.A.D.

LEGEND:



w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:

SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	DRAWING NUMBER:
AUG 31/10	S10-7447-3

PIEZO. ELEV.= 503.6 m

TEST HOLE 10-3

ELEV: 502.3 m

DEPTH (m)	N	U	γ_w	Pw	Lw	w	
0							
		pp					
				12	32	25.9	
						33.0	
1						27.1	
2						16.6	
3						24.8	
4				23	39	23.5	
5							
6						24.8	
7						18.2	
8							
9						19.7	
10						9.4	
11						11.9	

502.0 m SEPT 10/10

BENTONITE SEAL

50 mm diam. SCH 40, PVC RISER PIPE

50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN

SLOUGH

TOPSOIL, organic, brown, rootlets.

CLAY, silty, trace sand, firm, medium plastic, moist to wet, brown, oxide stained.

–P200 = 63.3% at 300 mm.

–sand lense, wet, seepage, sloughing at 1.0 m.

AT 300 mm:
GROUP INDEX = 5.1
CONVERTED CBR = 6 to 9

GLACIAL TILL, clay, some silt, some sand, trace gravel, firm, medium plastic, moist, brown, oxide stained.

CLAY SHALE, silty, trace sand, very stiff, medium plastic, moist, grey.

–oxide stained to 5.0 m.

SAND, some silt, compact to dense, poorly graded, fine grained, wet, grey, seepage, sloughing.

SAND AND GRAVEL, trace silt, dense, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.

NOTE:
1. Test Hole sloughed to 400 mm I.A.D.

LEGEND:

TOPSOIL, FILL, GRAVEL, SAND, SILT, CLAY, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

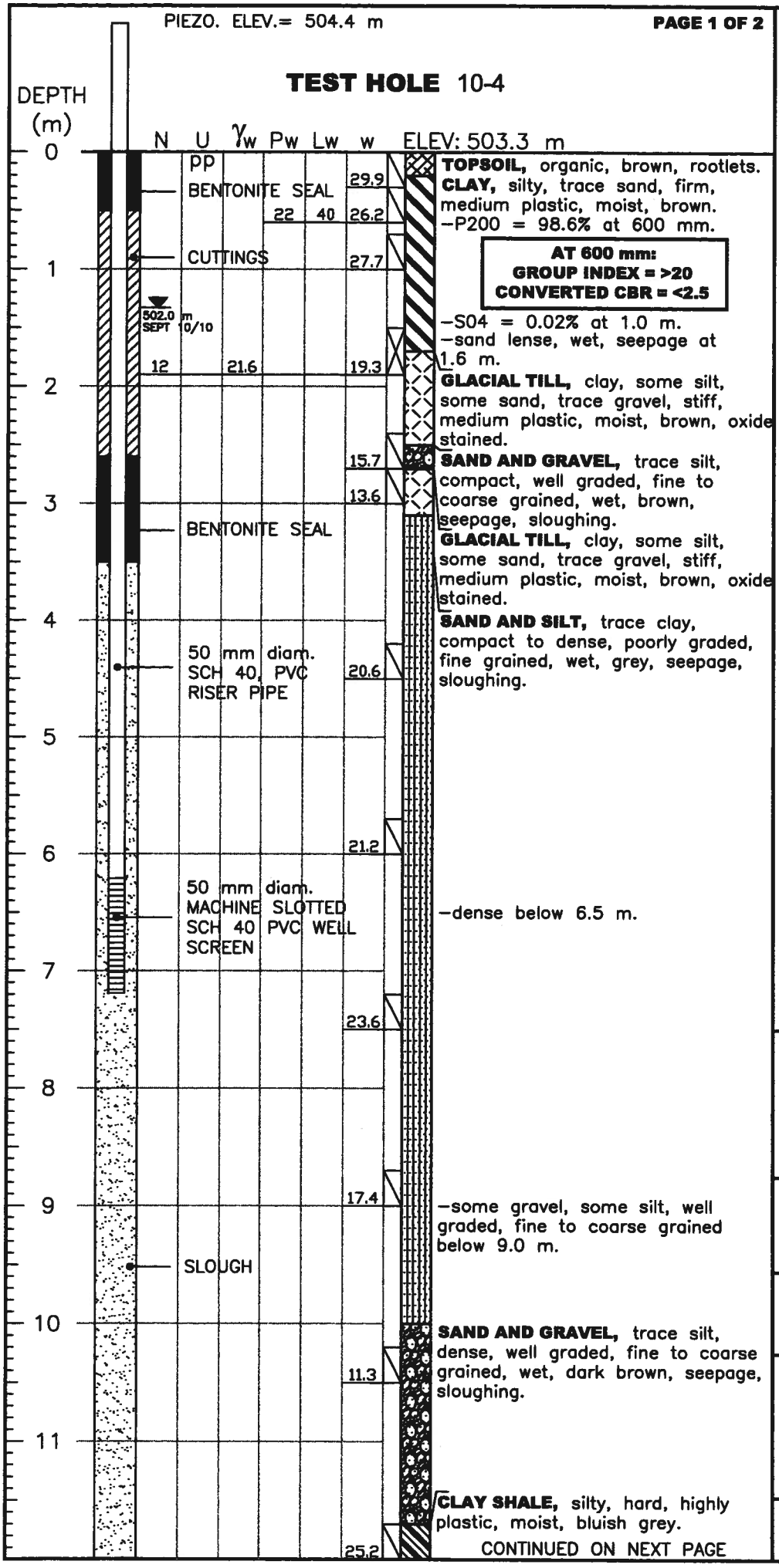
DATE DRILLED: AUG 31/10

DRAWING NUMBER: S10-7447-4

PIEZO. ELEV.= 504.4 m

TEST HOLE 10-4

ELEV: 503.3 m



TOPSOIL, organic, brown, rootlets.

CLAY, silty, trace sand, firm, medium plastic, moist, brown.
–P200 = 98.6% at 600 mm.

AT 600 mm:
GROUP INDEX = >20
CONVERTED CBR = <2.5

–S04 = 0.02% at 1.0 m.
–sand lense, wet, seepage at 1.6 m.

GLACIAL TILL, clay, some silt, some sand, trace gravel, stiff, medium plastic, moist, brown, oxide stained.

SAND AND GRAVEL, trace silt, compact, well graded, fine to coarse grained, wet, brown, seepage, sloughing.

GLACIAL TILL, clay, some silt, some sand, trace gravel, stiff, medium plastic, moist, brown, oxide stained.

SAND AND SILT, trace clay, compact to dense, poorly graded, fine grained, wet, grey, seepage, sloughing.

–dense below 6.5 m.

–some gravel, some silt, well graded, fine to coarse grained below 9.0 m.

SAND AND GRAVEL, trace silt, dense, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.

CLAY SHALE, silty, hard, highly plastic, moist, bluish grey.

CONTINUED ON NEXT PAGE

LEGEND:

FILL, SAND, CLAY
TOPSOIL, GRAVEL, SILT, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

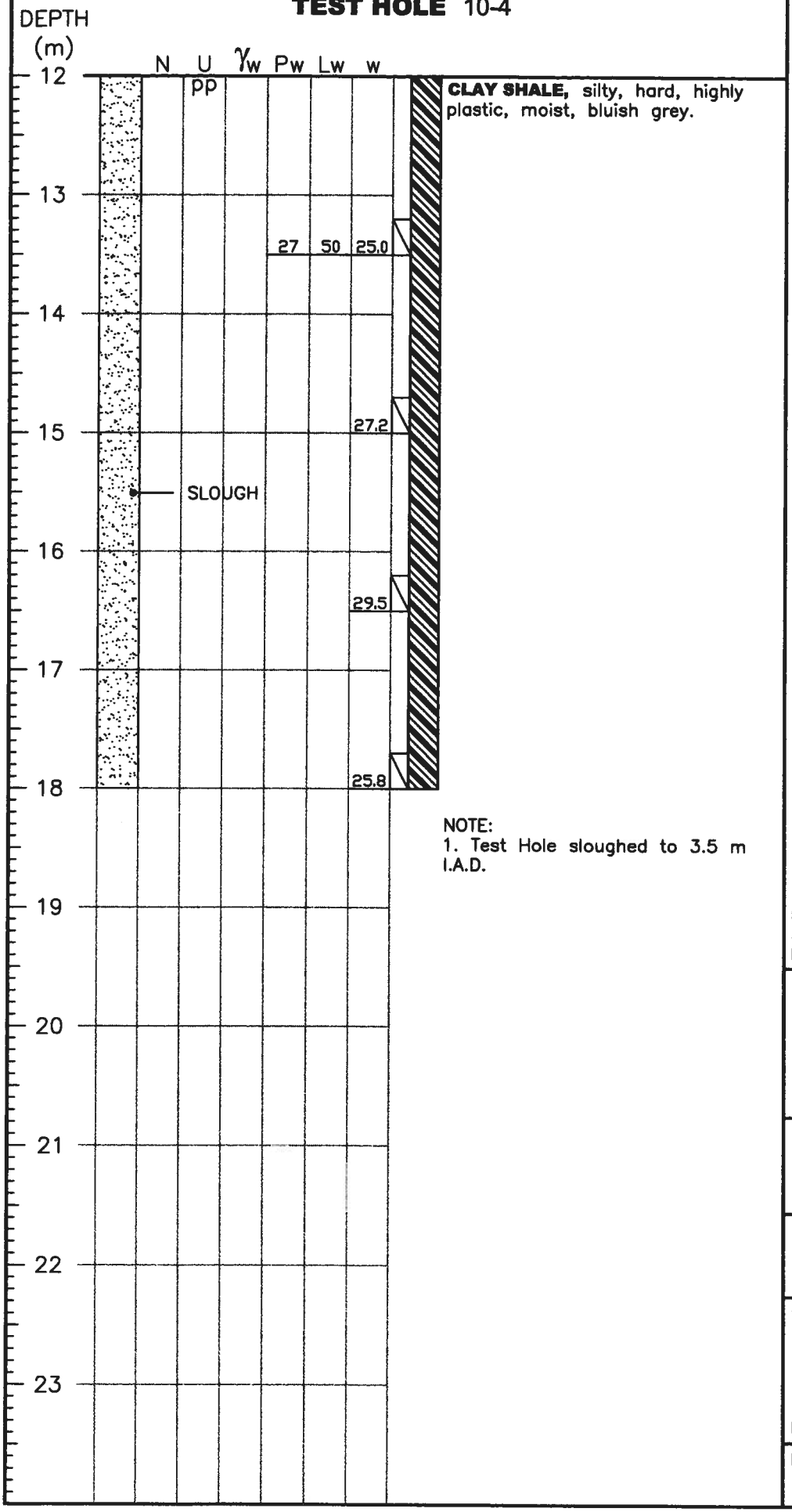
PROJECT:
PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
AUG 31/10	S10-7447-5

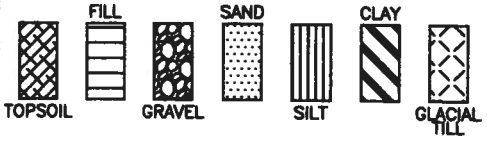
TEST HOLE 10-4



CLAY SHALE, silty, hard, highly plastic, moist, bluish grey.

NOTE:
1. Test Hole sloughed to 3.5 m I.A.D.

LEGEND:



w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:

SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

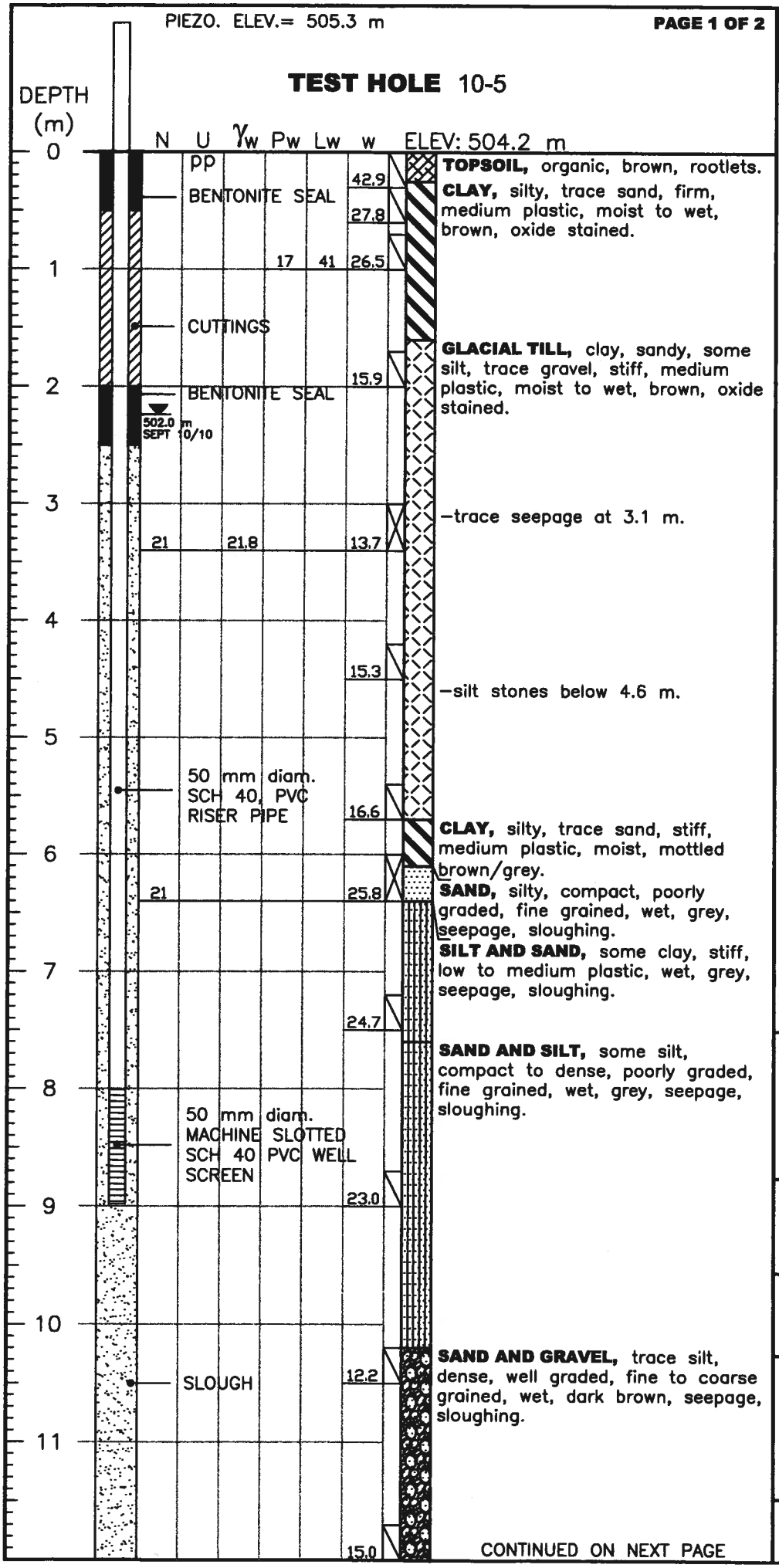
NORTHING: **EASTING:**

DATE DRILLED:	DRAWING NUMBER:
AUG 31/10	S10-7447-5A

PIEZO. ELEV.= 505.3 m

TEST HOLE 10-5

ELEV: 504.2 m



TOPSOIL, organic, brown, rootlets.

CLAY, silty, trace sand, firm, medium plastic, moist to wet, brown, oxide stained.

GLACIAL TILL, clay, sandy, some silt, trace gravel, stiff, medium plastic, moist to wet, brown, oxide stained.

–trace seepage at 3.1 m.

–silt stones below 4.6 m.

CLAY, silty, trace sand, stiff, medium plastic, moist, mottled brown/grey.

SAND, silty, compact, poorly graded, fine grained, wet, grey, seepage, sloughing.

SILT AND SAND, some clay, stiff, low to medium plastic, wet, grey, seepage, sloughing.

SAND AND SILT, some silt, compact to dense, poorly graded, fine grained, wet, grey, seepage, sloughing.

SAND AND GRAVEL, trace silt, dense, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.

CONTINUED ON NEXT PAGE

LEGEND:

TOPSOIL, FILL, GRAVEL, SAND, SILT, CLAY, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

PROPOSED COMMERCIAL DEVELOPMENT

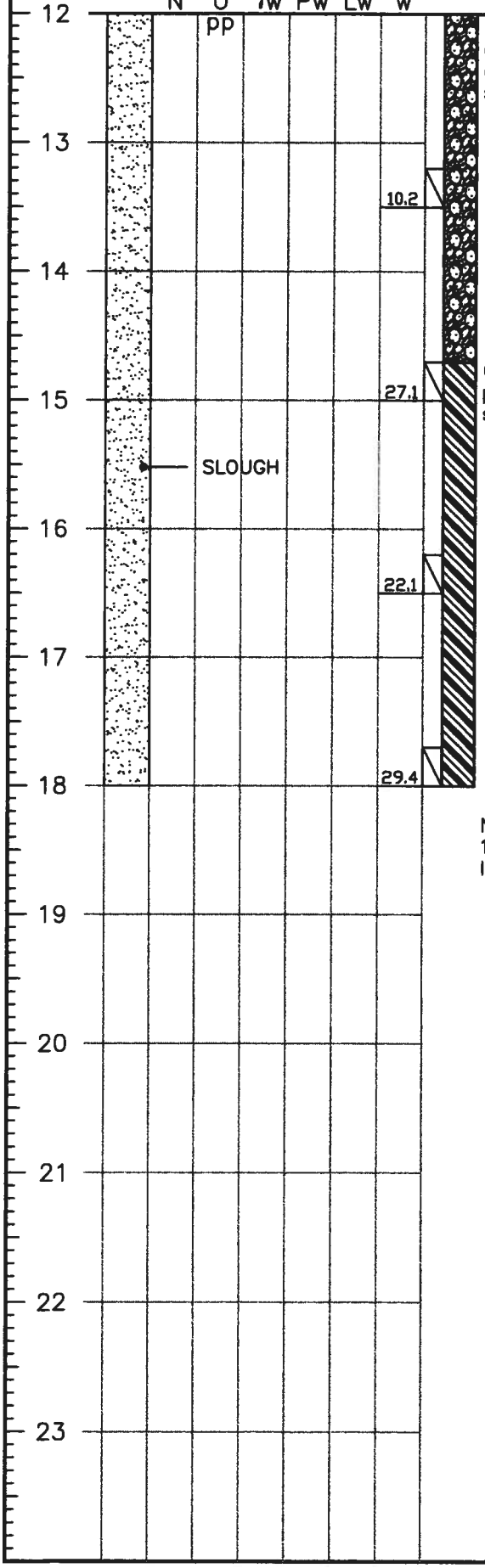
LOCATION:

SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	DRAWING NUMBER:
SEPT 1/10	S10-7447-6

TEST HOLE 10-5



SAND AND GRAVEL, trace silt, dense, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.

CLAY SHALE, silty, hard, highly plastic, moist, bluish grey, shale stones.

NOTE:
1. Test Hole sloughed to 2.5 m I.A.D.

LEGEND:

FILL, SAND, CLAY, TOPSOIL, GRAVEL, SILT, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	DRAWING NUMBER:
SEPT 1/10	S10-7447-6A

PIEZO. ELEV.= 505.2 m

TEST HOLE 10-6

ELEV: 504.1 m

DEPTH (m)	N	U	γ_w	Pw	Lw	w	
0		pp			17	49	27.9
							28.6
1							26.6
2	10		21.6				19.2
3							16.2
4							17.2
5							
6							21.1
7							23.2
8							
9							23.6
10							23.5
11							13.6

BENTONITE SEAL

501.7 m SEPT 10/10

50 mm diam. SCH 40 PVC RISER PIPE

50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN

SLOUGH

TOPSOIL, organic, brown, rootlets.
CLAY, silty, firm, medium plastic, moist, brown.
–P200 = 90.6% at 300 mm.

AT 300 mm:
GROUP INDEX = >20
CONVERTED CBR = <2.5

GLACIAL TILL, clay, sandy, some silt, trace gravel, stiff, medium plastic, moist, brown, oxide stained.
–trace seepage at 1.7 m.

–sand and gravel seam, wet, seepage, sloughing 2.5 to 2.7 m.

–stiff to very stiff below 3.1 m.

–cobbles/boulders below 4.0 m.

SAND, silty, compact to dense, poorly graded, fine grained, wet, brown, seepage, sloughing.

–grey below 8.5 m.

SAND AND GRAVEL, trace silt, dense, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.

CONTINUED ON NEXT PAGE

LEGEND:

TOPSOIL, FILL, GRAVEL, SAND, SILT, CLAY, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED COMMERCIAL DEVELOPMENT

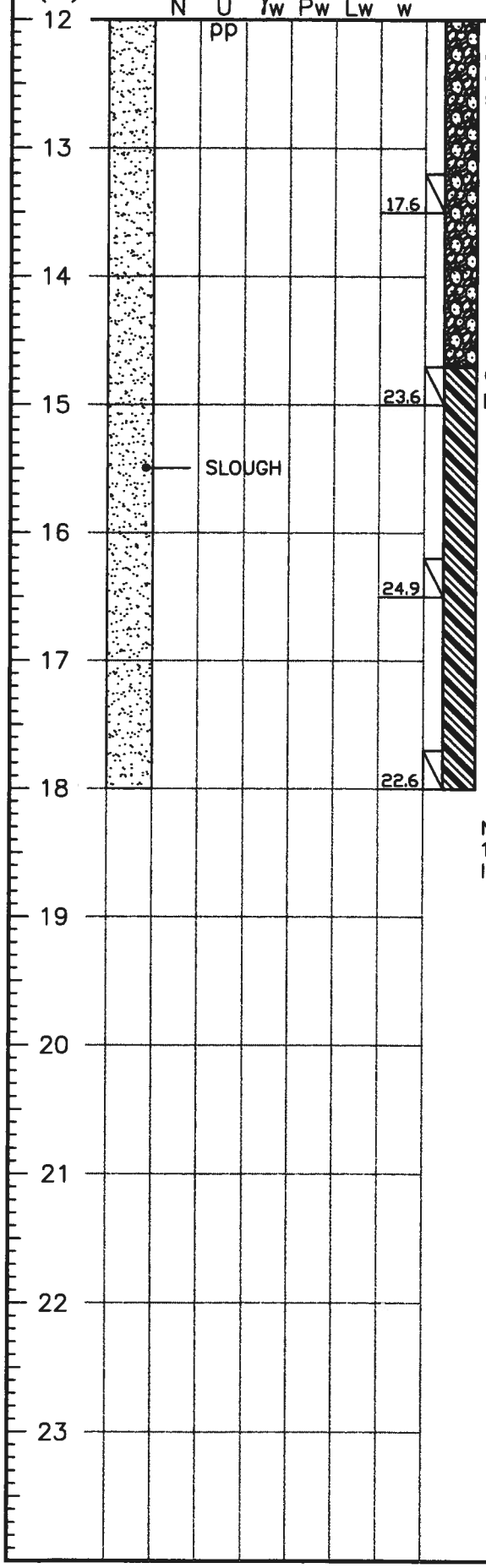
LOCATION:
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED: SEPT 1/10

DRAWING NUMBER: S10-7447-7

TEST HOLE 10-6

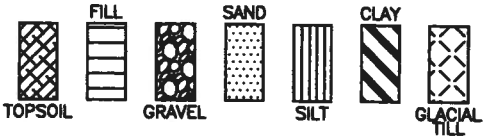


SAND AND GRAVEL, trace silt, dense, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.

CLAY SHALE, silty, hard, highly plastic, moist, bluish grey.

NOTE:
1. Test Hole sloughed to 1.8 m I.A.D.

LEGEND:



w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:

SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

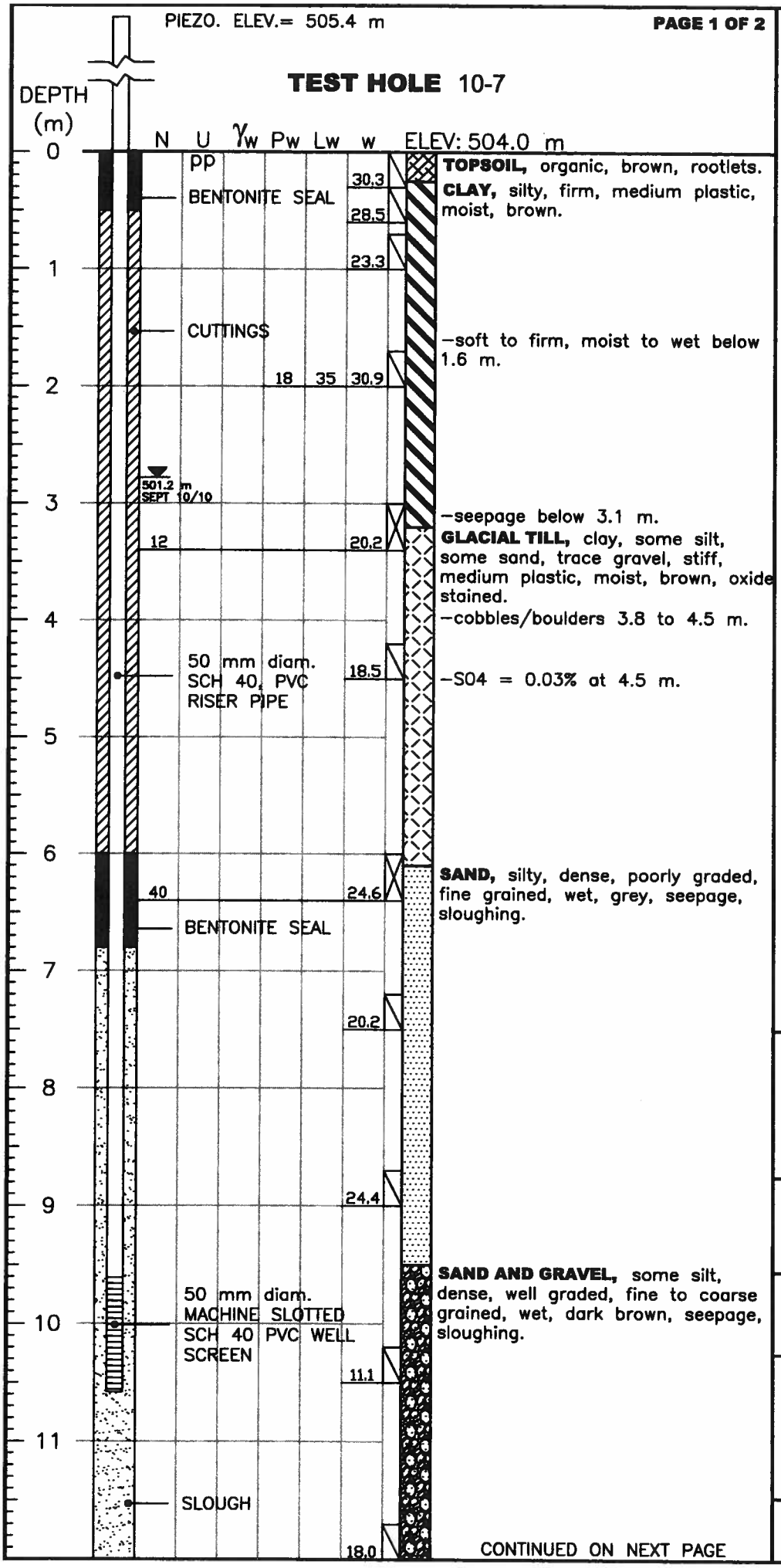
NORTHING: **EASTING:**

DATE DRILLED:	DRAWING NUMBER:
SEPT 1/10	S10-7447-7A

PIEZO. ELEV.= 505.4 m

TEST HOLE 10-7

ELEV: 504.0 m



TOPSOIL, organic, brown, rootlets.

CLAY, silty, firm, medium plastic, moist, brown.

–soft to firm, moist to wet below 1.6 m.

–seepage below 3.1 m.

GLACIAL TILL, clay, some silt, some sand, trace gravel, stiff, medium plastic, moist, brown, oxide stained.

–cobbles/boulders 3.8 to 4.5 m.

–SO4 = 0.03% at 4.5 m.

SAND, silty, dense, poorly graded, fine grained, wet, grey, seepage, sloughing.

SAND AND GRAVEL, some silt, dense, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.

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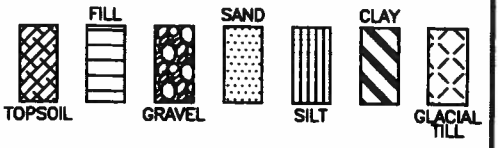


w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

PROPOSED COMMERCIAL DEVELOPMENT

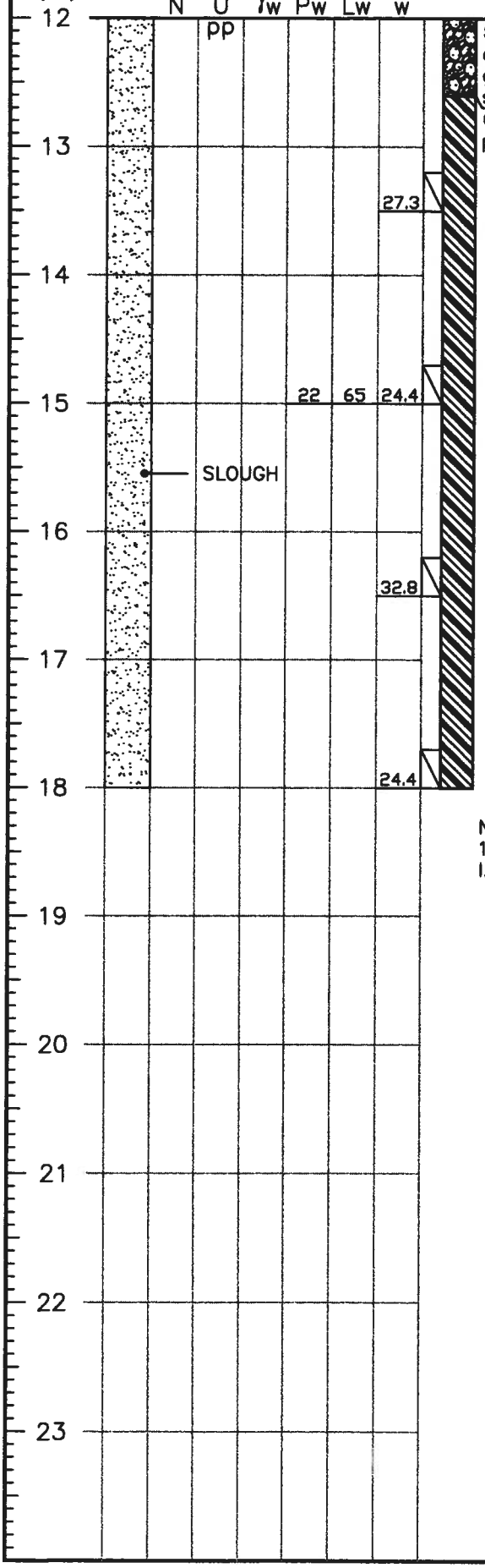
LOCATION:

SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	DRAWING NUMBER:
SEPT 1/10	S10-7447-8

TEST HOLE 10-7

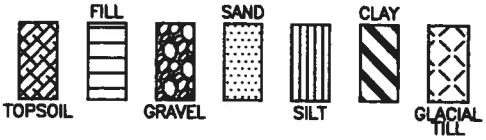


SAND AND GRAVEL, some silt, dense, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.

CLAY SHALE, silty, hard, highly plastic, moist, bluish grey.

NOTE:
1. Test Hole sloughed to 6.8 m I.A.D.

LEGEND:



w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:

SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	DRAWING NUMBER:
SEPT 1/10	S10-7447-8A

PIEZO. ELEV.= 507.8 m

TEST HOLE 10-8

ELEV: 506.7 m

DEPTH (m)	N	U	γ_w	Pw	Lw	w	
0		pp					BENTONITE SEAL
						27.0	
				17	43	25.0	
1						23.1	CUTTINGS
				19	34	24.8	
2							50 mm diam. SCH 40 PVC RISER PIPE
3						25.6	
4						25.4	BENTONITE SEAL
5							501.3 m SEPT 10/10
6						7.1	50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
7						13.9	SLOUGH
8						12.5	
9							
10							
11							

TOPSOIL, organic, brown, rootlets.

CLAY, silty, firm, medium plastic, moist, brown.
–P200 = 96.0% at 600 mm.

AT 600 mm:
GROUP INDEX = >20
CONVERTED CBR = <2.5

SILT, some clay, some sand, firm, medium plastic, moist, brown.
–P200 = 93.7% at 2.0 m.

–wet, seepage, sloughing below 3.5 m.

GRAVEL AND SAND, trace silt, compact, well graded, fine to coarse grained, wet, brown, seepage, sloughing.

NOTE:
1. Test Hole sloughed to 5.2 m I.A.D.
2. Auger refusal at 8.1 m.

LEGEND:

TOPSOIL, FILL, GRAVEL, SAND, SILT, CLAY, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	DRAWING NUMBER:
SEPT 1/10	S10-7447-9

PIEZO. ELEV.= 505.3 m

TEST HOLE 10-9

ELEV: 504.2 m

DEPTH (m)	N	U	γ_w	Pw	Lw	w	
0		pp				29.9	**TOPSOIL,** organic, brown, rootlets.
						28.5	**CLAY,** silty, trace sand, firm, medium plastic, moist, black.
							–organics to 500 mm.
1						23.6	–brown below 500 mm.
						28.2	
2							–wet below 2.5 m.
3	18				32	29.8	
4						30.4	–S04 = 0.07% at 4.5 m.
							SILT, clayey, firm, medium plastic, wet, grey, seepage, sloughing.
5							
6						27.3	**SILT AND SAND,** firm, low plastic, wet, grey, seepage, sloughing.
7						27.2	**SAND,** silty, compact to dense, well graded, fine to coarse grained, wet, grey, seepage, sloughing.
8							
9						15.1	**SAND AND GRAVEL,** trace silt, dense, well graded, fine to coarse grained, wet, grey, seepage, sloughing.
10						11.1	
11						10.4	

BENTONITE SEAL

CUTTINGS

501.5 m SEPT 10/10

50 mm diam. SCH 40, PVC RISER PIPE

BENTONITE SEAL

50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN

SLOUGH

NOTE:
1. Test Hole sloughed to 4.9 m I.A.D.

LEGEND:

TOPSOIL, FILL, GRAVEL, SAND, SILT, CLAY, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

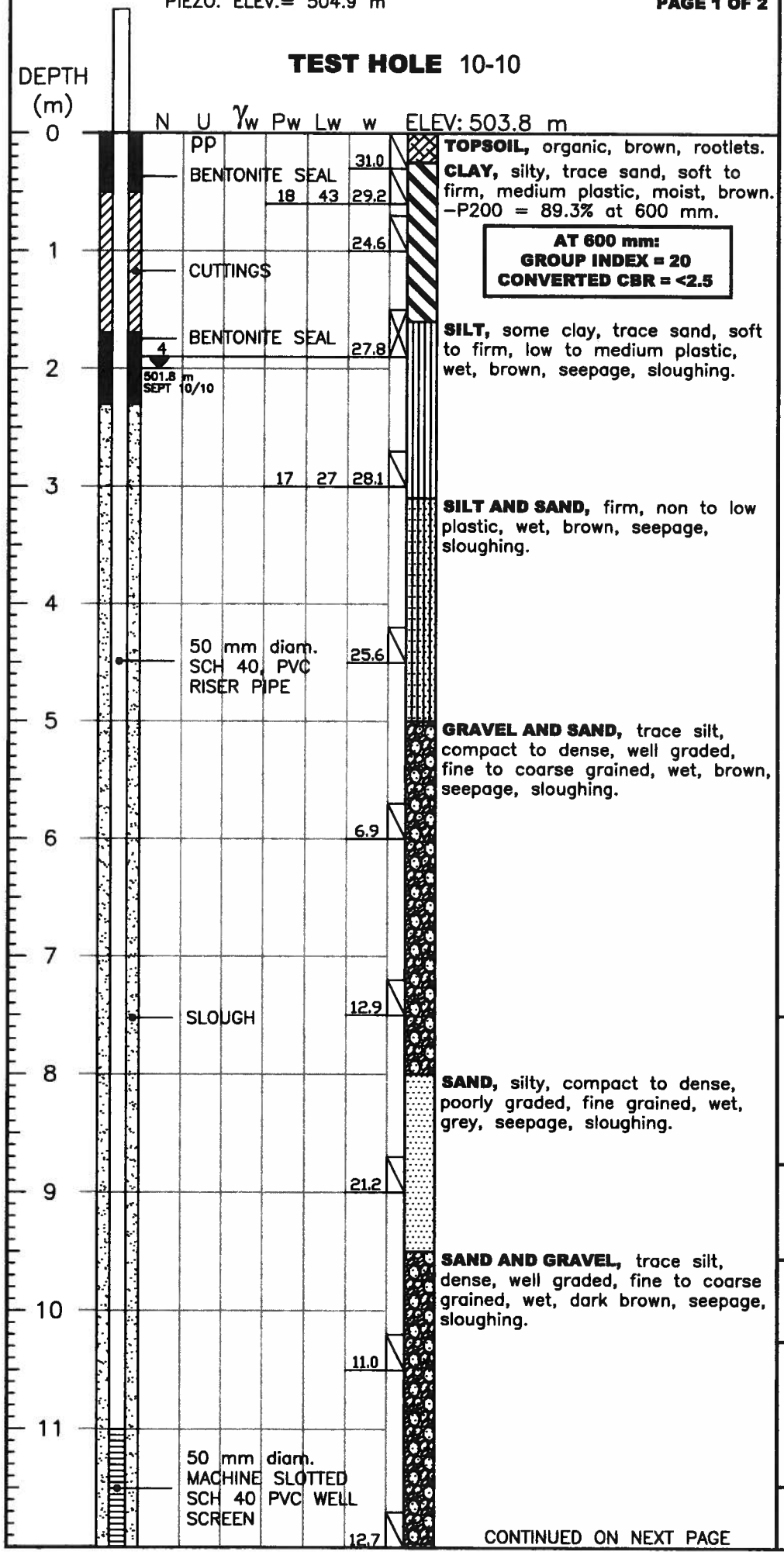
DATE DRILLED: SEPT 1/10

DRAWING NUMBER: S10-7447-10

PIEZO. ELEV.= 504.9 m

TEST HOLE 10-10

ELEV: 503.8 m



TOPSOIL, organic, brown, rootlets.

CLAY, silty, trace sand, soft to firm, medium plastic, moist, brown. –P200 = 89.3% at 600 mm.

AT 600 mm:
GROUP INDEX = 20
CONVERTED CBR = <2.5

SILT, some clay, trace sand, soft to firm, low to medium plastic, wet, brown, seepage, sloughing.

SILT AND SAND, firm, non to low plastic, wet, brown, seepage, sloughing.

GRAVEL AND SAND, trace silt, compact to dense, well graded, fine to coarse grained, wet, brown, seepage, sloughing.

SAND, silty, compact to dense, poorly graded, fine grained, wet, grey, seepage, sloughing.

SAND AND GRAVEL, trace silt, dense, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.

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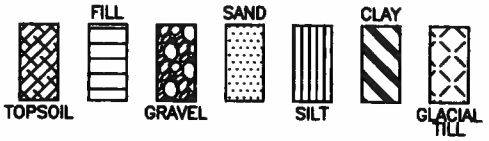
LEGEND:



w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

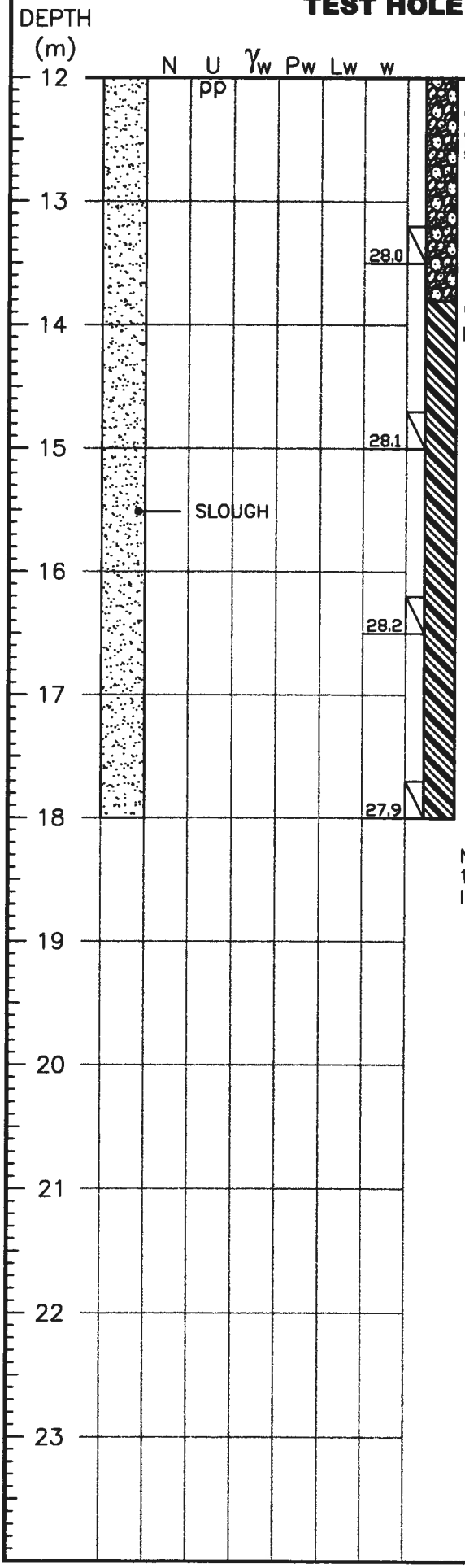
PROJECT:
PROPOSED
COMMERCIAL DEVELOPMENT

LOCATION:
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
SEPT 2/10	S10-7447-11

TEST HOLE 10-10

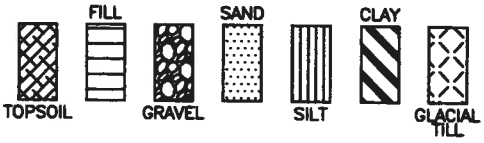


SAND AND GRAVEL, trace silt, dense, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.

CLAY SHALE, silty, hard, highly plastic, moist, grey.

NOTE:
1. Test Hole sloughed to 2.3 m I.A.D.

LEGEND:



w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:

SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
SEPT 2/10	S10-7447-11A

PIEZO. ELEV.= 506.3 m

TEST HOLE 10-11

ELEV: 504.9 m

DEPTH (m)	N	U	γ_w	Pw	Lw	w	
0			pp			25.4	**TOPSOIL,** organic, brown, rootlets.
			BENTONITE SEAL				
				19	41	23.3	**CLAY,** silty, trace sand, firm, medium plastic, moist, brown. –P200 = 87.7% at 600 mm.
1						24.1	**AT 600 mm: GROUP INDEX = 1.7 CONVERTED CBR = 2 to 4**
			CUTTINGS				
2						29.5	–wet below 1.7 m.
			50 mm diam. SCH 40, PVC RISER PIPE				
3							
	10					18.2	**SAND AND GRAVEL,** trace silt, compact, well graded, fine to coarse grained, wet, brown, seepage, sloughing.
			BENTONITE SEAL				
4							**GLACIAL TILL,** clay, some silt, some sand, trace gravel, stiff, medium plastic, moist, brown, oxide stained.
			▽ 500.6 m SEPT 10/10			14.2	**SAND,** silty, some gravel, compact to dense, well graded, fine to coarse grained, wet, brown, oxide stained, seepage, sloughing.
5							
6						12.5	
			50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN				
7							
						15.4	
8							
9						14.7	
			SLOUGH				
10						10.0	
11							**SAND,** silty, dense, poorly graded, fine grained, wet, grey, seepage, sloughing.
						17.1	

CONTINUED ON NEXT PAGE

LEGEND:

TOPSOIL, FILL, GRAVEL, SAND, SILT, CLAY, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

PROPOSED COMMERCIAL DEVELOPMENT

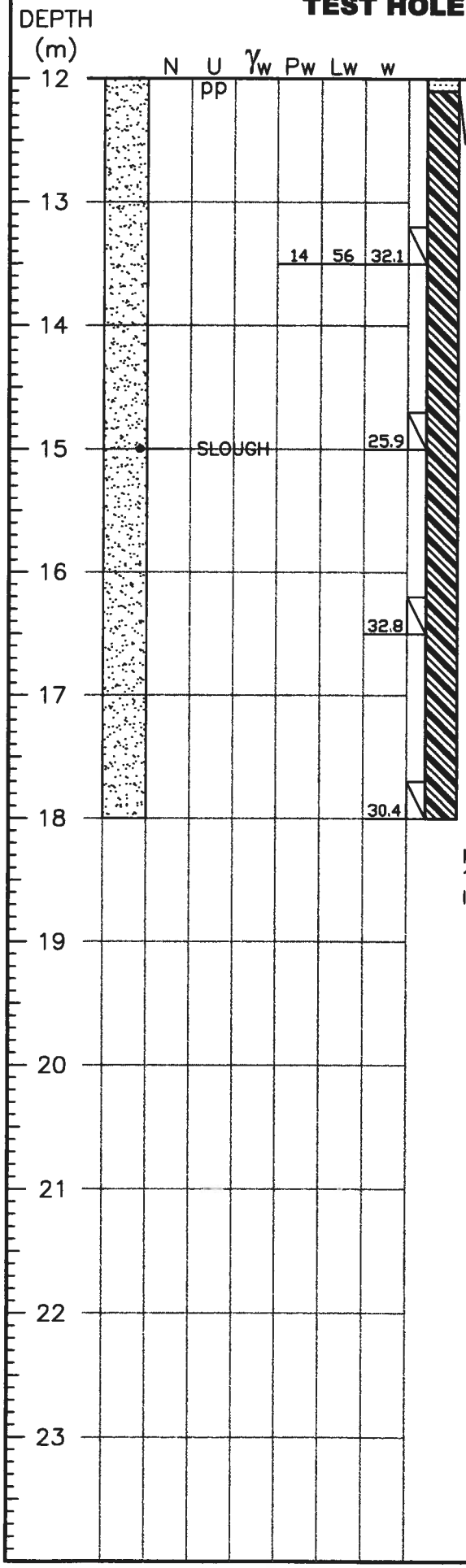
LOCATION:

SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	DRAWING NUMBER:
SEPT 2/10	S10-7447-12

TEST HOLE 10-11



SAND, silty, dense, poorly graded, fine grained, wet, grey, seepage, sloughing.
CLAY SHALE, silty, hard, highly plastic, moist, grey.

NOTE:
1. Test Hole sloughed to 4.4 m I.A.D.

LEGEND:

FILL, SAND, CLAY
TOPSOIL, GRAVEL, SILT, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED
COMMERCIAL DEVELOPMENT

LOCATION:
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED: SEPT 2/10

DRAWING NUMBER: S10-7447-12A

PIEZO. ELEV.= 506.6 m

TEST HOLE 10-12

ELEV: 505.4 m

DEPTH (m)	N	U	γ_w	Pw	Lw	w
0			pp			25.9
						25.2
1						15.2
2				13	22	12.6
3						10.3
4						14.3
5						
6						11.6
7						
8						16.0
9						17.7
10						13.6
11						10.1

BENTONITE SEAL

CUTTINGS

50 mm diam. SCH 40, PVC RISER PIPE

500.9 m SEPT 10/10

BENTONITE SEAL

50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN

SLOUGH

TOPSOIL, organic, brown, rootlets.

CLAY, silty, trace sand, firm, medium plastic, moist, brown.

GLACIAL TILL, clay, some silt, some sand, trace gravel, stiff, medium plastic, moist, brown, oxide stained.
–sandy, low plastic, moist to wet below 1.6 m.

SAND, silty, some gravel, compact to dense, well graded, fine to coarse grained, wet, brown, seepage, sloughing.

–grey below 10.6 m.

CONTINUED ON NEXT PAGE

LEGEND:

TOPSOIL, FILL, GRAVEL, SAND, SILT, CLAY, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:

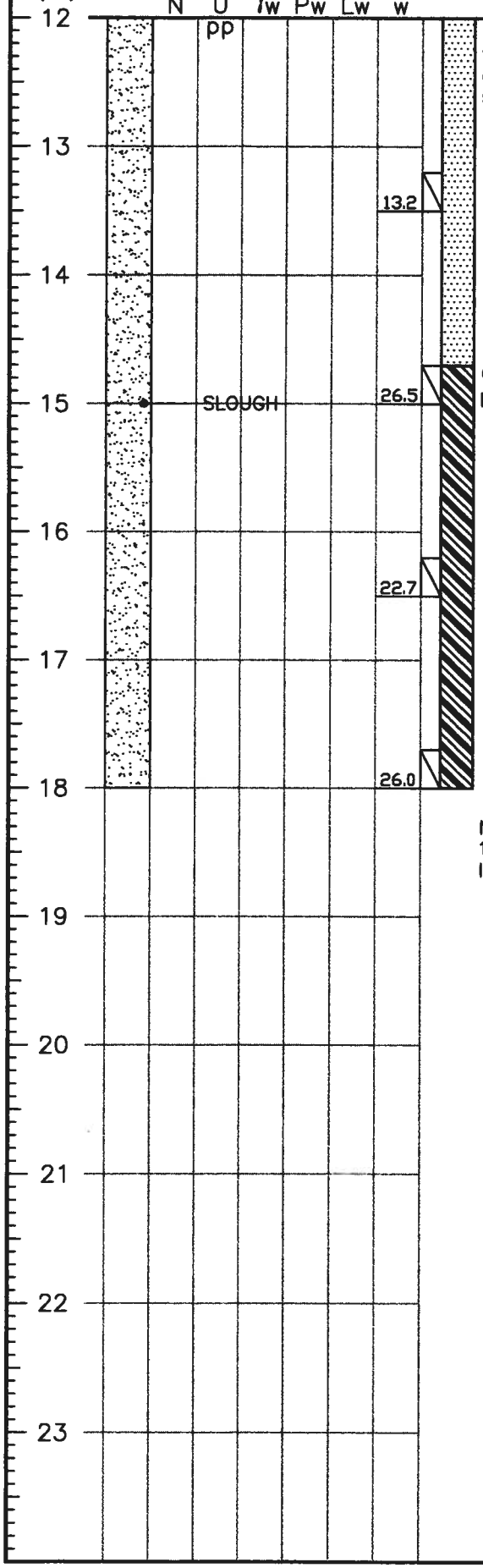
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED: SEPT 2/10

DRAWING NUMBER: S10-7447-13

TEST HOLE 10-12

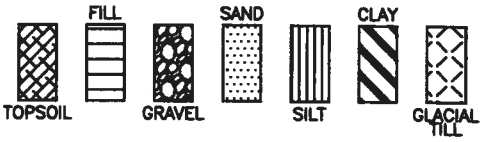


SAND, silty, some gravel, compact to dense, well graded, fine to coarse grained, wet, brown, seepage, sloughing.

CLAY SHALE, silty, hard, highly plastic, moist, grey.

NOTE:
1. Test Hole sloughed to 6.4 m I.A.D.

LEGEND:



w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

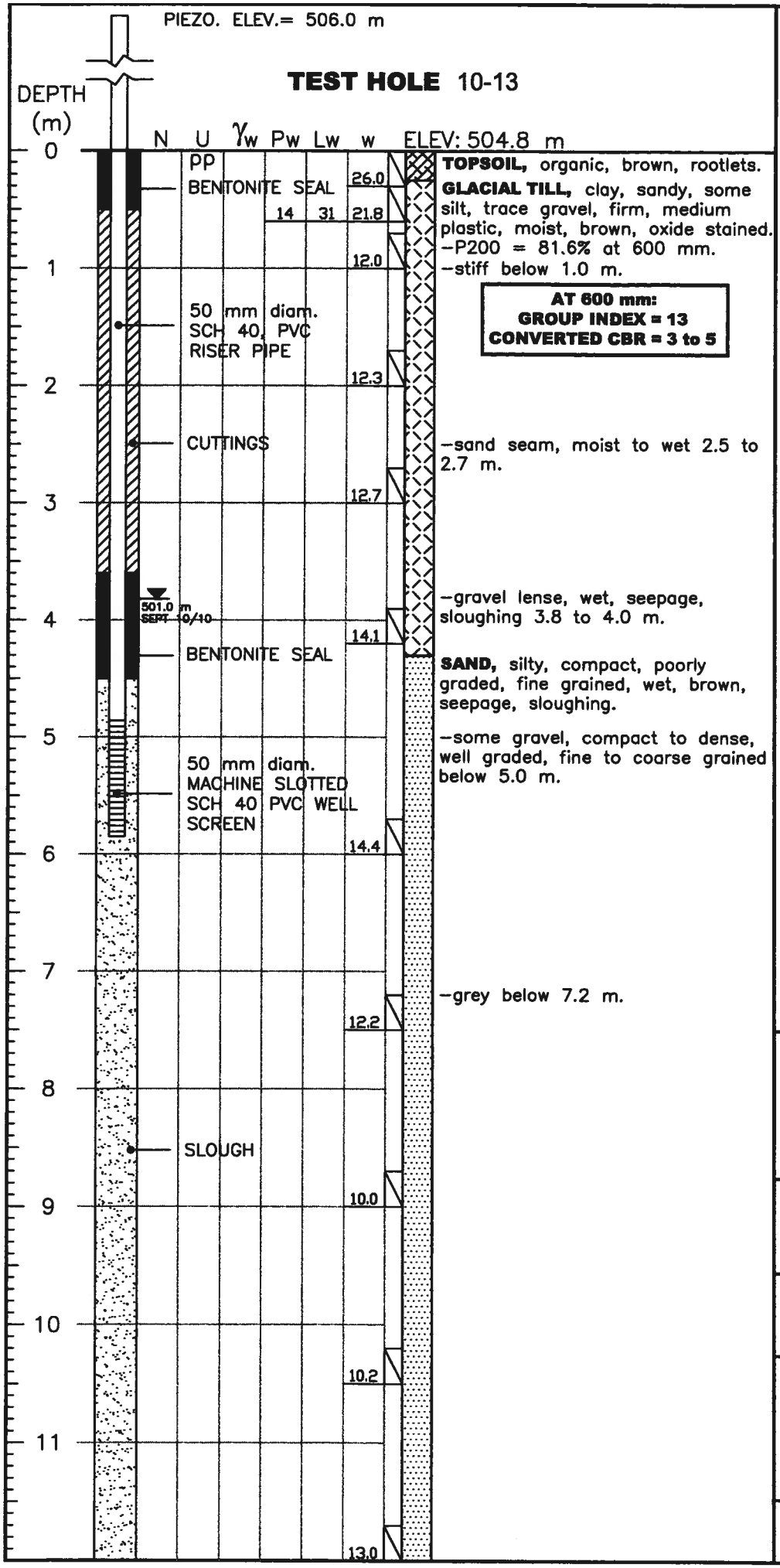
FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:
SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
SEPT 2/10	S10-7447-13A



LEGEND:

FILL, SAND, CLAY

TOPSOIL, GRAVEL, SILT, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (SAFETY HAMMER w/AUTOMATIC TRIP) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:

SW1/4-36-25-4-W2M
HWY 9/QUEEN STREET/CP RAILWAY
YORKTON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
SEPT 2/10	S10-7447-14

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 8, 2010

Test Hole No.: 10-2

Sample No.: 17

Depth (m): 4.5

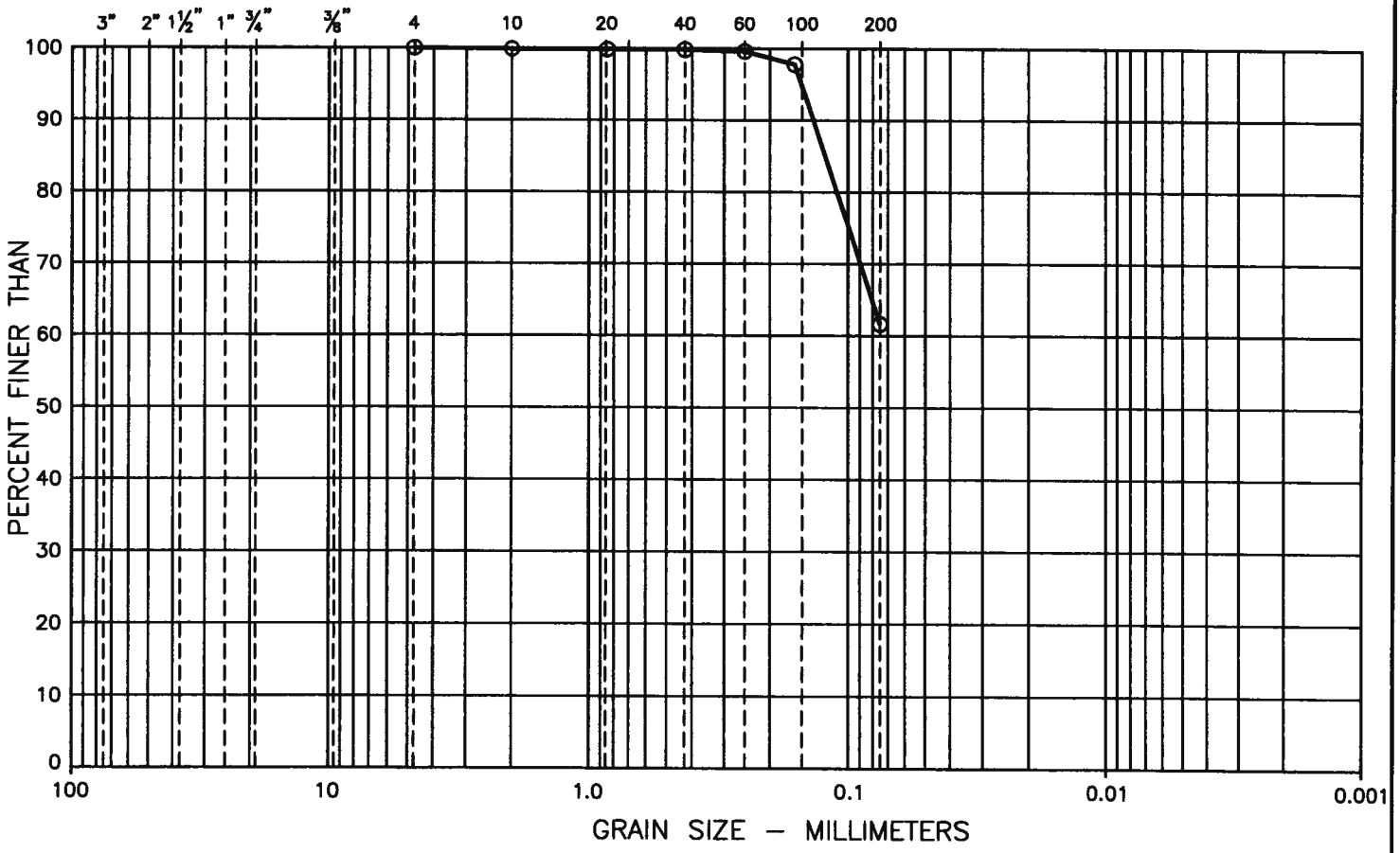
Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
4.750	100.0
2.000	99.9
0.850	99.8
0.425	99.8
0.250	99.6
0.160	97.8
0.075	61.6

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	38	62

GRAVEL SIZES		SAND SIZES			SILT AND CLAY SIZES
COARSE	FINE	COARSE	MEDIUM	FINE	
INCHES		SIEVE SIZES			



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-15

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 8, 2010

Test Hole No.: 10-3

Sample No.: 30

Depth (m): 7.5

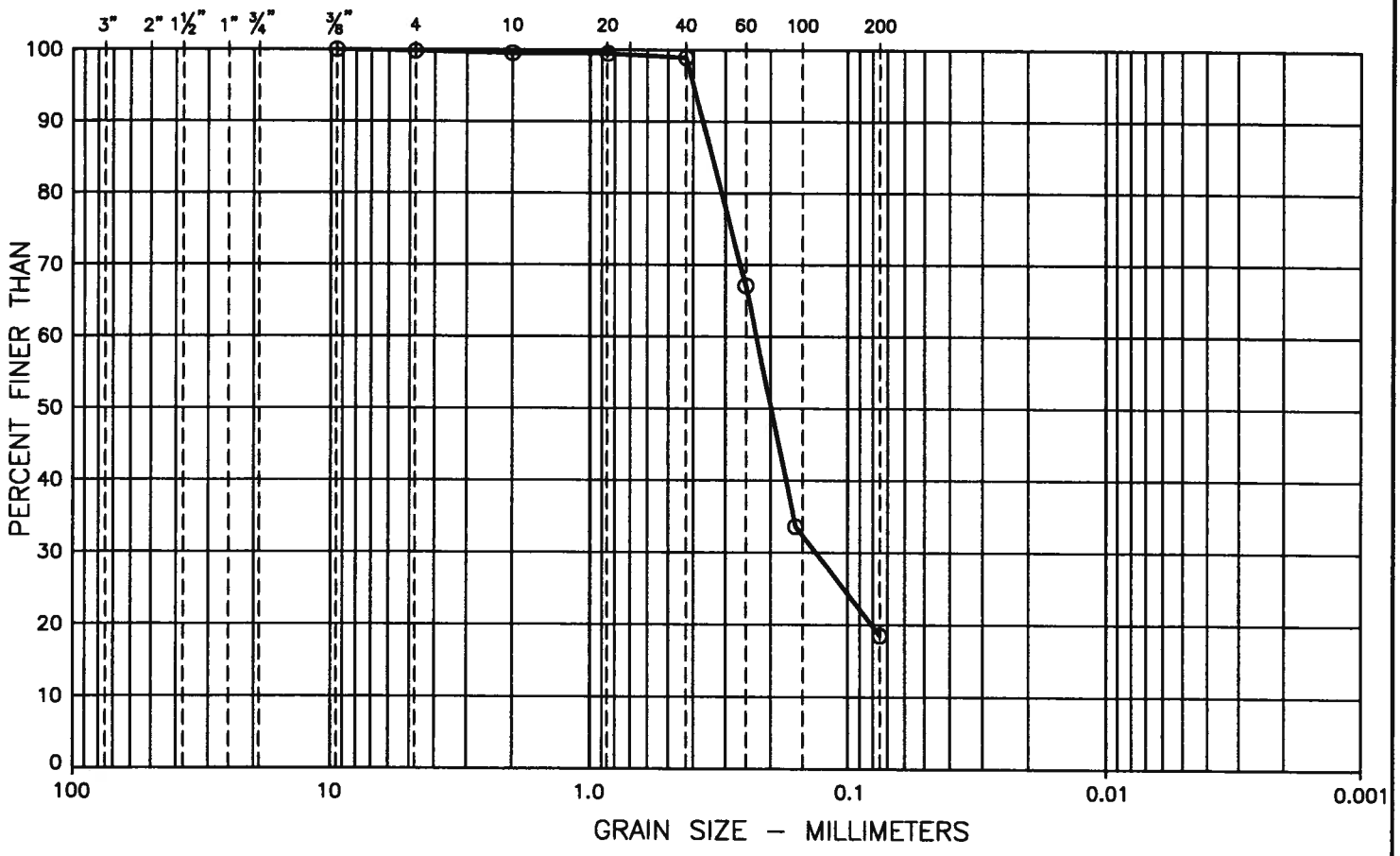
Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
9.500	100.0
4.750	99.8
2.000	99.5
0.850	99.5
0.425	98.9
0.250	67.1
0.160	33.6
0.075	18.5

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	81	19

GRAVEL SIZES		SAND SIZES			SILT AND CLAY SIZES
COARSE	FINE	COARSE	MEDIUM	FINE	
INCHES		SIEVE SIZES			



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-16

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 8, 2010

Test Hole No.: 10-3

Sample No.: 32

Depth (m): 10.5

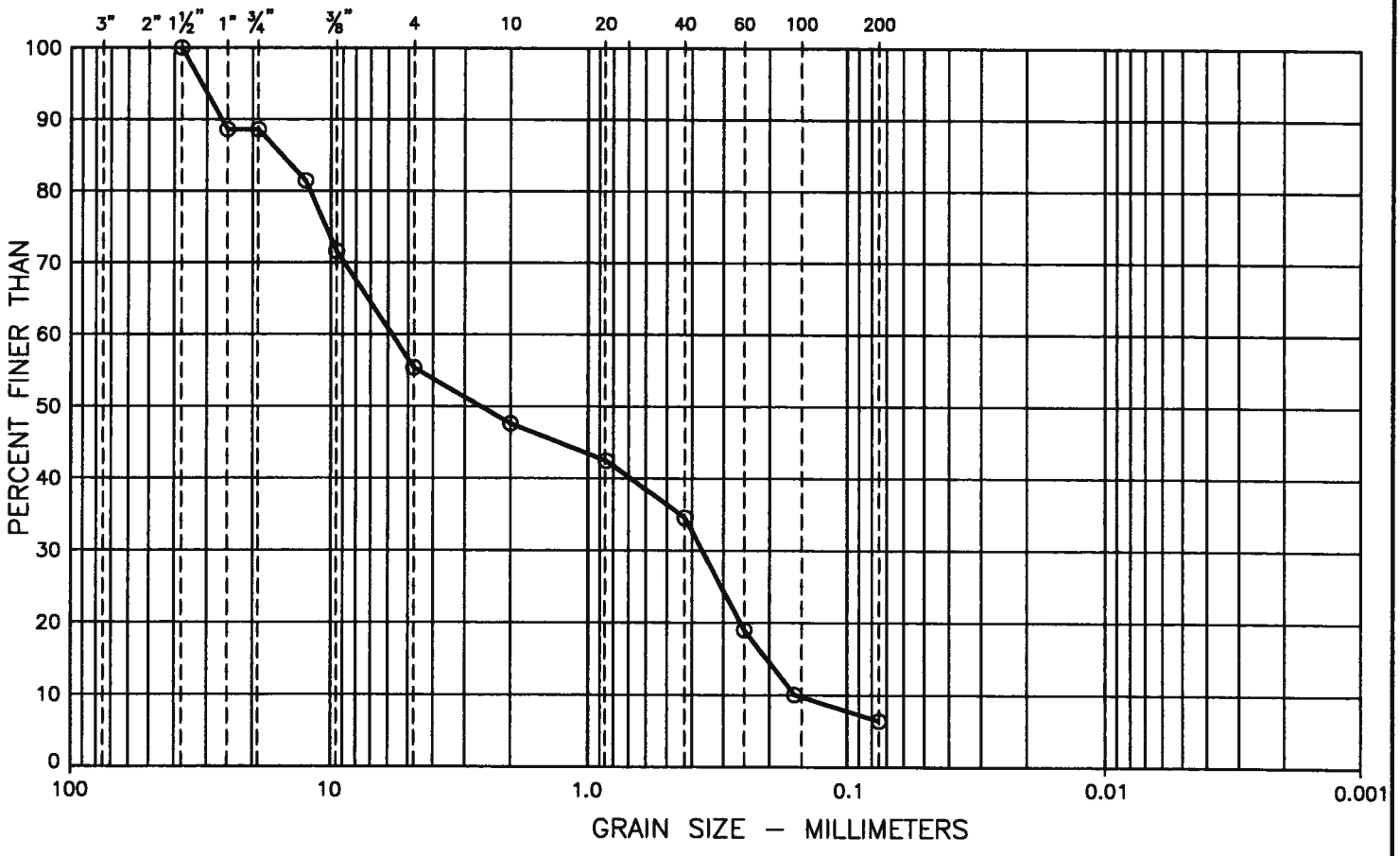
Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
37.500	100.0
25.000	88.6
19.000	88.6
12.500	81.4
9.500	71.6
4.750	55.4
2.000	47.6
0.850	42.4
0.425	34.5
0.250	19.0
0.160	10.0
0.075	6.4

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
45	49	6

GRAVEL SIZES		SAND SIZES			SILT AND CLAY SIZES
COARSE	FINE	COARSE	MEDIUM	FINE	
← INCHES →		← SIEVE SIZES →			



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-17

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 8, 2010

Test Hole No.: 10-4

Sample No.: 40

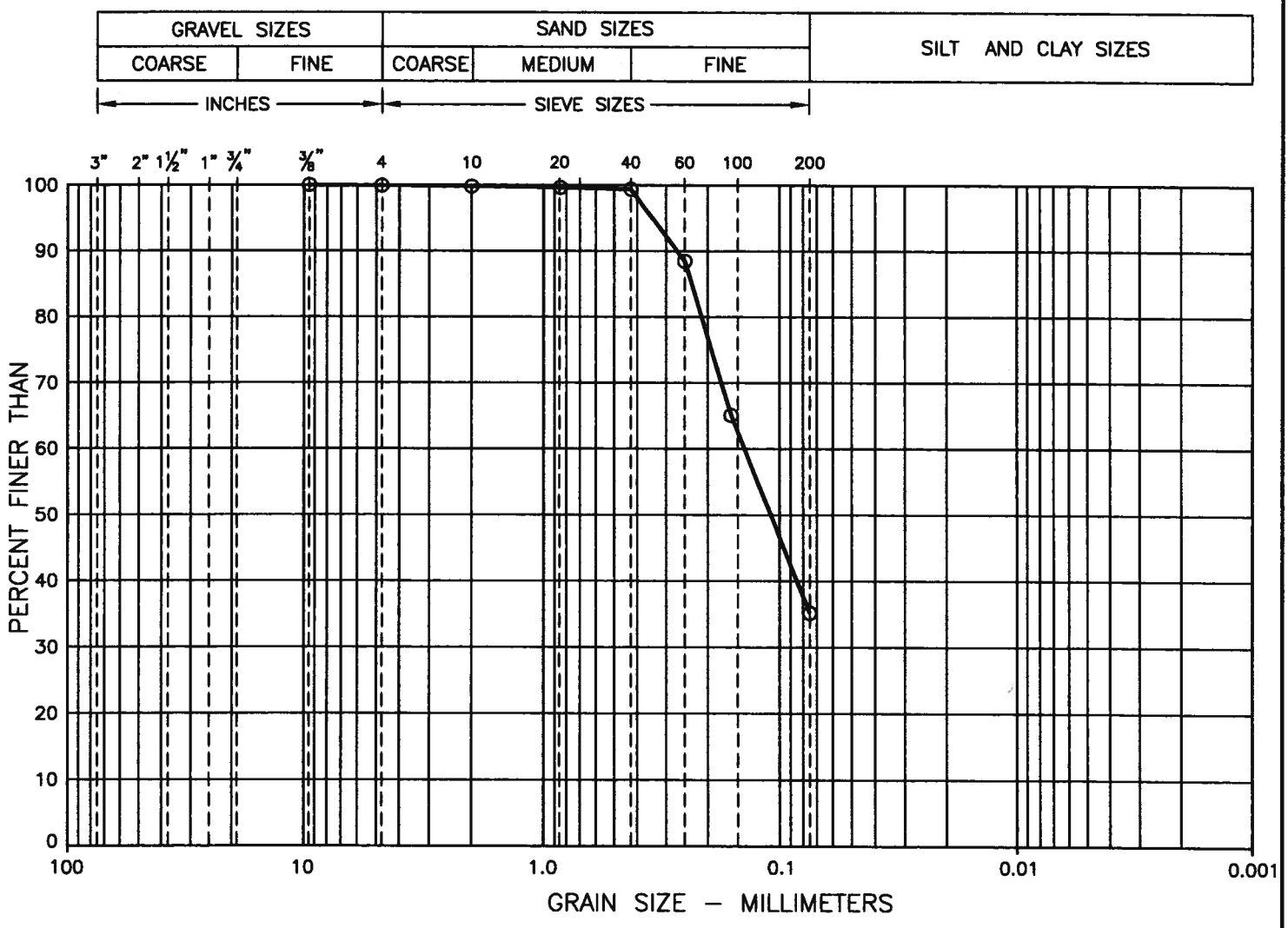
Depth (m): 4.5

Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
9.500	100.0
4.750	99.9
2.000	99.8
0.850	99.6
0.425	99.4
0.250	88.5
0.160	65.1
0.075	35.2

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	65	35



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-18

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 8, 2010

Test Hole No.: 10-4

Sample No.: 43

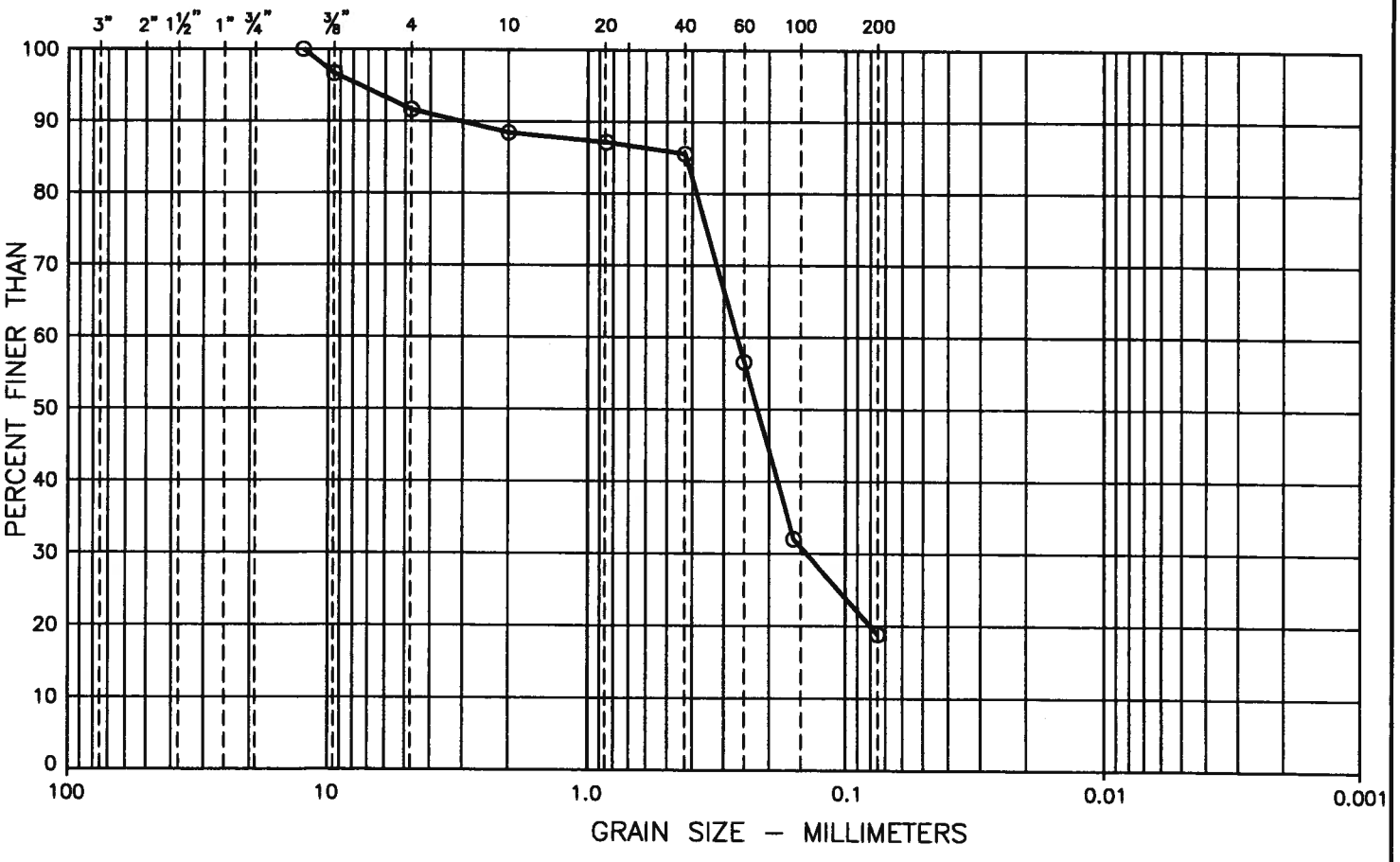
Depth (m): 9.0

Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
12.500	100.0
9.500	96.6
4.750	91.6
2.000	88.4
0.850	87.1
0.425	85.5
0.250	56.6
0.160	32.0
0.075	18.9

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
8	73	19



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-19

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 10, 2010

Test Hole No.: 10-7

Sample No.: 88

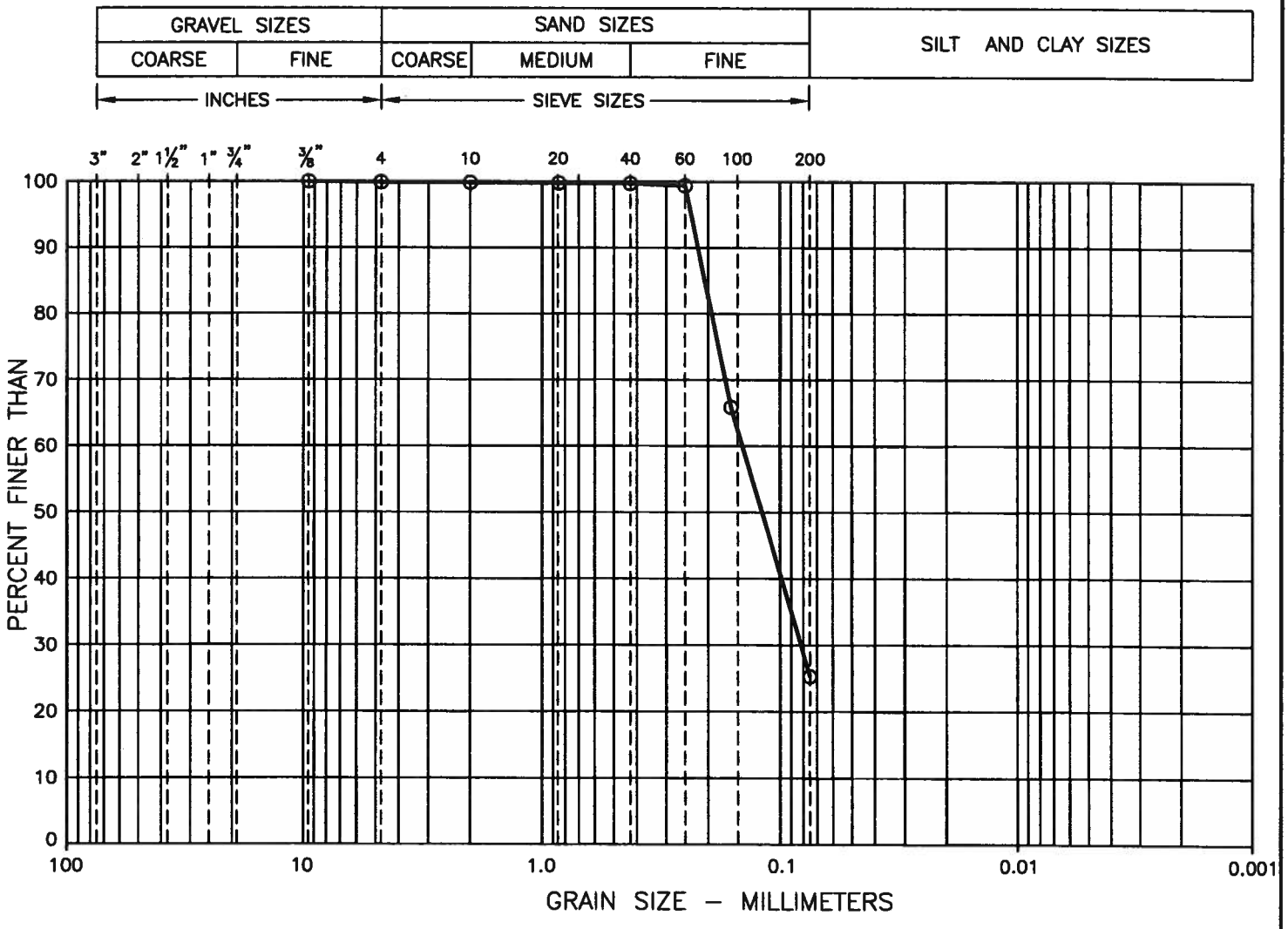
Depth (m): 7.5

Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
9.500	100.0
4.750	99.9
2.000	99.8
0.850	99.8
0.425	99.7
0.250	99.4
0.160	65.8
0.075	25.3

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	75	25



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-20

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 9, 2010

Test Hole No.: 10-7

Sample No.: 90

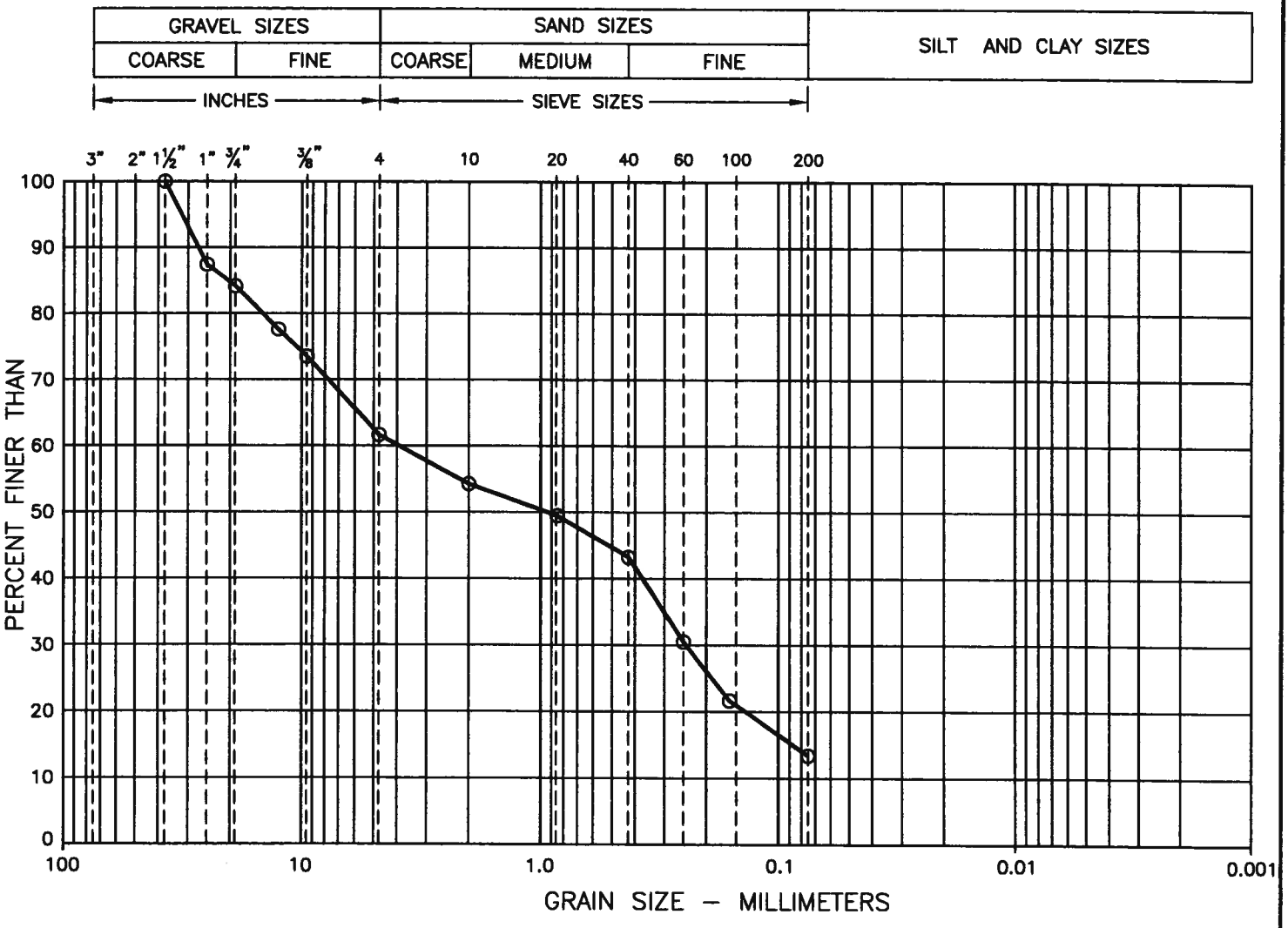
Depth (m): 10.5

Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
37.500	100.0
25.000	87.4
19.000	84.1
12.500	77.6
9.500	73.5
4.750	61.6
2.000	54.3
0.850	49.4
0.425	43.2
0.250	30.5
0.160	21.7
0.075	13.4

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
38	49	13



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-21

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 9, 2010

Test Hole No.: 10-8

Sample No.: 102

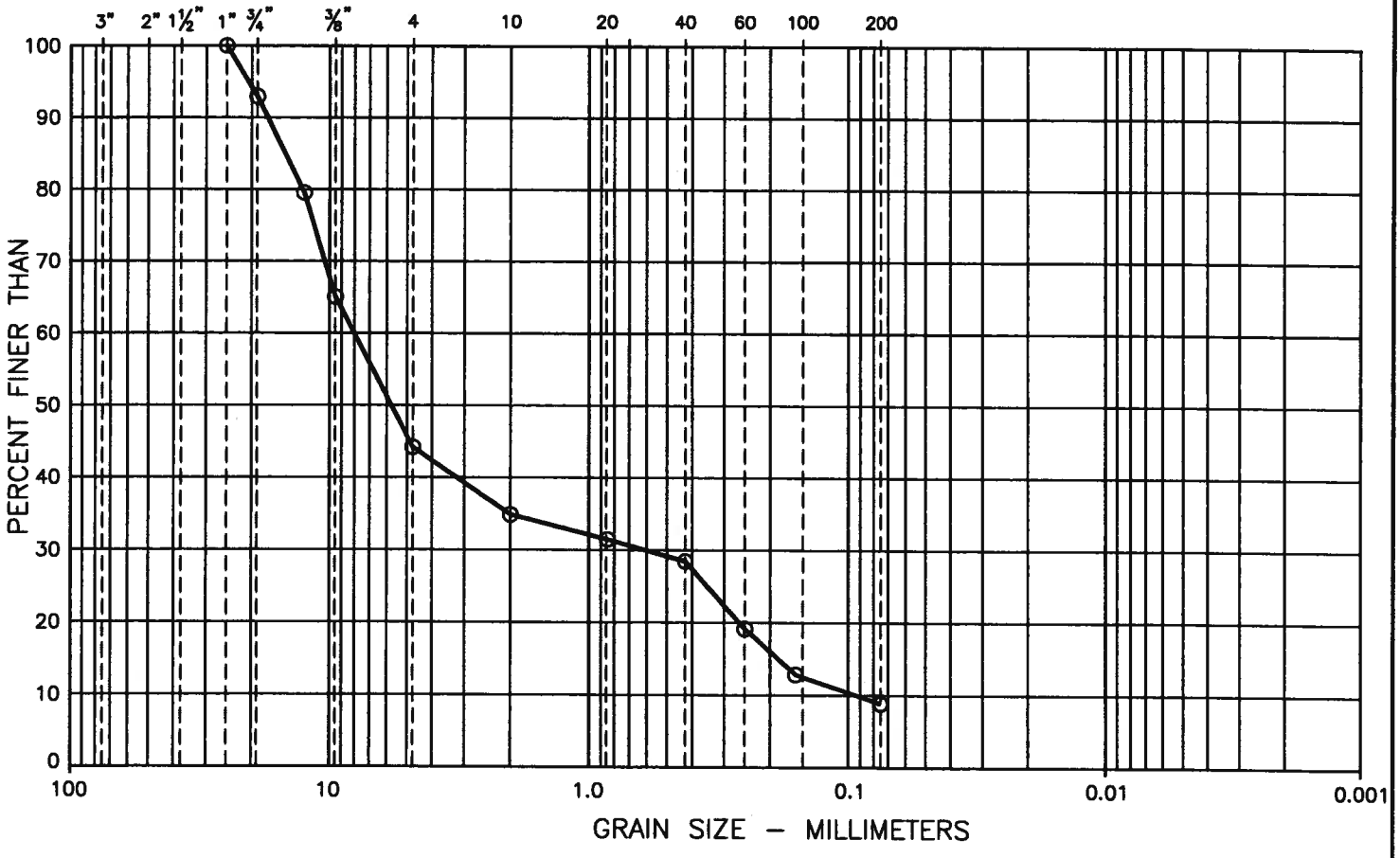
Depth (m): 6.0

Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
25.000	100.0
19.000	92.9
12.500	79.5
9.500	65.0
4.750	44.2
2.000	34.9
0.850	31.5
0.425	28.5
0.250	19.2
0.160	12.9
0.075	8.8

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
56	35	9



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-22

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 13, 2010

Test Hole No.: 10-10

Sample No.: 122

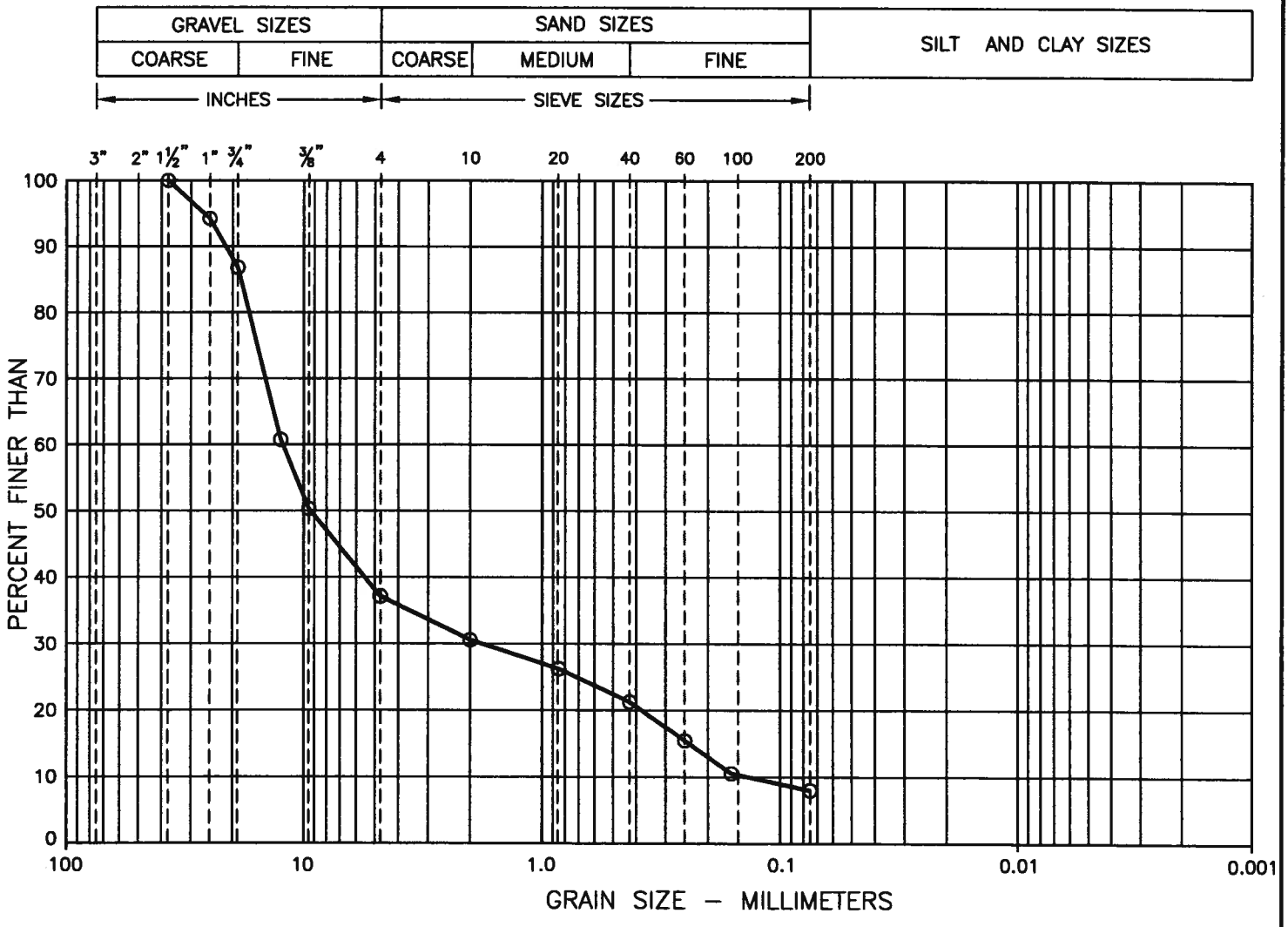
Depth (m): 6.0

Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
37.500	100.0
25.000	94.2
19.000	86.8
12.500	60.7
9.500	50.3
4.750	37.1
2.000	30.6
0.850	26.2
0.425	21.3
0.250	15.5
0.160	10.5
0.075	8.0

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
63	29	8



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-23

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 9, 2010

Test Hole No.: 10-11

Sample No.: 138

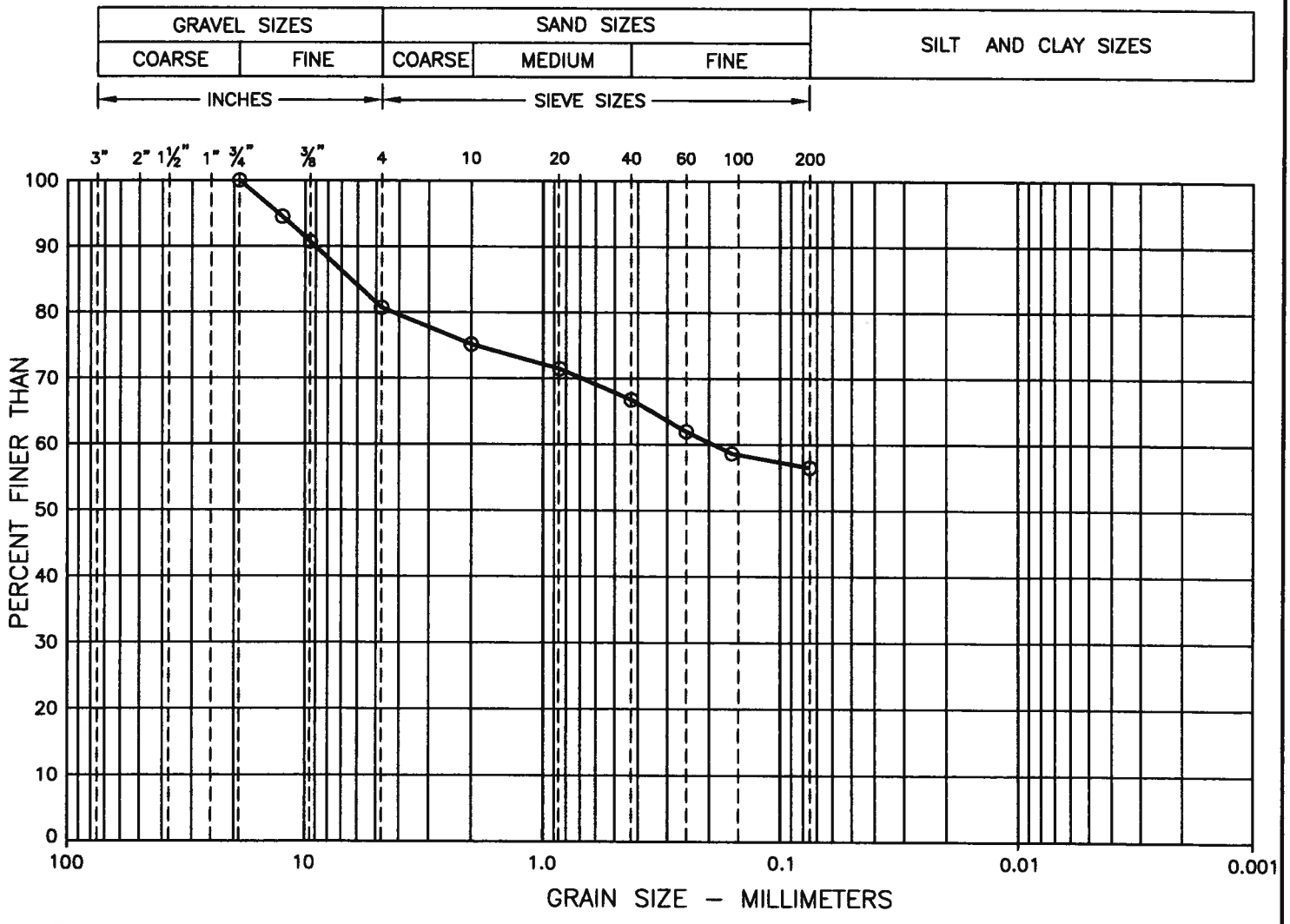
Depth (m): 7.5

Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
19.000	100.0
12.500	94.5
9.500	90.7
4.750	80.7
2.000	75.1
0.850	71.4
0.425	66.8
0.250	62.0
0.160	58.6
0.075	56.5

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
19	25	56



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-24

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED COMMERCIAL DEVELOPMENT
SW1/4-36-25-4-W2M, YORKTON, SK

Project No.: S10-7447

Date Tested: SEPTEMBER 9, 2010

Test Hole No.: 10-12

Sample No.: 154

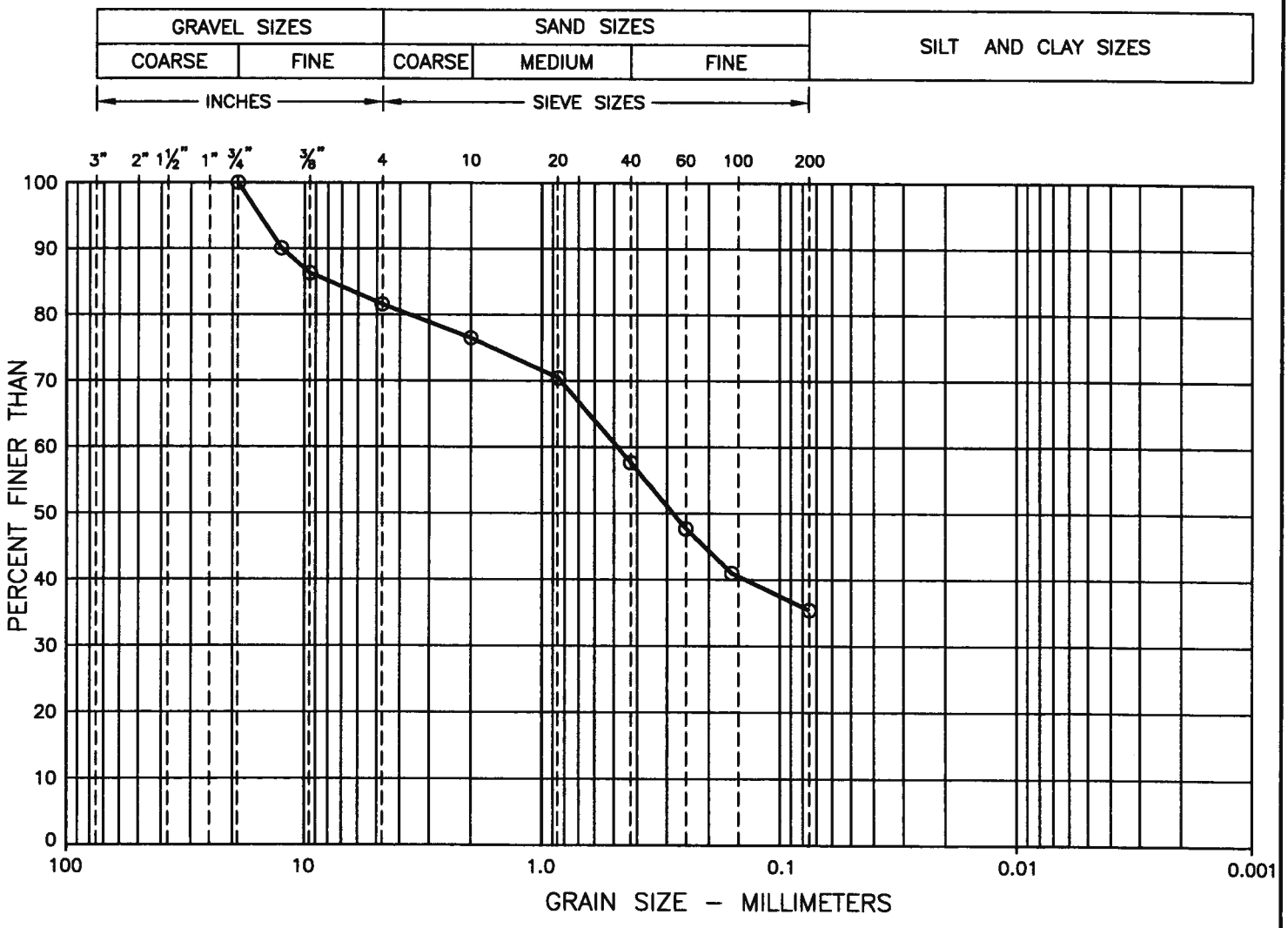
Depth (m): 9.0

Remarks:

SIEVE SIZE (mm)	PERCENT PASSING
19.000	100.0
12.500	90.0
9.500	86.3
4.750	81.6
2.000	76.5
0.850	70.4
0.425	57.6
0.250	47.6
0.160	41.0
0.075	35.4

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
18	47	35



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S10-7447-25

APPENDIX A

EXPLANATION OF TERMS ON TEST HOLE LOGS

P. MACHIBRODA ENGINEERING LTD.

CLASSIFICATION OF SOILS

Coarse-Grained Soils: Soils containing particles that are visible to the naked eye. They include gravels and sands and are generally referred to as cohesionless or non-cohesive soils. Coarse-grained soils are soils having more than 50 percent of the dry weight larger than particle size 0.080 mm.

Fine-Grained Soils: Soils containing particles that are not visible to the naked eye. They include silts and clays. Fine-grained soils are soils having more than 50 percent of the dry weight smaller than particle size 0.080 mm.

Organic Soils: Soils containing a high natural organic content.

Soil Classification By Particle Size

Clay – particles of size	< 0.002 mm
Silt – particles of size	0.002 – 0.060 mm
Sand – particles of size	0.06 – 2.0 mm
Gravel – particles of size	2.0 – 60 mm
Cobbles – particles of size	60 – 200 mm
Boulders – particles of size	>200 mm

TERMS DESCRIBING CONSISTENCY OR CONDITION

Coarse-grained soils: Described in terms of compactness condition and are often interpreted from the results of a Standard Penetration Test (SPT). The standard penetration test is described as the number of blows, N, required to drive a 51 mm outside diameter (O.D.) split barrel sampler into the soil a distance of 0.3 m (from 0.15 m to 0.45 m) with a 63.5 kg weight having a free fall of 0.76 m.

Compactness Condition	SPT N-Index (blows per 0.3 m)
Very loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	Over 50

Fine-Grained Soils: Classified in relation to undrained shear strength.

Consistency	Undrained Shear Strength (kPa)	N Value (Approximate)	Field Identification
Very Soft	<12	0-2	Easily penetrated several centimetres by the fist.
Soft	12-25	2-4	Easily penetrated several centimetres by the thumb.
Firm	25-50	4-8	Can be penetrated several centimetres by the thumb with moderate effort.
Stiff	50-100	8-15	Readily indented by the thumb, but penetrated only with great effort.
Very Stiff	100-200	15-30	Readily indented by the thumb nail.
Hard	>200	>30	Indented with difficulty by the thumbnail.

Organic Soils: Readily identified by colour, odour, spongy feel and frequently by fibrous texture.

DESCRIPTIVE TERMS COMMONLY USED TO CHARACTERIZE SOILS

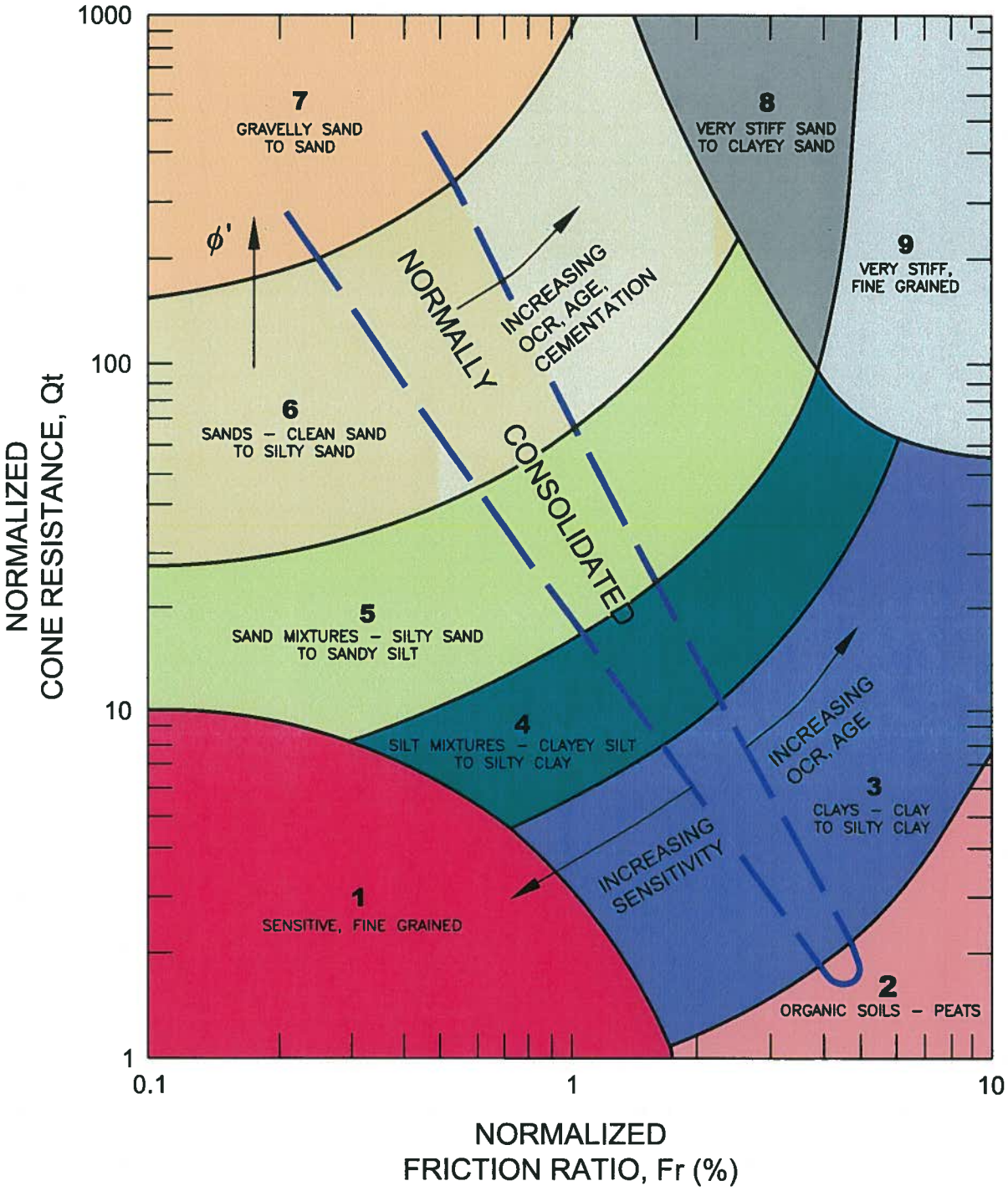
Poorly Graded	- predominance of particles of one grain size.
Well Graded	- having no excess of particles in any size range with no intermediate sizes lacking.
Mottled	- marked with different coloured spots.
Nuggety	- structure consisting of small prismatic cubes.
Laminated	- structure consisting of thin layers of varying colour and texture.
Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks.
Fractured	- broken by randomly oriented interconnecting cracks in all 3 dimensions.

APPENDIX B

PIEZOCONE PENETRATION TEST PLOTS

P. MACHIBRODA ENGINEERING LTD.

CPTu SOIL BEHAVIOUR TYPE CLASSIFICATION CHART
(AFTER ROBERTSON, 1990)



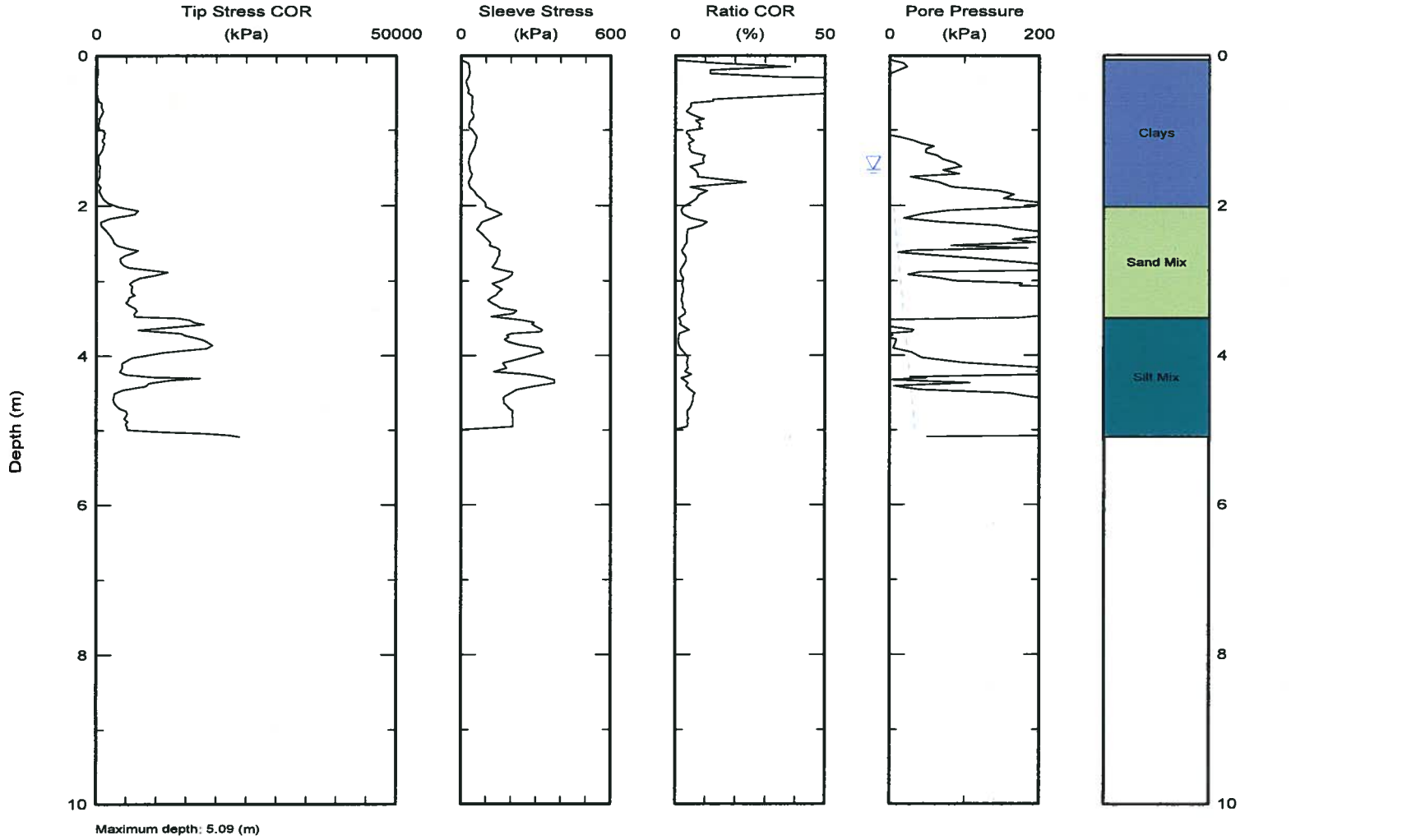
P. MACHIBRODA ENGINEERING LTD.

P. Machibroda Engineering Ltd.
Saskatoon, SK S7K 3Y4
(306) 665-8444
pmel.sk@machibroda.com

Latitude:
Longitude:
Elevation: 504.6 metres

Date: 02/Sep/2010
Test ID: CPTu 10-1
Project: S10-7447

Customer: Proposed Commercial Subdivision
Job Site: Yorkton, SK

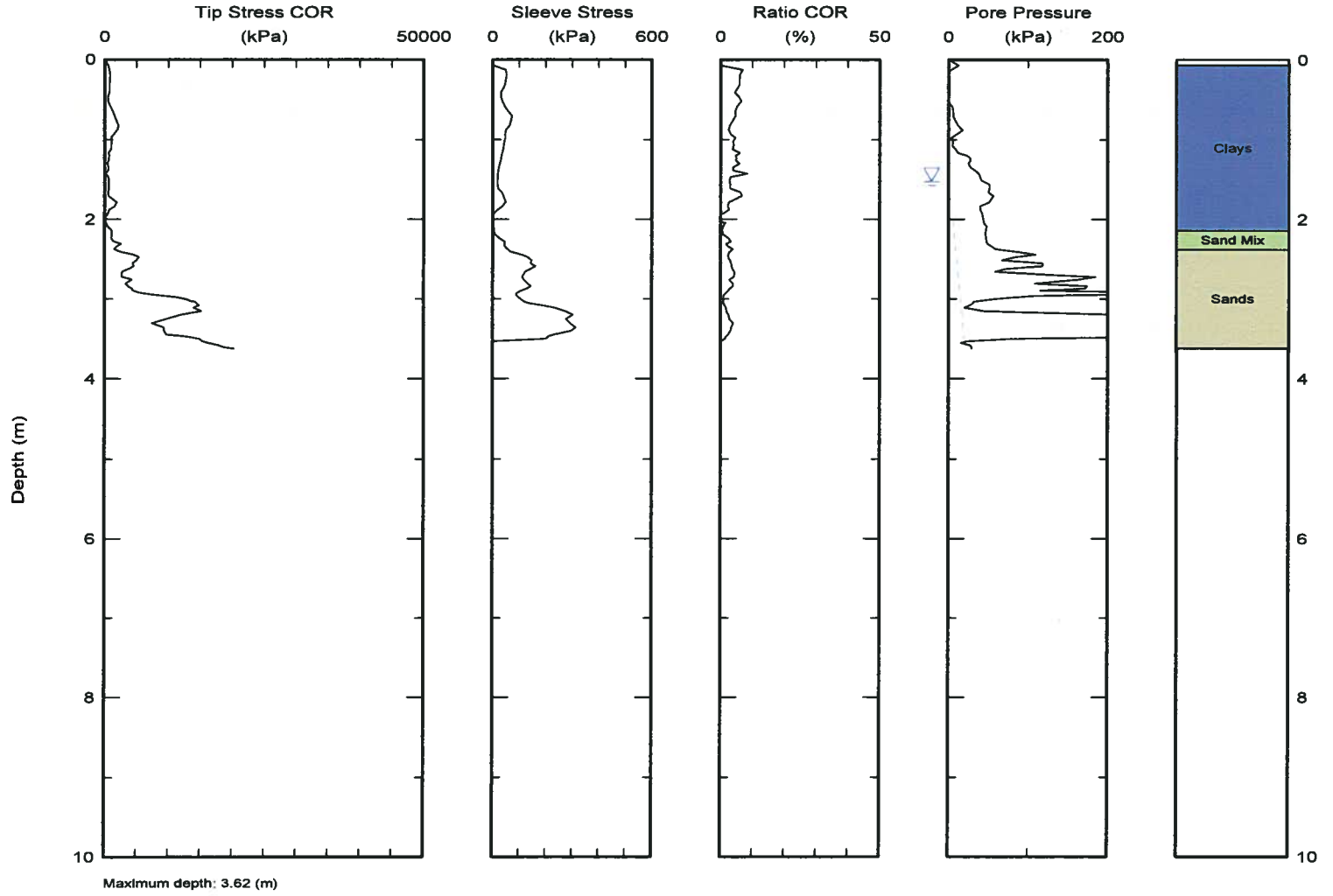


P. Machibroda Engineering Ltd.
Saskatoon, SK S7K 3Y4
(306) 665-8444
pmel.sk@machibroda.com

Latitude:
Longitude:
Elevation: 504.5 metres

Date: 02/Sep/2010
Test ID: CPTu 10-2
Project: S10-7447

Customer: Proposed Commercial Subdivision
Job Site: Yorkton, SK

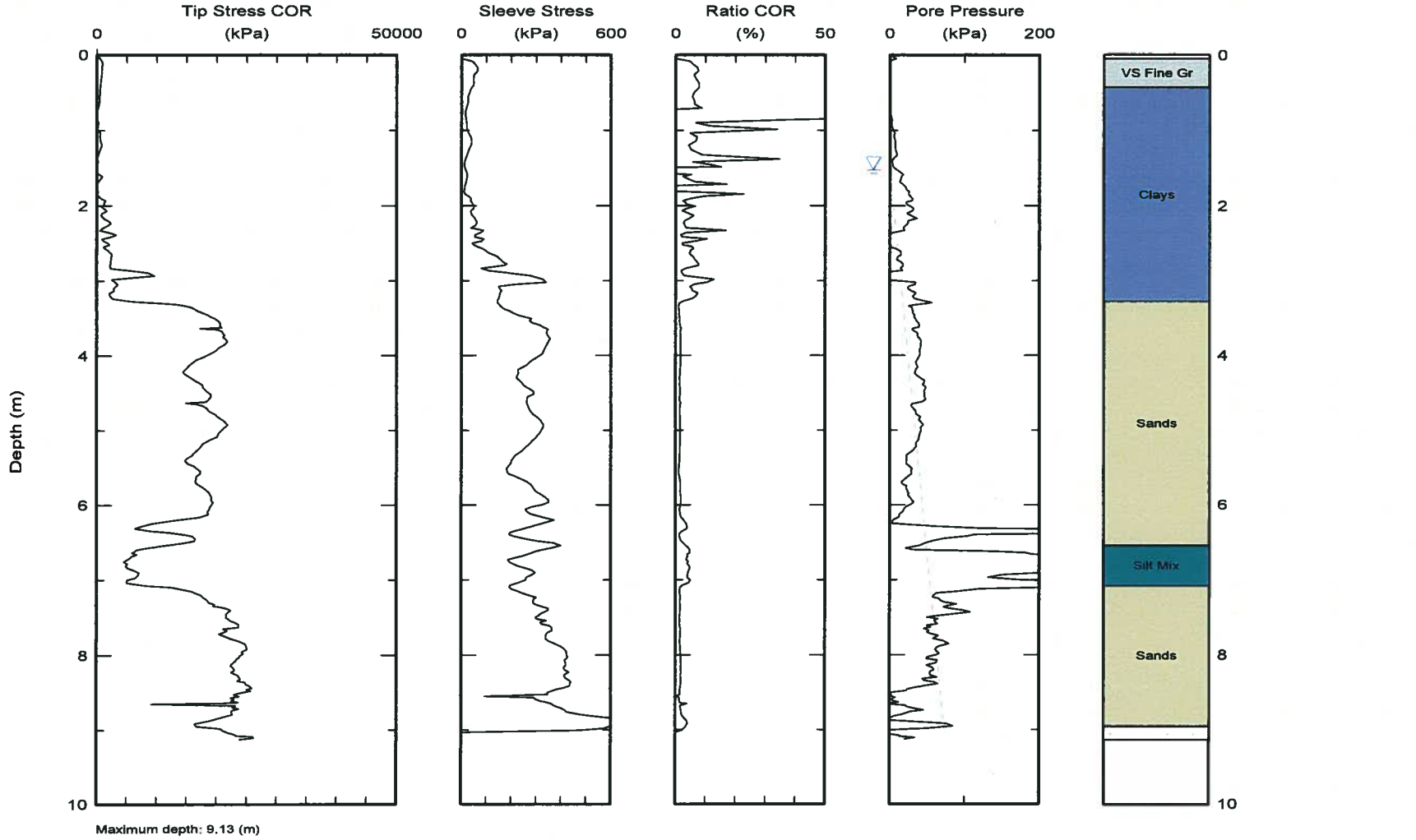


P. Machibroda Engineering Ltd.
Saskatoon, SK S7K 3Y4
(306) 665-8444
pmel.sk@machibroda.com

Latitude:
Longitude:
Elevation: 503.6 metres

Date: 02/Sep/2010
Test ID: CPTu 10-3
Project: S10-7447

Customer: Proposed Commercial Subdivision
Job Site: Yorkton, SK

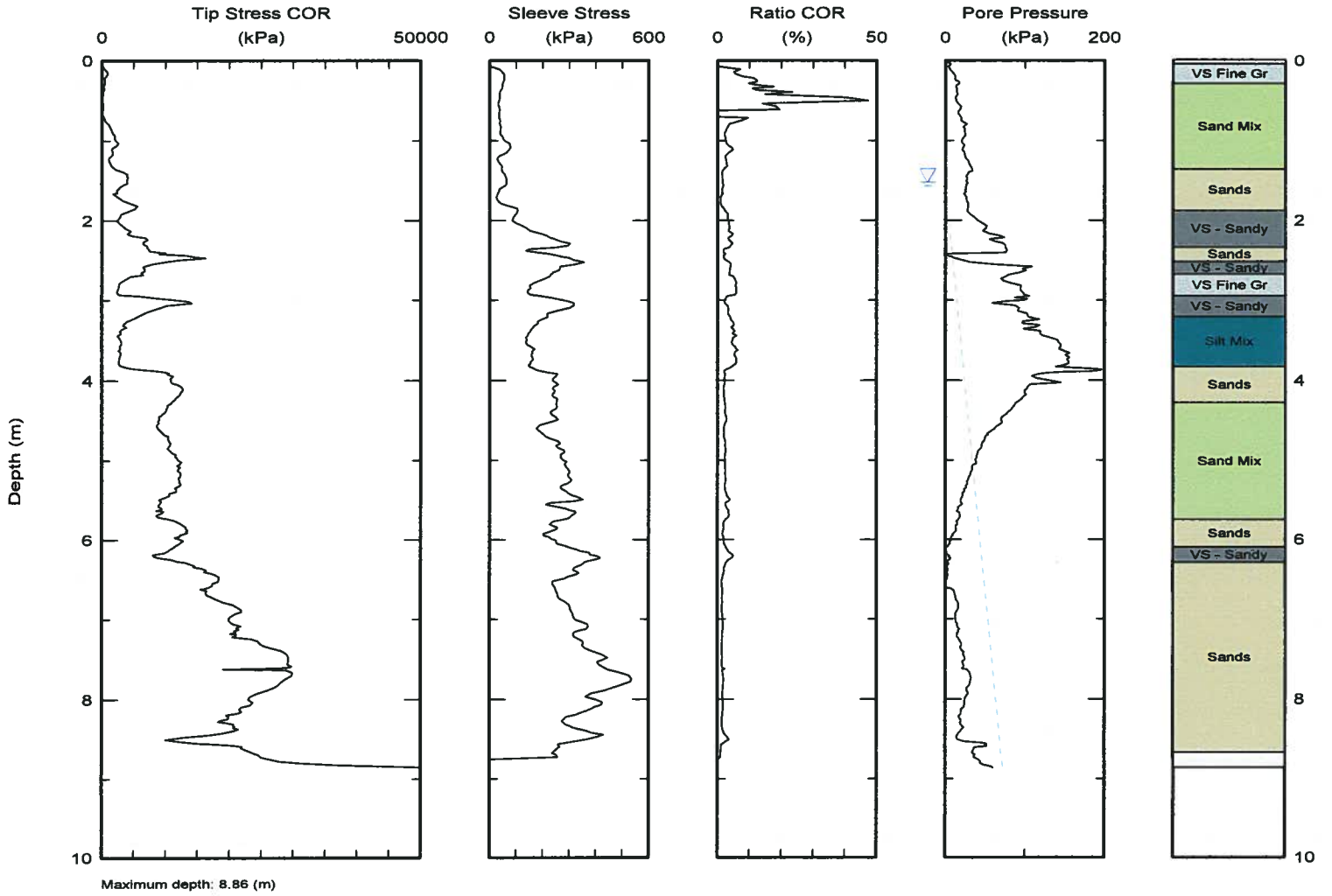


P. Machibroda Engineering Ltd.
Saskatoon, SK S7K 3Y4
(306) 665-8444
pmel.sk@machibroda.com

Latitude:
Longitude:
Elevation: 503.7 metres

Date: 02/Sep/2010
Test ID: CPTu 10-4
Project: S10-7447

Customer: Proposed Commercial Subdivision
Job Site: Yorkton, SK



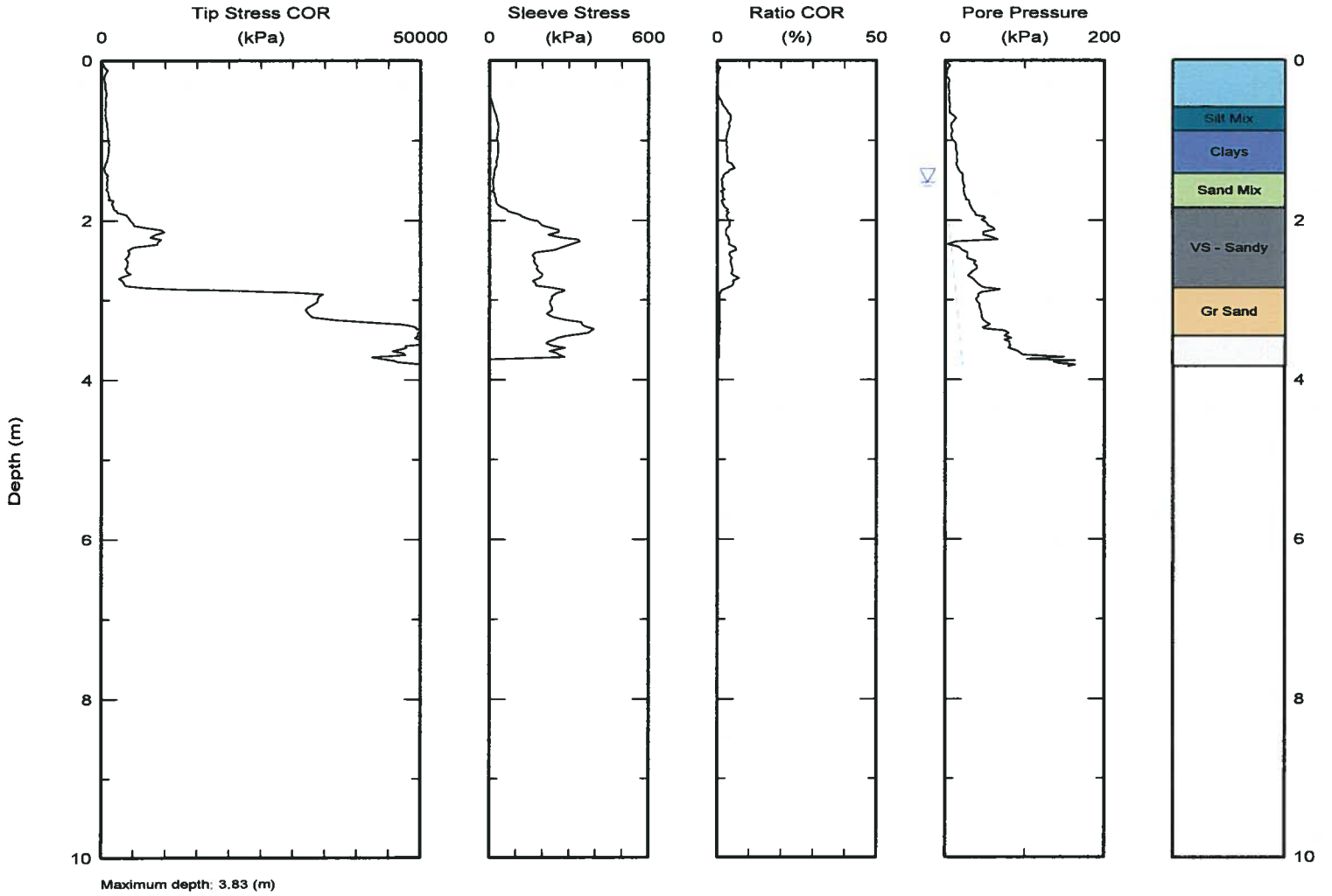
Estimated Phreatic Surface

P. Machibroda Engineering Ltd.
Saskatoon, SK S7K 3Y4
(306) 665-8444
pmel.sk@machibroda.com

Latitude:
Longitude:
Elevation: 502.6 metres

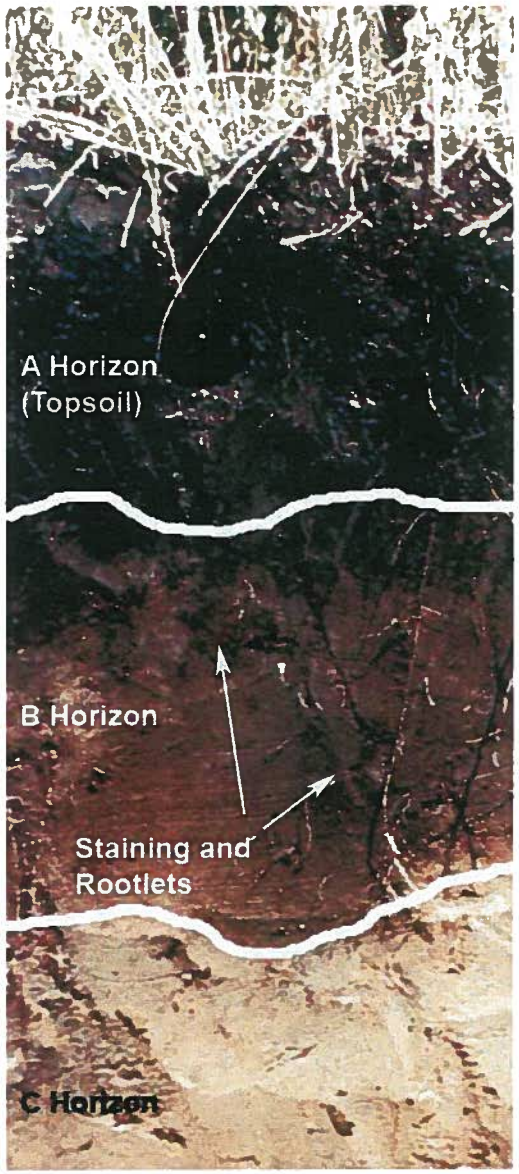
Date: 02/Sep/2010
Test ID: CPTu 10-5
Project: S10-7447

Customer: Proposed Commercial Subdivision
Job Site: Yorkton, SK



APPENDIX C

TOPSOIL, ORGANIC MATTER AND ORGANICS



A Horizon

The A horizon is the topsoil layer of the soil strata. It is characterized by a build up of organic matter, and a lower unit weight than subsequent layers. The organic matter content of this layer is typically 4-10% by mass.

The colour of this horizon varies from dark black to brown, depending on surface vegetation and climatic conditions.

B Horizon

Typically reddish brown in colour and contains accumulations of matter that have been washed down from the A Horizon. The B horizon is generally composed of clay that has been washed out of the A Horizon, but can also contain iron, calcium and sodium deposits as well.

C Horizon

Unweathered parent soil.

Topsoil is a mixture of mineral soil and organic matter. The organic matter is developed from decaying biological material (leaves, grass, trees, animals, etc.) and contributes to the brown to black colour of the soil. Following the topsoil is the B horizon which is a transition layer, where staining from the overlying topsoil is common. This results in a darker colour of the soil immediately below the organic topsoil layer. Depending on the surface vegetation, rootlets may be present below the depth of topsoil. However it should be recognized that these rootlets are not the same as organic matter in topsoil.

Physically speaking in comparison to mineral soil, topsoil has a significantly lower bulk density and a lower unit weight as compared to the underlying parent soil. This is due to larger pore spaces and non mineral materials in the soil matrix. Along with lower density, topsoil is often spongy and colloidal/fibrous. The following figure is of a typical prairie soil. Each horizon is labelled accordingly to demonstrate a typical soil profile.

Reference

Henry L. 2003. Henry's Handbook of Soil and Water, Henry Perspectives, Saskatoon, SK.

C Appendix C - Environmental and Heritage Screening Report (Golder)

October 2010

Environmental and Heritage Screening for the City of Yorkton Commercial Subdivision Project

Submitted to:
Jason Horner, P.Eng., Infrastructure Manager
Associated Engineering (Sask) Ltd.
#1 - 2225 Northridge Drive
Saskatoon, Saskatchewan
S7L 6X6

REPORT

Report Number: 10-1361-0046

Distribution:

1 Copy - Associated Engineering (Sask) Ltd., Saskatoon, Saskatchewan (PDF)
2 Copies - Golder Associates Ltd., Saskatoon, Saskatchewan

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TABLES

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FIGURES

APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was commissioned by Associated Engineering (Sask) Ltd. (AEL), on behalf of the City of Yorkton, to complete a “desktop” environmental and heritage screening as part of the permitting process for a proposed commercial subdivision located on the southeastern edge of the city limits (Figure 1). The objective of the desktop screening report is to document the current environmental conditions, to summarize the regulatory contacts that will likely be required were the proposed commercial subdivision to proceed, identify any potential environmental issues that may require further assessment, and provide any recommended mitigation measures that could be implemented during site preparation and construction.

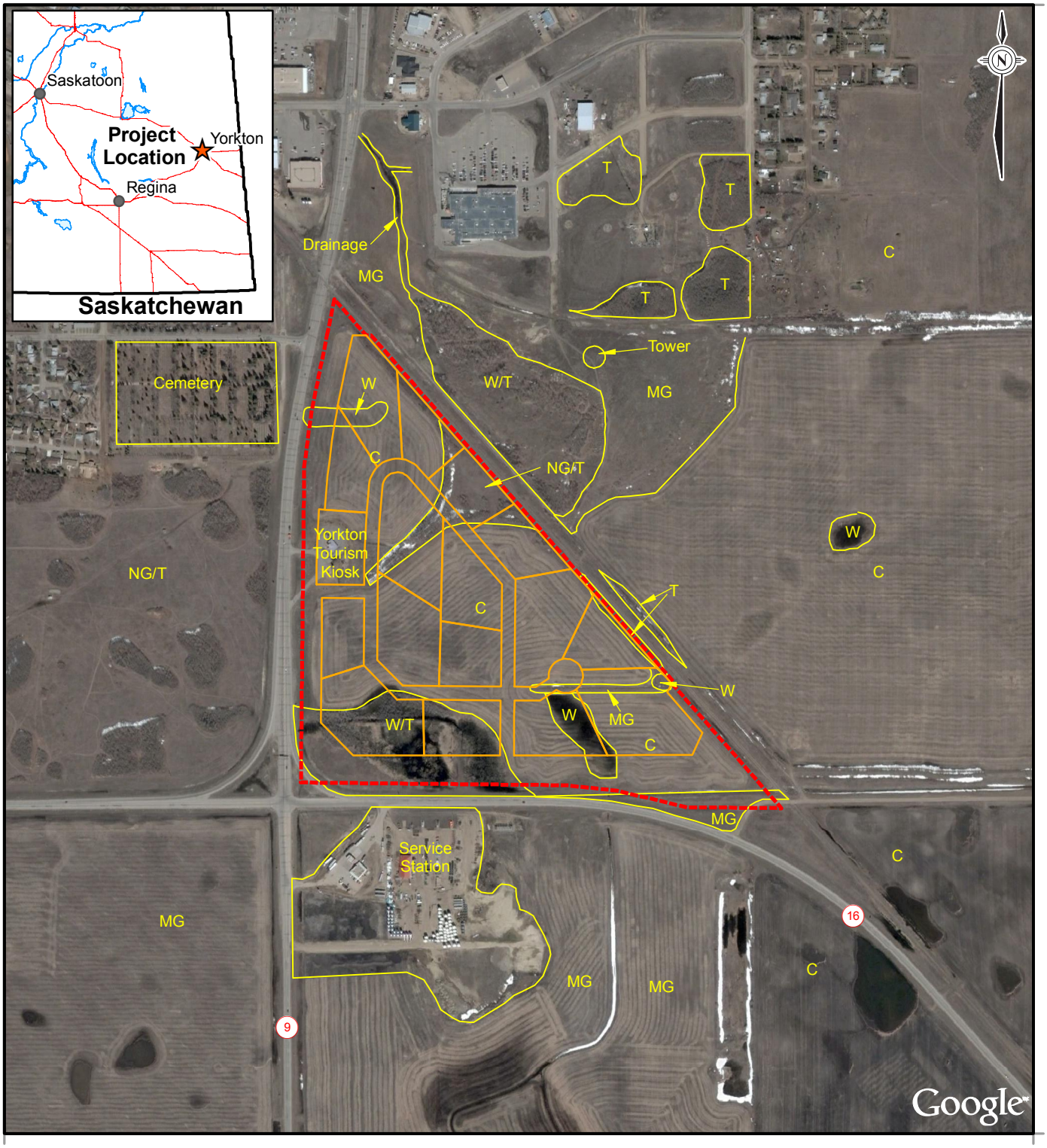
A site visit for the study area was conducted on August 20, 2010 by Ian Prokopetz (ecologist, Golder) to assess environmental sensitivities (e.g., presence of any listed plant and wildlife species) and where applicable, identify site-specific mitigation recommendations that may need to be considered as part of the Project planning. For the purposes of this report, the study area is defined as a 1 km wide buffer around the proposed commercial subdivision located in the SW 36-25-4 W2M. Photographs from the site visit are provided in Appendix A.

2.0 PROJECT REGULATORY REQUIREMENTS AND RECOMMENDATIONS

2.1 Regulatory Requirements

The following recommendations are intended to provide AEL with a preliminary list of regulatory requirements and recommendations in the event that the Project does proceed. These requirements are based on current processes and procedures but are subject to change in the future. It is expected that the City of Yorkton will be responsible for any specific requirements pertaining to new developments within their jurisdiction. Land use and development within the City of Yorkton must be completed in accordance with their City Development Plan and Zoning Bylaw (City of Yorkton 2010).

Although this development is entirely within the city limits, the Ministry of Environment (MOE) office in Melville should be contacted regarding any concerns, they may have with the proposed Project (e.g., wildlife or habitat issues). In the event the Project proceeds, MOE may request surveys for sensitive plant and wildlife species be completed, depending on the time of year construction will commence and/or occur. MOE should also be contacted well in advance of construction regarding the requirements for the preparation and submission of an Aquatic Habitat Protection Permit (AHPP) for the proposed construction activities associated with the wetland basins located within the subdivision. MOE may request compensation for the loss of the wetland basins affected by the Project, based on a no-net loss principle, according to the Saskatchewan Wetland Policy (SaskWater 2001). Submission of a wetland compensation plan may be required as part of Project approvals.



Legend

- Habitat
- Proposed Commercial Subdivision
- Subdivision Lot
- C Cultivated
- MG Modified Grassland
- NG Native Grassland
- T Treed
- W Wetland

Reference:
Image © 2010 DigitalGlobe
NAD 83 UTM Zone 13

PROJECT
Associated Engineering
CITY OF YORKTON SCREENING

TITLE
COMMERCIAL SUBDIVISION LOCATION

Golder Associates
Saskatoon, Saskatchewan

PROJECT		10-1361-0046	FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	MK	23/09/10	**FIGURE: 1**	
CHECK	CJ	04/10/10		
REVIEW	ME	04/10/10		

G:\2010\1361\10-1361-0046 Associated Screening Yorkton\GIS\Maps\10-1361-0046-City of Yorkton Commercial Subdivision Location.mxd

Heritage resources, as defined under *The Heritage Property Act*, include all Saskatchewan's historic and pre-contact archaeological sites, architecturally significant structures, and paleontological resources. As per Section 66 of *The Heritage Property Act*, all heritage resources on privately owned land and provincial Crown land are considered to be property of the Crown. These sites are managed by the Heritage Resources Branch at the Ministry of Tourism, Parks, Culture and Sport in Regina. Section 63 of *The Heritage Property Act* empowers the Minister to require a proponent to conduct a Heritage Resources Impact Assessment (HRIA) for any project that has the potential to impact significant heritage resources. It is the responsibility of the developer to submit all proposed operations for regulatory review to the Heritage Resources Branch. The proposed Project was submitted to the Heritage Resources Branch for review on August 20, 2010. The Heritage Resources Branch reviewed the Project details and determined that an HRIA is not required should the Project proceed as proposed. A copy of the response letter has been included in Appendix B.

3.0 EXISTING ENVIRONMENTAL OVERVIEW

3.1 Land Use

The Project is located within the limits of the City of Yorkton (Figure 1). Currently, the land is primarily used for agricultural purposes (e.g., cereal grain production); however, remnant patches of aspen parkland and wetland complexes do occur. Rural and urban residences, along with commercial business development, surround the Project, although lands on the eastern portion of the Project area are used for agricultural purposes. A tourist information centre is located on the west boundary of the Project, adjacent to Highway No. 9 and Highway No. 16 (also known as Queen Street) is located adjacent to the south boundary of the Project. A Canadian Pacific Railway (CPR) rail-line parallels the east boundary, travelling in a northeast to southwest direction. A service station/truck-stop and industrial development are located south of the Project, while a shopping centre and residential areas are located north and west of the Project, respectively. A cemetery and a park are located on the west side of Highway No. 9 near the Project. A communications tower is located within SW 36-25-4 W2M, northeast of the CPR rail-line.

3.2 Terrain and Soils

The Project is located within the Yorkton Plain Landscape Area (Acton et al. 1998). This landscape area is described as a large, nearly level landscape that extends from Canora to Spy Hill. Specifically, the Project area is located on gently sloping, undulating terrain (Saskatchewan Land Resource Unit [SLRU] 2004),

The study area is located within the Hoodoo-Oxbow soil association within the Black Soil Zone of Saskatchewan (SLRU 2004). Specific information about the Hoodoo-Oxbow soil association is provided in Table 1.

Table 1: Soil Association in the Yorkton Commercial Subdivision Project Area

Soil Association (map unit)	Association Description	Dominant Soils	Dominant Surface Texture(s)	Surface Stoniness	Susceptibility To Wind Erosion	Susceptibility to Water Erosion
Hoodoo-Oxbow (HdOx14)	A group of dominantly Chernozemic Black soils formed in a mixture of shallow, strongly calcareous, silty lacustrine materials underlain by glacial till (Hoodoo) and loamy glacial till (Oxbow).	Hoodoo Orthic Black Chernozems with substantial areas of Oxbow Orthic Black, Rego Black, and Calcareous Black Chernozems	Clay Loam and Loam	Slightly stony where stones seldom hinder cultivation	Very Low	Low

Source: SLRU (1997 and 2004).

3.3 Aquatic Habitat

No watercourses will be encountered or otherwise encroached upon within the Project area. However, a large, permanent wetland exists in the southwest corner of the proposed subdivision, and three small ephemeral wetland basins (cultivated) were identified in the southern and eastern portions of the proposed subdivision during the field survey. None of the wetlands observed were deemed to be potential fish habitat.

3.4 Native Vegetation

The Project is located within the Yorkton Plain landscape area in the Aspen Parkland Ecoregion (Acton et al. 1998). In its natural state, the majority of this ecoregion tends to support a mixture of trembling aspen (*Populus tremuloides*) groves and grasslands; representing the transition zone between open grasslands to the south and continuous forest to the north (Acton et al. 1998). Woodland areas are often represented by open stands of trembling aspen with an understory of shrubs such as western snowberry (*Symphoricarpos occidentalis*), prairie rose (*Rosa arkansana*), and saskatoon (*Amelanchier alnifolia*). Characteristic graminoids found in the remnant grassland areas include species such as western porcupine grass (*Stipa curtiseta*), june grass (*Koeleria macrantha*), awned wheatgrass (*Elymus trachycaulus* ssp. *subsecundus*), and slender wheatgrass (*Elymus trachycaulus* ssp. *trachycaulus*).

A vegetation assessment was conducted in the Project area on August 20, 2010 to categorize existing vegetation communities and to identify any listed plants or potential listed plant habitat, as well as any noxious weedy species listed under the Saskatchewan *Noxious Weed Act* (1999). Vegetation data was gathered visually using a meander search technique.

Remnant patches of native vegetation occur in non-cultivated areas of the proposed subdivision. Native vegetation observed during the field survey include trembling aspen, willow (*Salix* spp.), silverberry (*Elaeagnus commutata*), goldenrod (*Solidago canadensis*), wormwood (*Artemisia absinthium*), western snowberry, prickly rose (*Rosa acicularis*), spreading dogbane (*Apocynum androsaemilfolium*), and wild licorice (*Glycyrrhiza lepidota*). Native vegetative species associated with the semi-permanent wetland basin include cattail (*Typha* spp.), reed canary grass (*Phalaris arundinacea*), duckweed (*Lemna minor*), and broad-leaved water-plantain (*Alisma triviale*).

The modified habitats associated with the periphery of the proposed subdivision area include non-native vegetative species such as yellow sweet clover (*Melilotus officinalis*), white sweet clover (*Melilotus alba*), alsike clover (*Trifolium hybridum*), western goatsbeard (*Tragopogon dubius*), perennial sow thistle (*Sonchus arvensis*), canada thistle (*Cirsium arvense*), common toadflax (*Linaria vulgaris*), and smooth brome (*Bromus inermis*). Of the species observed canada thistle, common toadflax, and perennial sowthistle are listed in the *Noxious Weed Act* (1999).

3.5 Listed Plant Species

The Saskatchewan Conservation Data Centre (SKCDC) database (SKCDC/MOE 2010) was consulted and the known occurrences of three provincially tracked plants species have been previously documented in and adjacent to the Project area (Table 2). However, these documented locations are large (i.e., >3 km) in diameter and are centered around an approximate location (i.e., the exact location of the historical sighting was not included in the database record). There are no plant species listed under the federal *Species At Risk Act* (*SARA*) (2010) or the Committee on the Status of Endangered Wildlife Species in Canada (COSEWIC) (2010) previously documented within the Project area. During the field assessment, no federal or listed plant species were observed within the proposed subdivision area.

Table 2: Provincially Tracked Plant Species Previously Documented in the Yorkton Commercial Subdivision Project Area

Common Name	Scientific Name	National Status[(a)]	Provincial Status[(b)]	Habitat	Potential for Occurrence in the Project Area
Eastern Yellow Stargrass	*Hypoxis hirsuta*	NA	S2	Moist to somewhat dry prairies and in open deciduous forests.	Moderate
Crowfoot	*Viola pedatifida*	NA	S3	Mesic black prairie soils and open woodlands.	Low
Hairy Germander	*Teucrium canadense* var. *occidentale*	NA	S2	Lake and stream shores, prairie depressions.	Low

[(a)]COSEWIC (2010); [(b)]SKCDC/MOE (2010).

Provincial Rank Definitions

S2 Rare – 6 to 20 occurrences in Saskatchewan or few remaining individuals.

S3 Rare/Uncommon – 21 to 100 occurrences in Saskatchewan; may be rare and local throughout province or may occur in a restricted provincial range (may be abundant in places).

3.6 Wildlife Habitat and Wildlife

The Aspen Parkland Ecoregion can provide suitable habitat for numerous wildlife species including white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*), Franklin's ground squirrel (*Poliocitellus franklinii*), Richardson's ground squirrel (*Urocitellus richardsonii*), several amphibians and retiles, and as many as 320 bird species including red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsonii*), American crow (*Corvus brachyrhynchos*), mallard (*Anas platyrhynchos*), and American robin (*Turdus migratorius*).

While the Project area has been fragmented by cultivation and influenced by urban development, the natural habitat that remains still provides nesting, breeding, foraging, and escape cover habitat for birds, small mammals, and ungulates. This includes the remnant trembling aspen stands and open native grassland are located west of the Project (i.e., Logan Green Park), as well as north and east of the Project (e.g., northeast of the CPR rail-line within SW 36-25-4 W2M). Narrow stands of trembling aspen, shrub habitat, and grassland also occurs within the right-of-way for the CPR rail-line, which may act as a travel corridor for wildlife species or be used for breeding and/or foraging purposes.

A visual wildlife survey was conducted on August 20, 2010 to determine if there were any rare or listed species present or if any sensitive and/or key wildlife habitats for these species are encountered by the proposed commercial subdivision. Incidental wildlife observations or their sign (e.g., scat, tracks, feeding sites, discarded/shed fur, feathers, and nests) were recorded.

Wildlife species observed during the site visit was limited to killdeer (*Charadrius vociferus*), red-winged blackbird (*Agelaius phoeniceus*), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*). No unique habitat types or features were observed in the immediate area.

3.7 Listed Wildlife Species

The historical ranges of eleven wildlife species listed by COSEWIC (2010) that may breed or nest within the Project area are described in Table 3. COSEWIC species listed as endangered and threatened, as well as provincial species classified as endangered or threatened, are also protected under the federal *SARA* (2010), while migratory bird species are protected by the *Migratory Birds Convention Act* (1994).

3.8 Designated Areas

The Project is located within corporate limits of the City of Yorkton and within the Rural Municipality of Orkney No. 244. No provincial or federal Crown land is encountered or otherwise encroached upon by the Project. Ducks Unlimited Canada was contacted and none of their wetland or upland projects or properties are in conflict with the Project area (J. Trevor, pers. comm. 2010).

No First Nations Reserves are located within the study area; however, three First Nations have Reserve lands located south of the Project area. The Kahkewistahaw First Nation is the closest with lands located approximately 2.25 km southwest in the NW 34-25-4 W2M. Keeseekoose First Nation is located approximately 13.0 km southeast in the W½ 28-24-3 W2M, and Sakimay First Nation has lands located in the S½ and NE 18-24-3 W3M, approximately 16.0 km south.

Table 3: Sensitive Wildlife Species that may Occur in the Yorkton Commercial Subdivision Project Area

Common Name	Scientific Name	*SARA* Status [(a)]	COSEWIC Status [(b)]	Provincial Status[(c)]	Habitat	Potential for Occurrence in the Project Area
Burrowing Owl	*Athene cunicularia*	Endangered Schedule 1	Endangered	S2B	Burrowing owls prefer pasture land that has been grazed, but they can be found nesting in ditches and along road allowances (Godfrey 1986).	Low to moderate – there are no historic records for the Project area and potential habitat is limited.
Piping Plover	*Charadrius melodus*	Endangered Schedule 1	Endangered	S3B	The piping plover prefers to nest on sand or gravel beaches of saline or freshwater lakes, rivers, and wetlands (Godfrey 1986).	Low – suitable habitat is limited in the Project area.
Sprague's Pipit	*Anthus spragueii*	Threatened Schedule 1	Threatened	S4B	Sprague's pipits are typically found in prairie grasslands that have been unburned and unploughed (Godfrey 1986). They can also be found in areas of native grassland with intermediate vegetation height and litter depth, or in moderately grazed areas (Smith 1996).	Low to moderate – suitable habitat is limited in the Project area.
Loggerhead Shrike	*Lanius ludovicianus excubitorides*	Threatened Schedule 1	Threatened	S4B	Loggerhead shrikes prefer open areas with scattered shrubby growth. They can be found in open country, savannah, and desert scrub (Godfrey 1986). They typically breed in shelterbelts and willow-ringed ponds on the prairies (Smith 1996).	Moderate – species is a confirm breeder in the 72 M/1 map sheet (Smith 1996); potential habitat likely occurs in the Project area.
Common nighthawk	*Chordeiles minor*	Threatened Schedule 1	Threatened	S4S5B S4S5M	Forages in the air over city or wilderness. Roosts in trees in open woodlands, fence posts in open areas or on the ground. Nests on the ground in woodland openings and clearings, natural open areas, burnt lands, flat tops of buildings (Godfrey 1986).	Moderate – suitable habitat occurs in the Project area.
Bobolink	*Dolichonyx oryzivorus*	No Status	Threatened	No Status	Species prefers open grassland areas (Martin and Gavin 1995).	Moderate to High – species has been observed in various habitats during the breeding season near the Project area.
Yellow rail	*Coturnicops noveboracensis*	Special Concern Schedule 1	Special Concern	S3B S2M	Species typically nests in marshes dominated by sedges, grasses, and rushes where there is little or no standing water (generally 0.0 cm to 12.0 cm water depth) and where the substrate remains saturated throughout the summer (Alvo and Robert 1999).	Low – not documented in the region after 1960 although suitable habitat may be present around wetlands and along drainages in the region.

Table 3: Sensitive Wildlife Species that may Occur in the Yorkton Commercial Subdivision Project Area (continued)

Common Name	Scientific Name	*SARA* Status [a]	COSEWIC Status [b]	Provincial Status[c]	Habitat	Potential for Occurrence in the Project Area
Short-eared owl	*Asio flammeus*	Special Concern Schedule 3	Special Concern	S3B S2N	Short-eared owls typically prefer open grassland and hayland areas. Potential nesting and foraging habitat for short-eared owls may occur in Project area, especially in the low areas containing native vegetation or grassy wetland margins.	Moderate – meadow areas around wetlands and along drainages may provide suitable habitat for this species. Species has been observed near the Project area (D. Dean, pers. comm. 2010).
Horned grebe	*Podiceps auritus*	No status	Special Concern	S5B	This species prefers small waterbodies (slough, ponds, and dugout) with extensive marshy areas.	Low to Moderate – suitable habitat is limited in the Project area.
Northern leopard frog	*Rana pipiens*	Special Concern Schedule 1	Special Concern	S3	Species prefers small, permanent waterbodies with emergent vegetation in the spring for breeding, and moves out to the permanent wet areas adjacent to the breeding sites in summer (Alberta Fish and Wildlife 1991; Alberta Sustainable Resource Development 2003).	Low to moderate – suitable habitat is sparse in Project area.
Monarch butterfly	*Danaus plexippus*	Special Concern Schedule 1	Special Concern	S3B	Exist primarily wherever milkweed (*Asclepius*) and wildflowers exist. This includes abandoned farmland, along roadsides, and other open spaces where these plants grow. Monarchs are migratory, leaving the prairies in August.	Low to moderate – potential for the species to occur but the Project is at the northern fringe of its current active range and would be dependant on the occurrence of milkweed plants.

[a] *Species at Risk Act* (2010); [b] COSEWIC (2010); [c] SKCDC/MOE (2010).

Provincial Rank Definitions

S1 Extremely Rare – 5 or fewer occurrences in Saskatchewan, or very few remaining individuals.

S2 Rare – 6 to 20 occurrences in Saskatchewan, or few remaining individuals.

S3 Rare/Uncommon – 21 to 100 occurrences in Saskatchewan; may be rare and local throughout province or may occur in a restricted provincial range (may be abundant in places).

S4 Common – more than 100 occurrences; generally widespread and abundant, but may be rare in parts of its range.

S5 Very Common – more than 100 occurrences wide spread and abundant, but may be rare in parts of its range.

B – for a migratory species, rank applies to the breeding population in the province.

M – for a migratory species, rank applies to the transient population in the province.

N – for a migratory species, rank applies to the non-breeding population in the province.

3.9 Heritage Resources

In determining the need for a heritage assessment for a proposed project, the Heritage Resources Branch considers four factors: 1) the nature and scope of proposed construction activities; 2) the presence of previously recorded heritage resources; 3) the potential for significant archaeological sites to be identified in the Project area; and 4) the extent of previous land disturbance.

Golder queried the provincial heritage resources database maintained by the Ministry of Tourism, Parks, Culture and Sport to determine if previously recorded archaeological sites are known in the proposed Project area. Results indicate there are five previously recorded heritage sites within the same NTS Map Sheet (62 M/01) as the Project; however, these sites are not in conflict with the proposed Project (Table 4).

Table 4: Previously Recorded Heritage Resources Located within NTS Map Sheet 62 M/01

Borden No.	Site Type	Cultural Affiliation	Permit No.
EhMm-1	Artifact Find	-	60-000:00
EgMn-1	Artifact Find	-	85-000:00
EgMo-1	Artifact Find	-	60-000:00
EgMo-2	Artifact Scatter	-	60-000:00
EgMo-3	Artifact Scatter	Avonlea, Besant, Pelican Lake, McKean, Oxbow, Cody, Agate Basin	73-000:00

The survey plan for the commercial subdivision was submitted to the Heritage Resources Branch for review on August 20, 2010 to determine the need for an HRIA. The results of the heritage screening were received on September 1, 2010 and an HRIA is not required prior to development (Appendix B). Should the location or extent of the planned development change, further assessment would be required.

4.0 RECOMMENDATIONS

4.1 Recommended Mitigation Measures

The following section identifies recommended mitigation measures that developers could use to limit the potential effects to the local physical environmental (Table 5).

Table 5: Recommended Mitigation Measures for the Yorkton Commercial Subdivision Project Area

Component	Mitigation Measures
Land Use	■ Confine site preparation, construction, and post-construction activities to the subdivision area only. ■ Visual aesthetics will be affected by the presence of equipment, removal of existing habitat, exposed soils, and other related activities, but will diminish following site preparation, construction and revegetation/landscaping of the subdivision in the following years. ■ Promote vegetation and retention of vegetative buffer areas within the subdivision as much as feasible.

Table 5: Recommended Mitigation Measures for the Yorkton Commercial Subdivision Project Area (continued)

Component	Mitigation Measures
Terrain and Soils	■ Topsoil will be stripped and stored during construction. Topsoil is anticipated to be redistributed over landscaped areas within the commercial subdivision. Any excess topsoil will be stockpiled for use at adjacent developments or purposes (e.g., will be salvaged and not be used for fill). ■ If graded or salvaged soils are stored for an extended period, to minimize soil loss and dust, the piles should be as low as possible, compacted and possibly an annual vegetation cover seeded onto the piles to help hold the material in place. ■ Soil stockpiles should be placed away from drainages, or wetlands. ■ To avoid off-site movement of exposed soils, site-specific erosion and sediment control measures may need to be implemented (e.g., dust control) ■ If possible, employ just-in-time" grading (i.e., only grade areas needed for immediate construction activities). ■ Contractors will make sure that proper storage, spill containment and clean-up methods are in place. ■ Any spills will be isolated and cleaned up immediately and an appropriate soil remediation program will be implemented that addresses site-specific conditions. ■ Garbage and waste materials will be placed in suitable containers and removed to a local licensed landfill site during the construction of the Project.
Surficial Hydrology	■ While the majority of the proposed subdivision is located on level terrain there are low areas and wetlands present in the Project area. Filling in and dewatering the wetlands will be required to accommodate preparation of the commercial parcels. To avoid disruption to current drainage patterns, developers will implement suitable surface water management and site drainage plans as part of the overall design, layout and construction of the proposed subdivision.
Vegetation	■ The proposed subdivision is comprised of previously disturbed (i.e., cultivated) habitat with limited parcels of native habitat types (i.e., wetlands and woody habitat) present. ■ Limited clearing of woody material will be required. Removal of woody material may be completed using bulldozers or trackhoes to push over and stock pile the slash material, which would be hauled off-site to an approved disposal facility. Alternatively, the woody material could be mulched and salvaged for use during landscaping of the commercial parcels (or for other uses by the City of Yorkton). ■ Construction equipment should be cleaned prior to entering the Project area to prevent introducing any noxious weeds that do not currently exist. ■ No federally or provincially listed plant species were observed during the 2010 field survey, and habitat suitability for these species is generally limited in the area. No specific mitigation measures are required.
Wildlife	■ Clearing and grading operations should be completed prior to the spring nesting and breeding period to avoid destroying occupied nests. If construction activities are delayed into the spring/summer period, pre-construction surveys will be required to identify wildlife nesting/breeding locations. If nesting or breeding sites are found during the surveys, additional mitigation measures may be required and the appropriate activity restrictions will be adhered to (Saskatchewan Environment 2003). ■ The proposed subdivision is comprised largely of previously disturbed habitat (i.e., cropland) and wildlife habitat is limited. No unique or sensitive wildlife habitats occur.
Heritage Resources	■ The proposed subdivision is located in an area with low potential for encountering heritage resources, and an HRIA was not required for the Project. ■ If heritage resources are found during construction, construction will cease immediately and the site will be documented. Consultation will occur with the Heritage Resources Branch to determine the best course of action (e.g., feature mapping, excavation, and avoidance).

4.2 Additional Requirements

As discussed in Section 2.1, it is recommended that the regional MOE office (Rick Wright, Ecological Protection Specialist, Melville, 728-7494) be contacted regarding any concerns there may be with the proposed Project (e.g., wildlife or habitat issues). In the event the Project is delayed into the spring/summer season, MOE may request surveys for sensitive plant and wildlife species be completed. If a sensitive species is found to be occupying or breeding within the study area, restrictions on construction activities may be imposed during important growing periods for plants and the critical breeding and rearing period (typically mid-March to August) (Saskatchewan Environment 2003). This will be dependent on the species and proximity to the Project.

MOE will likely require the preparation and submission of an AHPP for the proposed construction activities associated with the wetland basins located within the subdivision.

MOE may request compensation for the loss of the wetland basins affected by the Project, based on a no-net loss principle, according to the Saskatchewan Wetland Policy (SaskWater 2001). Submission of a wetland compensation plan may be required as part of Project approvals. Any specific compensation requirements can be confirmed with MOE.

5.0 CLOSURE

We trust that this report presents the information that you require. Should any portion of the report require clarification, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

Mark Ealey, B.Sc., Associate
Senior Ecologist/Reclamation Specialist

DD/ME/ldmg

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6.0 REFERENCES CITED

Acton, D.F., G.A. Padbury, and C.T. Stushnoff. 1998. The Ecoregions of Saskatchewan. Canadian Plains Research Centre, University of Regina.

Alberta Fish and Wildlife. 1991. Alberta's Threatened Wildlife. Northern Leopard Frog. Edmonton, Alberta.

Alberta Sustainable Resource Development. 2003. Alberta Fish and Wildlife Sensitive Species Inventory Protocol Guidelines.

Alvo, R. and M. Robert. 1999. COSEWIC Status Report on the Yellow Rail (*Coturnicops noveboracensis*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario.

City of Yorkton. 2010. City of Yorkton Municipal Zoning Bylaw. Bylaw No. 14/2003. Website: http://www.city.yorkton.sk.ca (accessed August 2010).

Committee on the Status of Endangered Wildlife in Canada. 2010. Canadian Species at Risk. August 2010.

Dean, Denis. 2010. Biological Technician, Golder Associates Ltd. Saskatoon, Saskatchewan. Personal communication August 27, 2010.

Godfrey, W.E. 1986. The Birds of Canada. National Museum of Canada. 595 pp.

Martin, Stephen G. and Thomas A. Gavin. 1995. Bobolink (*Dolichonyx oryzivorus*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/176 (accessed August 2010).

Saskatchewan Conservation Data Centre/Ministry of Environment. 2010. Website: http://www.biodiversity.sk.ca (accessed August 26, 2010).

Saskatchewan Environment. 2003. Activity Restrictions for Sensitive Species in Saskatchewan.

Saskatchewan Land Resource Unit. 1997. Saskatchewan Map Units, Detail 1:100,000 Soil Survey Information. Internal Unpublished Document. Agriculture and Agri-Food Canada, Saskatoon, Saskatchewan.

Saskatchewan Land Resource Unit. 2004. SKSISv2, Digital Soil Resource Information for Agricultural Saskatchewan, 1:100,000 scale. Agriculture and Agri-Food Canada, Saskatoon, Saskatchewan.

Smith, A.R. 1996. Atlas of Saskatchewan Birds. Special Publication No. 22. Environment Canada, Nature Saskatchewan.

Trevor, J. 2010. Ducks Unlimited Canada. Saskatoon, Saskatchewan. Personal communication August 26, 2010.

APPENDIX A

Photoplates

Photo 1: Looking east across cultivated lands from the Yorkton Tourist Kiosk onto the proposed subdivision area.

Photo 2: Looking west onto a narrow band of modified habitat from the east boundary of the project area.

Photo 3: Looking east at the ephemeral wetland basin in the northwest corner of the project area.

Photo 4: Looking north at the permanent wetland in the southwest corner of the project area.

APPENDIX B

Heritage Resources Branch Screening Letter

Saskatchewan

Ministry of
Tourism, Parks,
Culture and Sport

Heritage Resources Branch
9th Floor 1919 Saskatchewan Dr.
Regina, Saskatchewan
S4P 4H2

(306) 787-5753
wade.dargin@gov.sk.ca

September 1, 2010

Our Files: 10-1672; 10-1673

Mr. Michael Markowski
Golder Associates Ltd.
Agent For: Associated Engineering (Sask) Ltd.
1721 8th Street East
SASKATOON SK S7H 0T4

Dear Mr. Markowski:

RE: Associated Engineering Subdivision:
SW 36-25-4 W2M;
SW 12-26-4 W2M;
HERITAGE RESOURCE REVIEW

Thank you for referring these development proposals to our office for heritage resource review.

No known archaeological sites are in direct conflict with the proposed developments. The subdivisions will be constructed on cultivated lands. The likelihood that intact archaeological sites exist in these areas is low. Therefore, our office has no further concerns with these developments proceeding as planned.

If you have any questions regarding this project please do not hesitate to contact me.

Sincerely,

Wade Dargin

Wade Dargin
Archaeologist/First Nation Liaison Officer
Archaeological Resource Management

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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solutions@golder.com
www.golder.com

Golder Associates Ltd.
1721 8th Street East
Saskatoon, Saskatchewan, Canada S7H 0T4
Canada
T: +1 (306) 665 7989

Golder Associates

D Appendix D - Conceptual Design Figures

KING STREET

PROPOSED ACCESS

DRACUP AVENUE

PROPOSED BUFFER

SURVEYED ROAD

CANADIAN NATIONAL RAILWAY

HWY No. 9

PROPOSED ACCESS

CANADIAN NATIONAL RAILWAY

PROPOSED BUFFER & DRAINAGE EASEMENT

PROPOSED ACCESS

QUEEN STREET (HWY No. 10)

HWY No. 16

3	4.0ac.	
2	3.5ac.	
2	2.9ac.	
1	2.7ac.	
1	4.4ac.	
3	3.6ac.	
1	3.6ac.	
3	2.4ac.	
2	3.9ac.	
1	4.1ac.	
2	4.4ac.	
3	3.6ac.	
2	5.2ac.	
1	3.3ac.	
4	4.3ac.	
5	3.5ac.	

LEGEND

- STAGE 1
- STAGE 2
- STAGE 3
- (1) CITY OF YORKTON TOURISM & CHAMBER OF COMMERCE CENTRE

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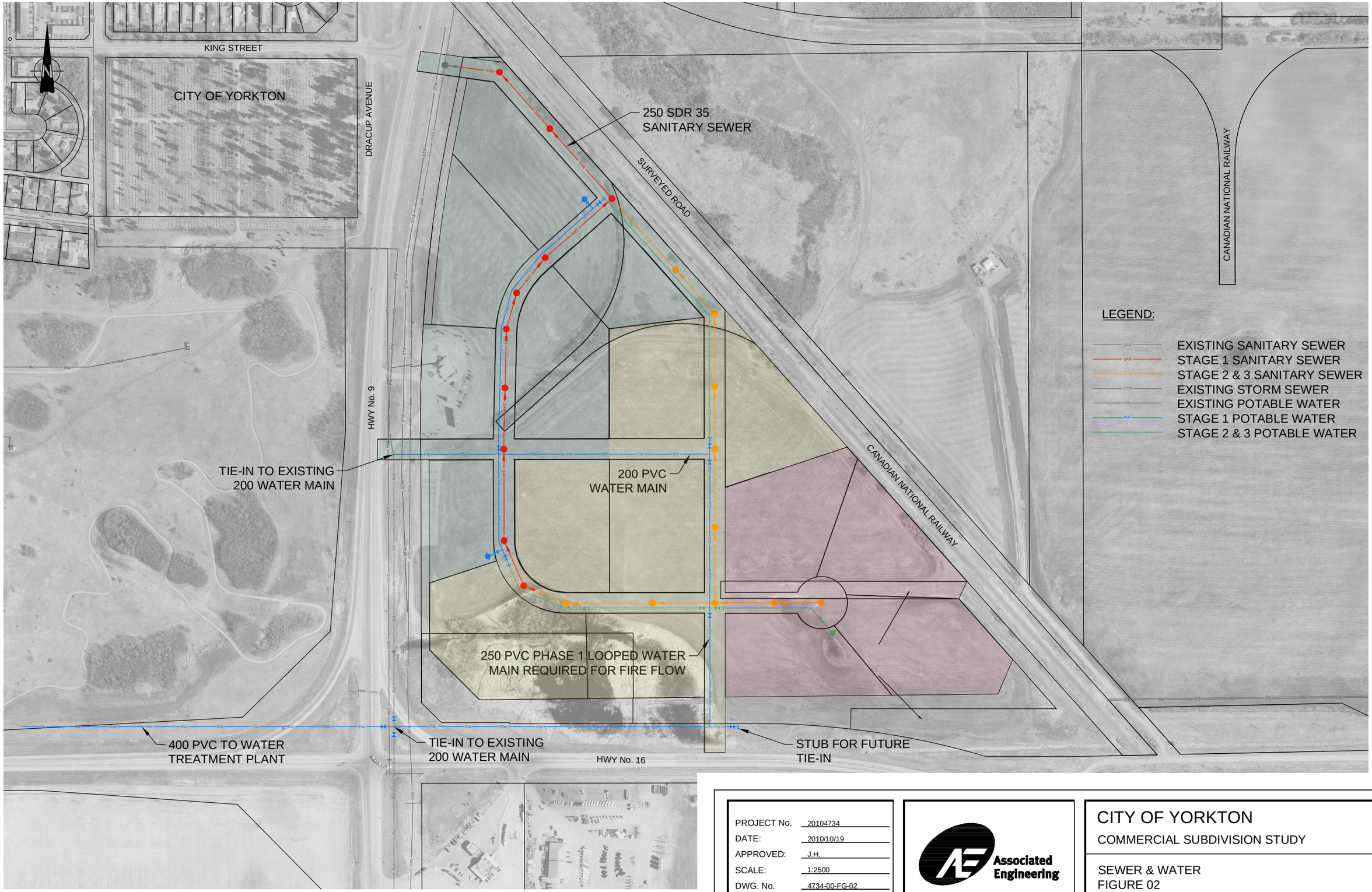
PROJECT No.	20104734
DATE:	2010/10/19
APPROVED:	J.H.
SCALE:	1:2500
DWG. No.	4734-00-FG-01

Associated Engineering

CITY OF YORKTON

COMMERCIAL SUBDIVISION STUDY

LOCATION PLAN
PREFERRED LAYOUT
FIGURE 01



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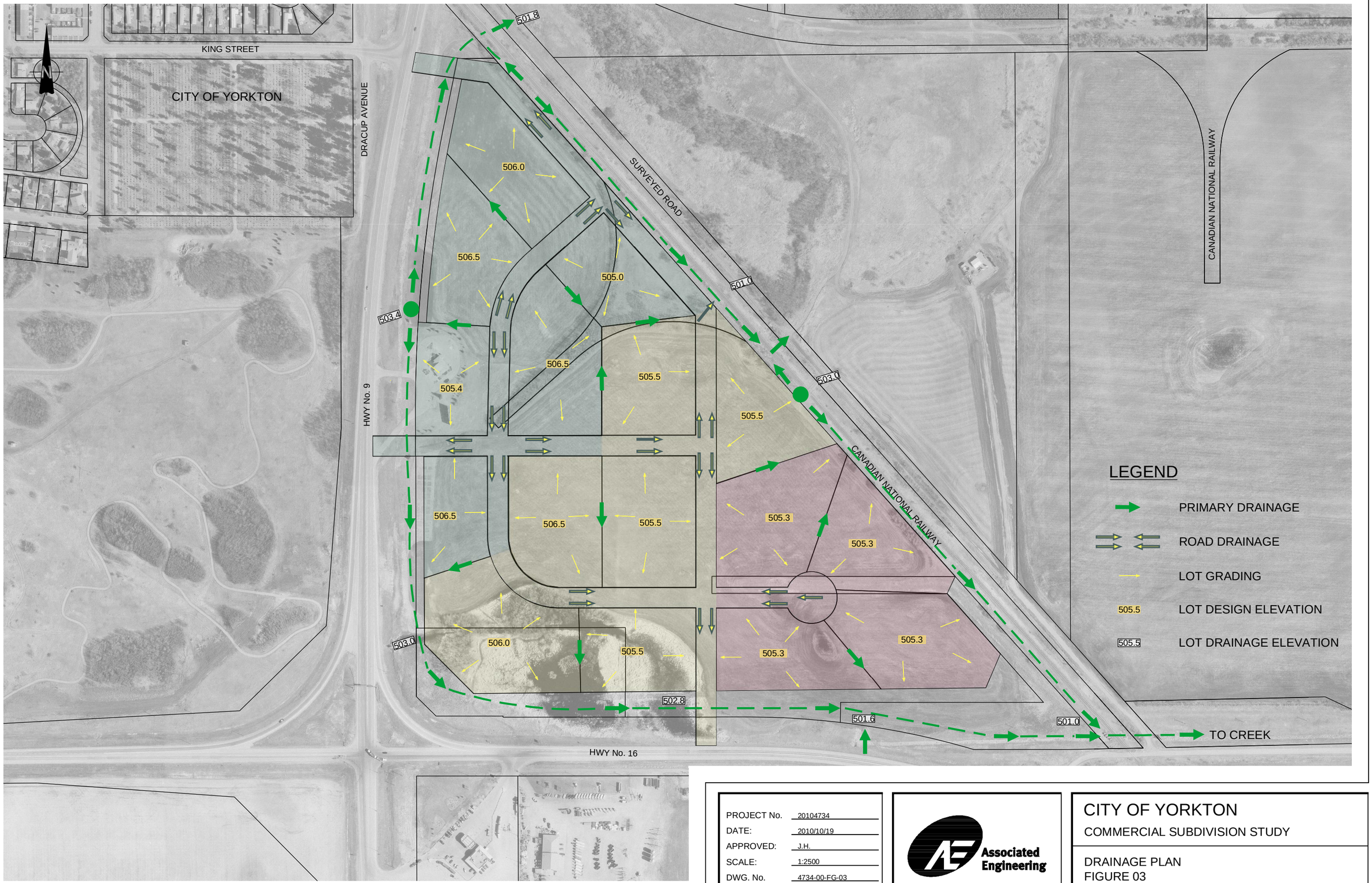
DATE:	2010/10/19
APPROVED:	J.H.
SCALE:	1:2500
DWG. No.	4734-00-FG-02

Associated Engineering

CITY OF YORKTON

COMMERCIAL SUBDIVISION STUDY

SEWER & WATER
FIGURE 02



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DATE:	2010/10/19
APPROVED:	J.H.
SCALE:	1:2500
DWG. No.	4734-00-FG-03

Associated Engineering

CITY OF YORKTON

COMMERCIAL SUBDIVISION STUDY

DRAINAGE PLAN
FIGURE 03

KING STREET

CITY OF YORKTON

DRACUP AVENUE

HWY No. 9

SURVEYED ROAD

CANADIAN NATIONAL RAILWAY

CANADIAN NATIONAL RAILWAY

HWY No. 16

3
4.0ac.
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2
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506.5

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506.5

1
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LEGEND

505.5 LOT DESIGN ELEVATION

505.5 EXISTING ELEVATION

PROJECT No.	20104734
DATE:	2010/10/19
APPROVED:	J.H.
SCALE:	1:2500
DWG. No.	4734-00-FG-04

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CITY OF YORKTON

COMMERCIAL SUBDIVISION STUDY

LOT GRADING PLAN
FIGURE 04

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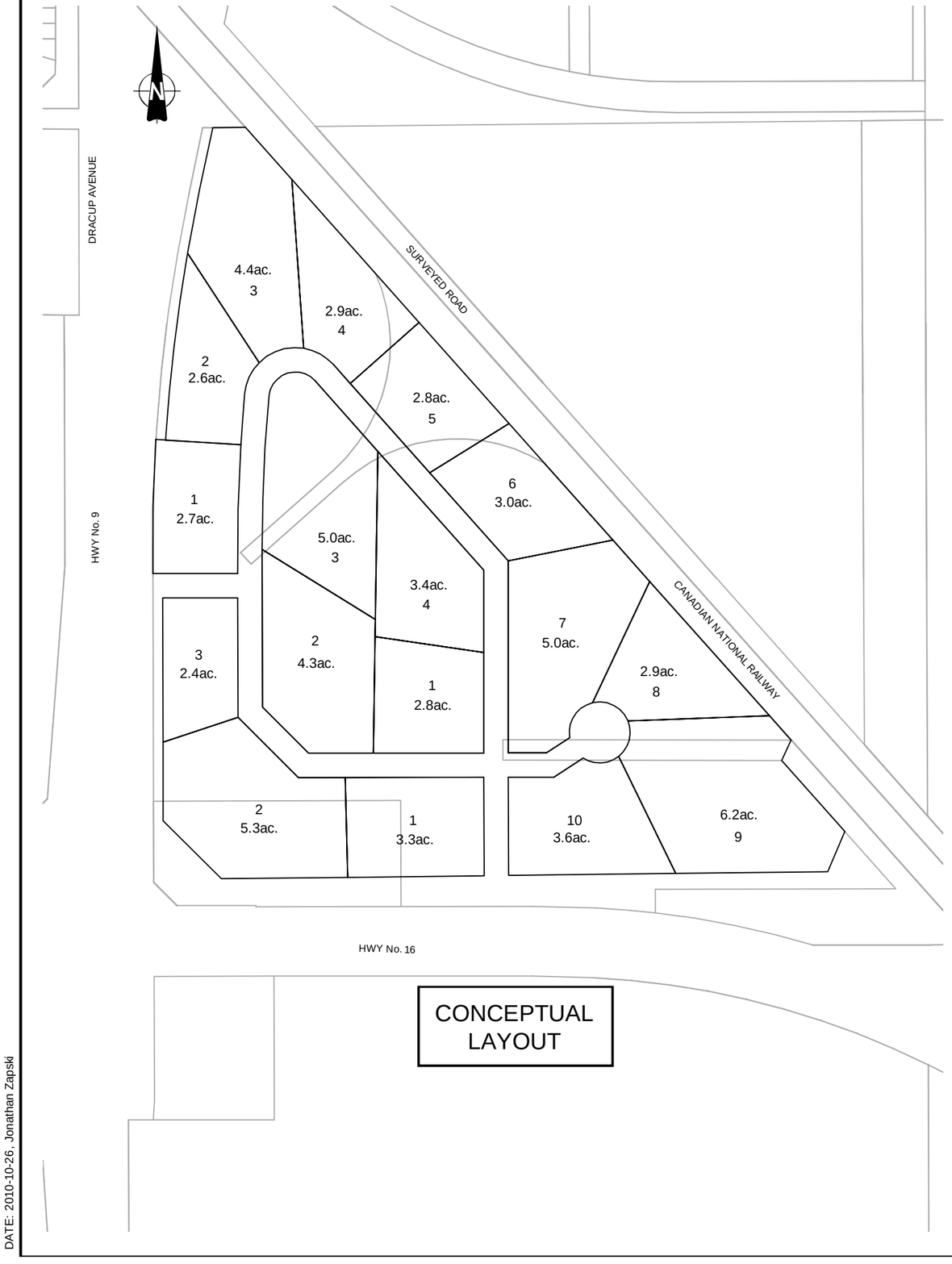
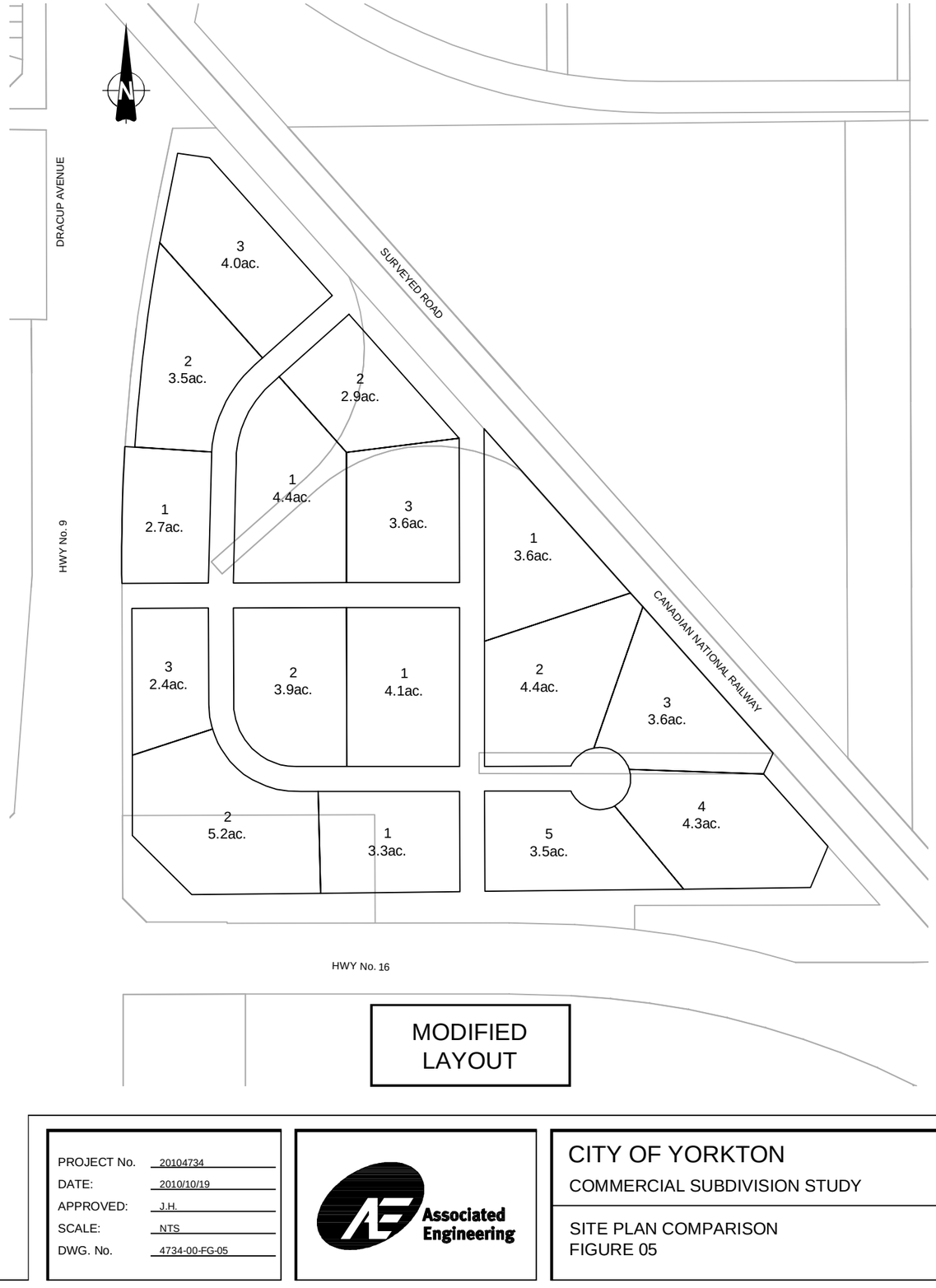


CONCEPTUAL LAYOUT



MODIFIED LAYOUT

PROJECT No.	20104734
DATE:	2010/10/19
APPROVED:	J.H.
SCALE:	NTS
DWG. No.	4734-00-FG-05

Associated Engineering

CITY OF YORKTON

COMMERCIAL SUBDIVISION STUDY

SITE PLAN COMPARISON
FIGURE 05

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DATE: 2010-10-26, Jonathan Zapski

E Appendix E - Traffic Analysis

1. Traffic Analysis

The traffic analysis was completed by following the Institute of Transportation Engineers (ITE) methodology for Transportation Impact Analysis for Site Development. The analysis was completed at a very high level to determine serviceability needs for the development. Several assumptions are noted throughout the analysis which will require confirmation as the development progresses.

1.1 Background Traffic

The background traffic is the existing traffic on the adjacent roadways and the growth that will occur on them regardless of the site development. The 2003 transportation study included detailed turning movement counts for the pm peak hour, at the intersections of Highway 9 & King Street and Highway 9 & Highway 16. The volumes along Highway 9 didn't balance. An assumption was made that the King Street intersection was accurate. Adjustments were made to the Highway 16 intersection so that the volumes would balance. We referred to the Saskatchewan Ministry of Highways and Infrastructure's (MHI) average annual daily traffic (AADT) to ensure the estimates were consistent with the daily traffic flow patterns.

MHI provided historic AADT from 2005 to 2010. This data indicated a 4% per year growth rate on Highway 9. This growth rate was applied to the 2003 data to determine the 2010 existing traffic volume and the 2015 background traffic volume.

Figures 1 and 2 are provided.

1.2 Proposed Development

Two potential developments at the north end of the proposed site have been identified: a car dealership and a hotel. The remainder of the site will be some form of commercial or light industrial land use that has not been specified. The type of land use has a large impact on the amount of traffic that will be generated. As such, we have completed the traffic analysis for two land use conditions. One is a minimum land use based on the majority of the land being light industrial. The other one is based on higher trip generators in the commercial retail category.

Table 1 shows the potential trip generation for the lower trip generator land use (light industrial).

Table 2 shows the potential trip generation for the higher trip generator land use (commercial).

1.3 Development Traffic

The development traffic was estimated for three different scenarios. The first scenario is based on full development with the lower trip generation. The second scenario is based on

full development with the higher trip generation. The final scenario is based on only a car dealership and hotel being developed initially, providing the City with an opportunity to test the phasing for implementing improvements on adjacent roadways.

Figures 3 and 4 and 5 provided.

The intersection for the various traffic/development scenarios are as follows:

Scenario 1 – Full Development, Lower Trip Generation

King Street Intersection Improvements:

- Southbound left turn lane, 45 m of storage length and 60 m taper.
- Northbound left turn lane to align with southbound, minimum length consisting of 15 m storage and 60 m taper.
- Northbound acceleration lane not recommended due to proximity of railway tracks.
- Northbound right turn lane not required for capacity but recommended for safety and consistency along the corridor.
- Westbound right turn lane and a shared through/left turn lane.
- Traffic Signals would be required.
- Improvements to the railway crossing warning system may be required.

South intersection on Highway 9 Improvements:

- Southbound left turn lane, 85 m of storage length and 60 m taper.
- Northbound right turn lane.
- Westbound right turn lane.
- Stop sign on the new road for westbound traffic.

Highway 16 Intersection:

- Eastbound left turn lane is not warranted.
- Westbound right turn is not warranted.
- Reduce speed limit to 70 km/hr.
- Stop sign on the new road for southbound traffic.
- Separate southbound right turn lane and left turn lane.

Scenario 2 – Full Development, Higher Trip Generation

King Street Intersection Improvements:

- Southbound left turn lane, 85 m of storage length and 60 m taper.
- Northbound left turn lane to align with southbound, minimum length consisting of 15 m storage and 60 m taper.
- Northbound acceleration lane not recommended due to proximity of railway tracks.
- Northbound right turn lane not required for capacity but recommended for safety and consistency along the corridor.
- Westbound right turn lane and a shared through/left turn lane.
- Traffic Signals would be required.
- Improvements to the railway crossing warning system would likely be required.

South intersection on Highway 9 Improvements:

- Southbound left turn lane, 85 m of storage length and 60 m taper.
- Northbound right turn lane.
- Westbound right turn lane.
- Traffic Signals may be required with this scenario but is dependent on traffic distribution.

Highway 16 Intersection:

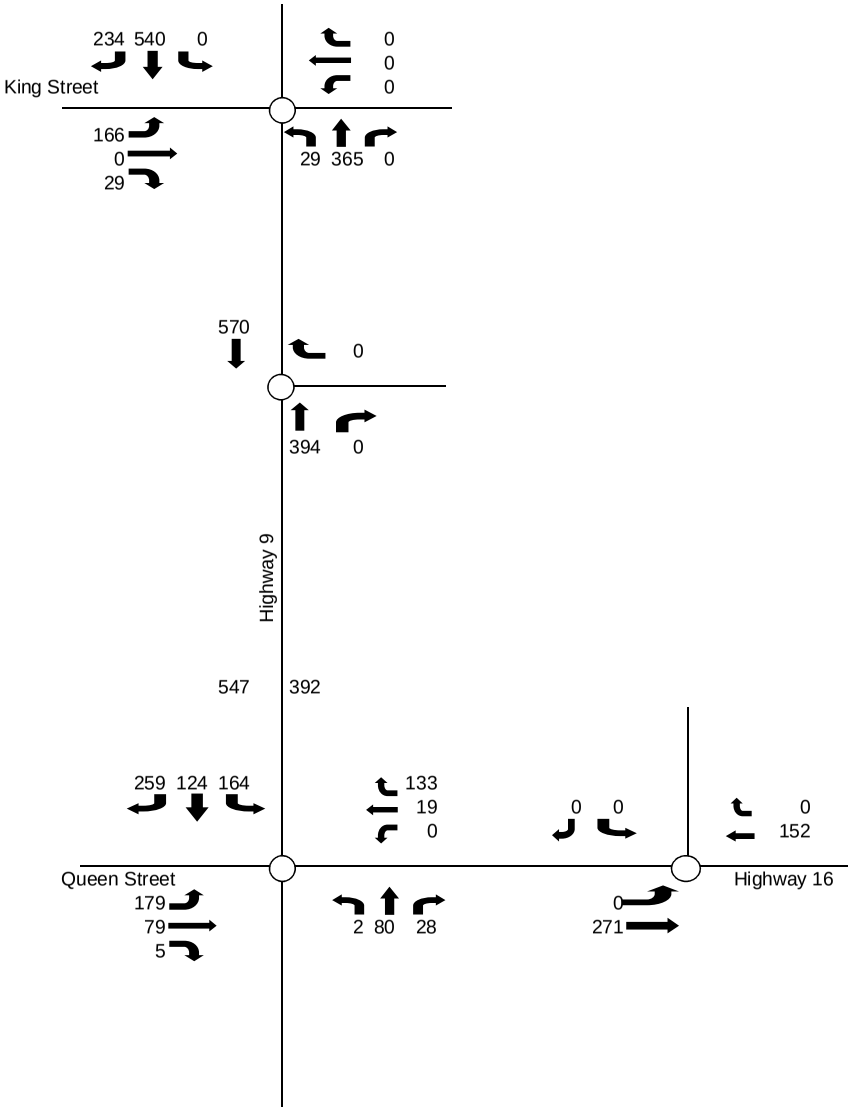
- Eastbound left turn lane is not warranted.
- Westbound right turn is not warranted.
- Reduce speed limit to 70 km/hr.
- Stop sign on the new road for southbound traffic.
- Separate southbound right turn lane and left turn lane.

Scenario 3 – Hotel and Car Dealership Developed as First Phase

King Street Intersection Improvements:

- Traffic Signals warranted by 2015. Would be prudent to monitor traffic volumes and install only when warranted.
- Construct all turn lanes to ultimate size requirements.
- Southbound left turn lane. The City would be required to make a decision around the storage length (ie. construct for lower or higher trip generation scenarios).
- Northbound left turn lane to align with southbound, minimum length consisting of 15 m storage and 60 m taper.
- Northbound acceleration lane not recommended due to proximity of railway tracks.
- Northbound right turn lane not required for capacity but recommended for safety and consistency along the corridor.
- Westbound right turn lane and a shared through/left turn lane.
- Improvements to the railway crossing warning system would likely not be required. Additional traffic studies would be required to provide justification to CPR.

Figure 1
2010 PM Existing (projected from 2003 data)



Distribution

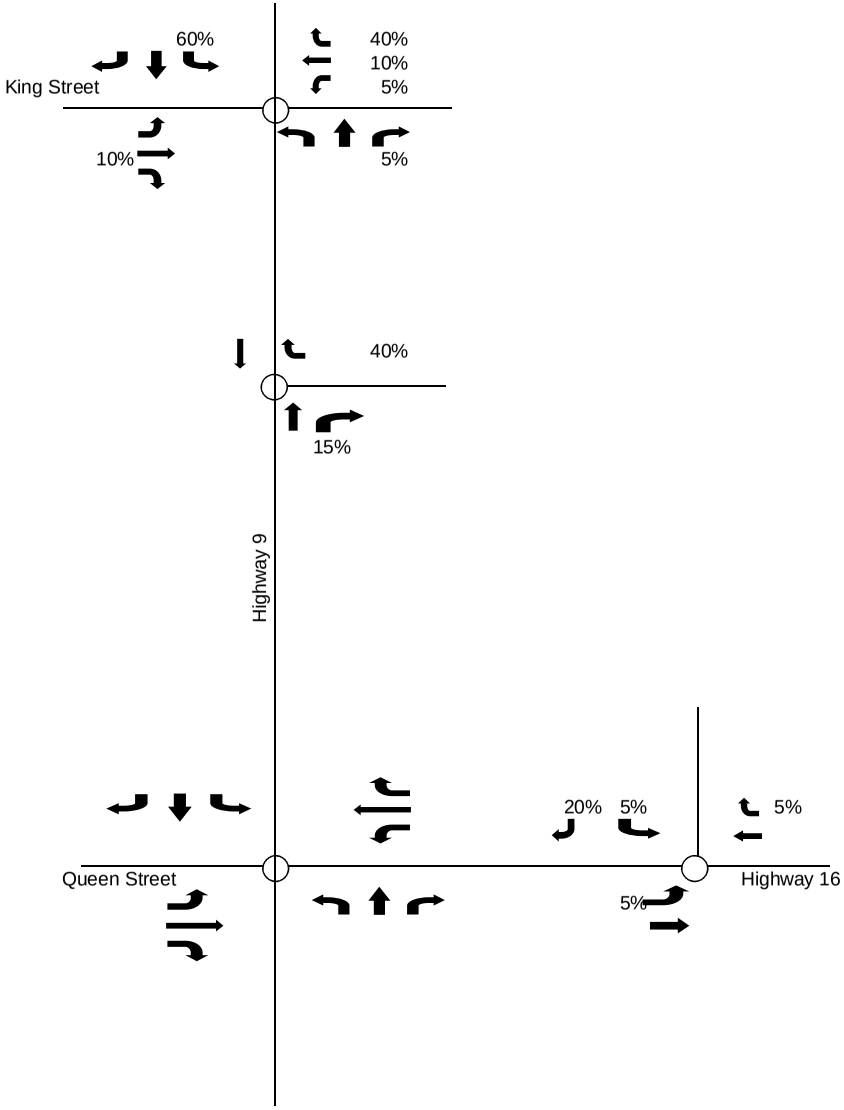
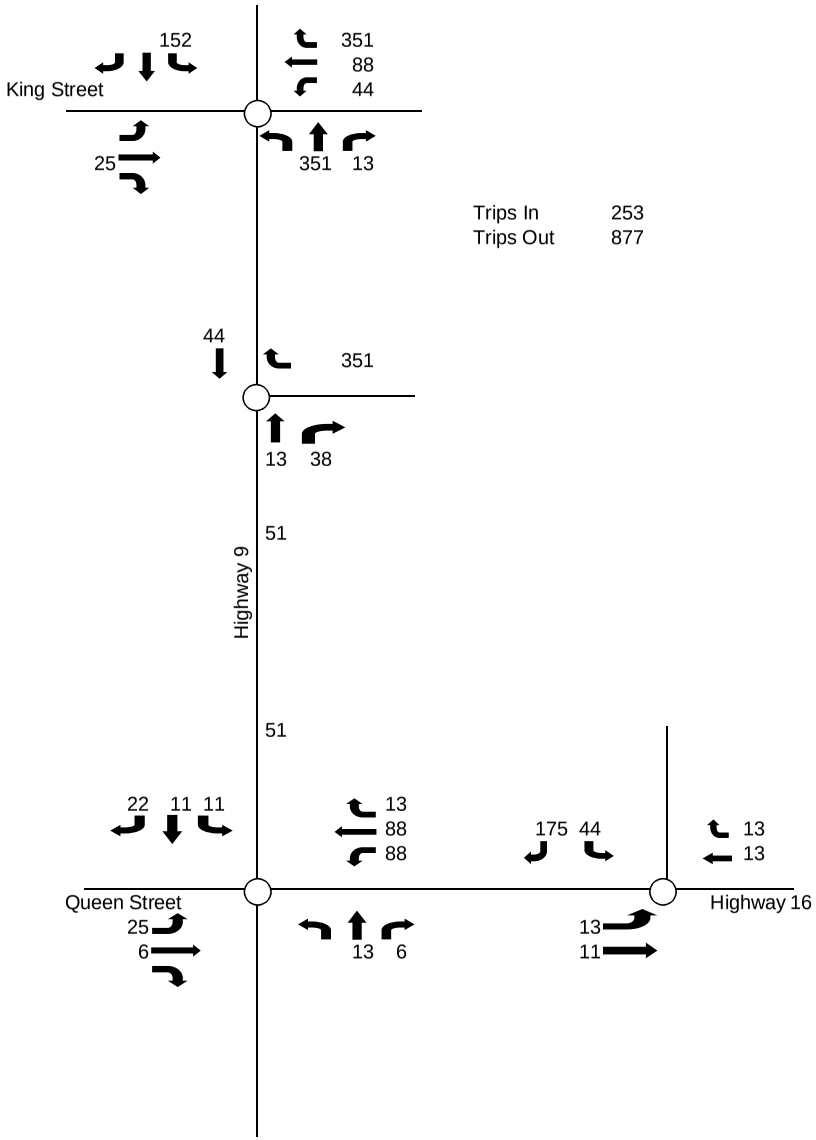


Figure 1 - Continued
Development Trips



2010 PM Total with Development

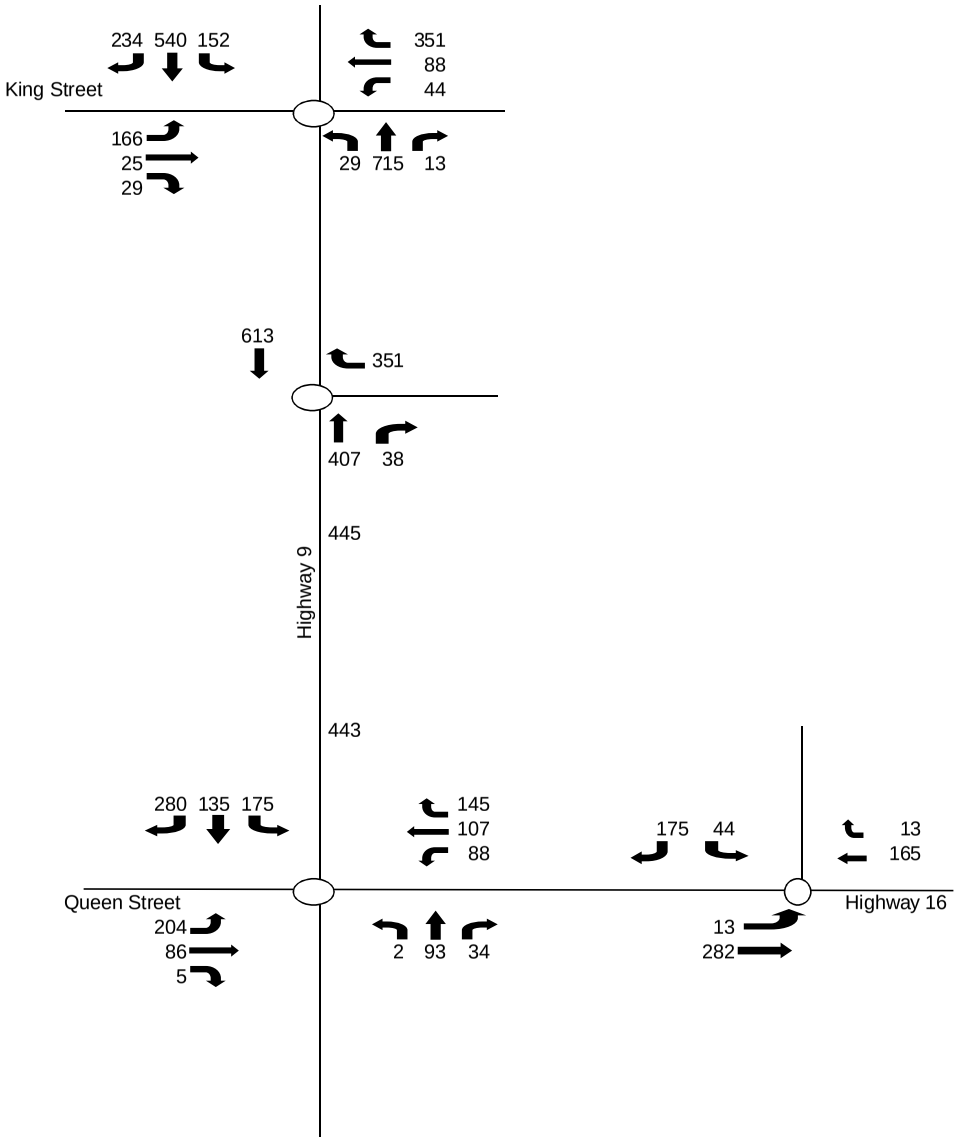
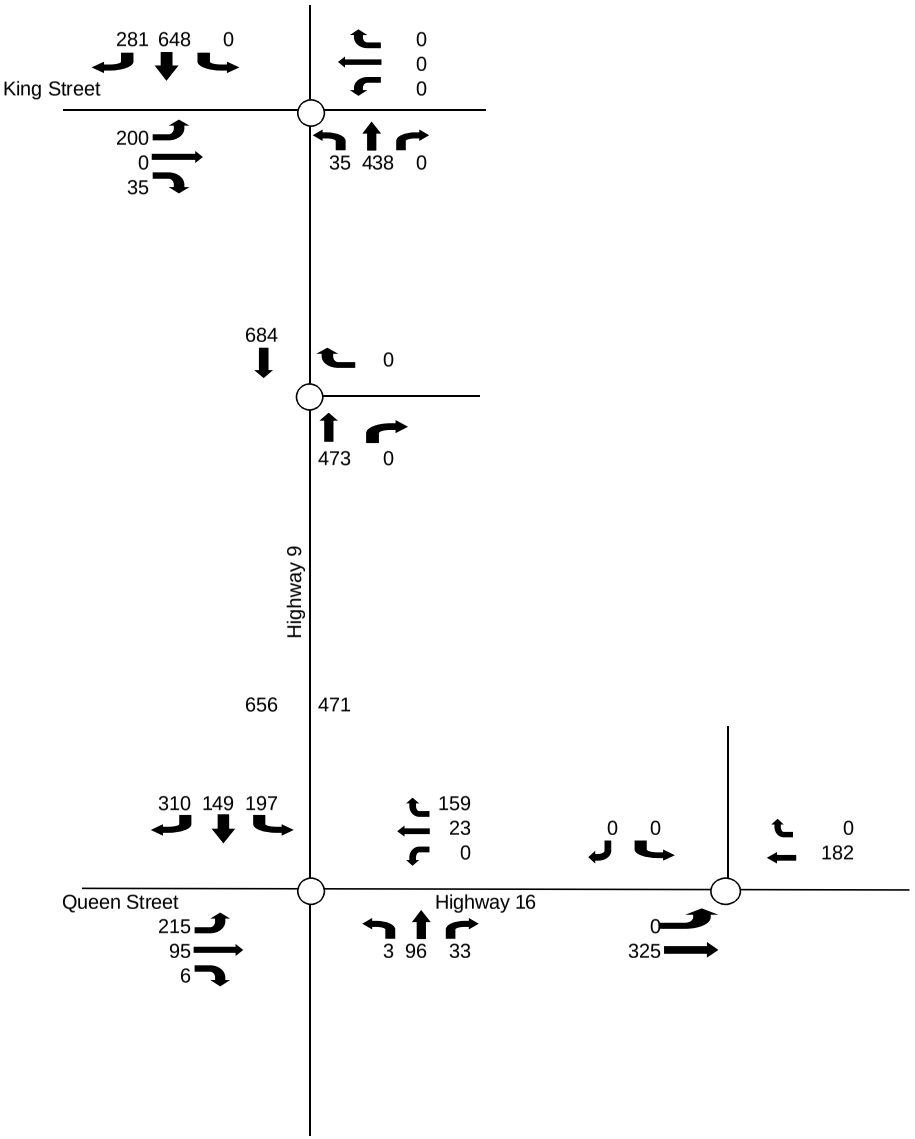


Figure 2
2015 PM Background



Distribution

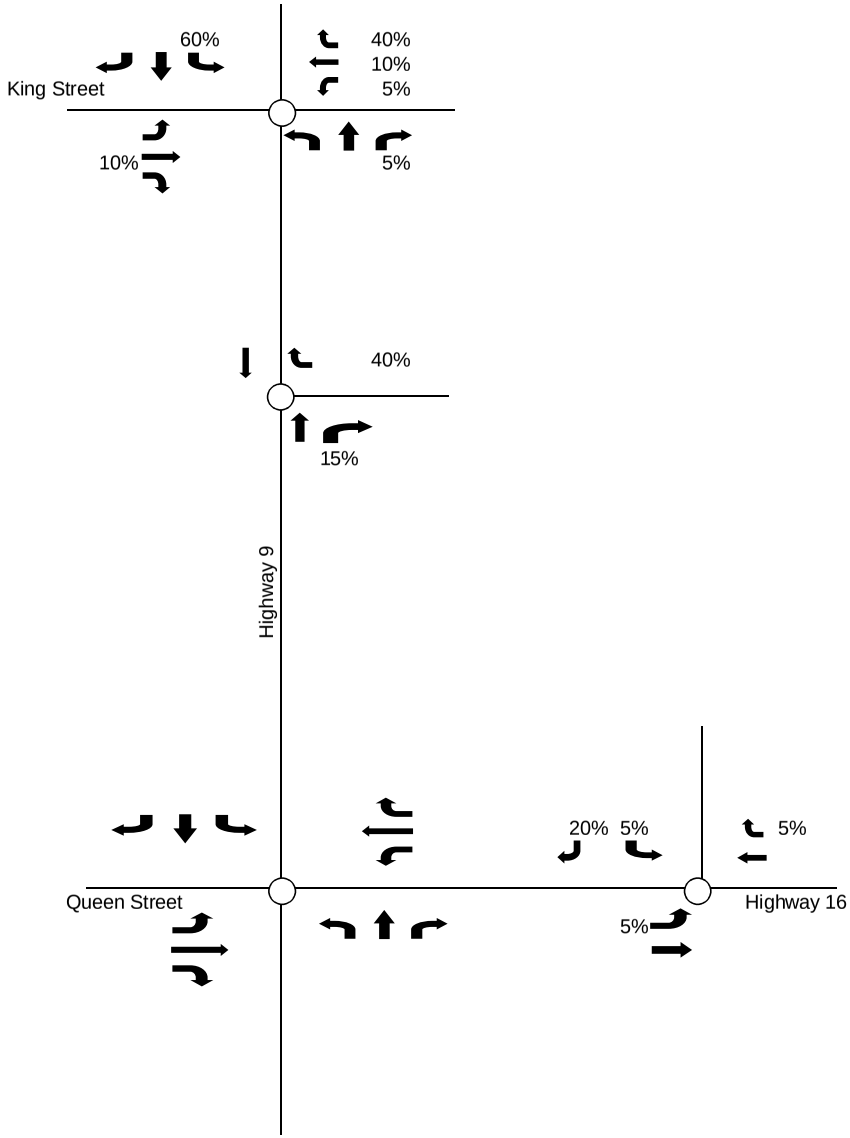


Figure 3
Scenario 1 Lower Trip Generator - Development Trips

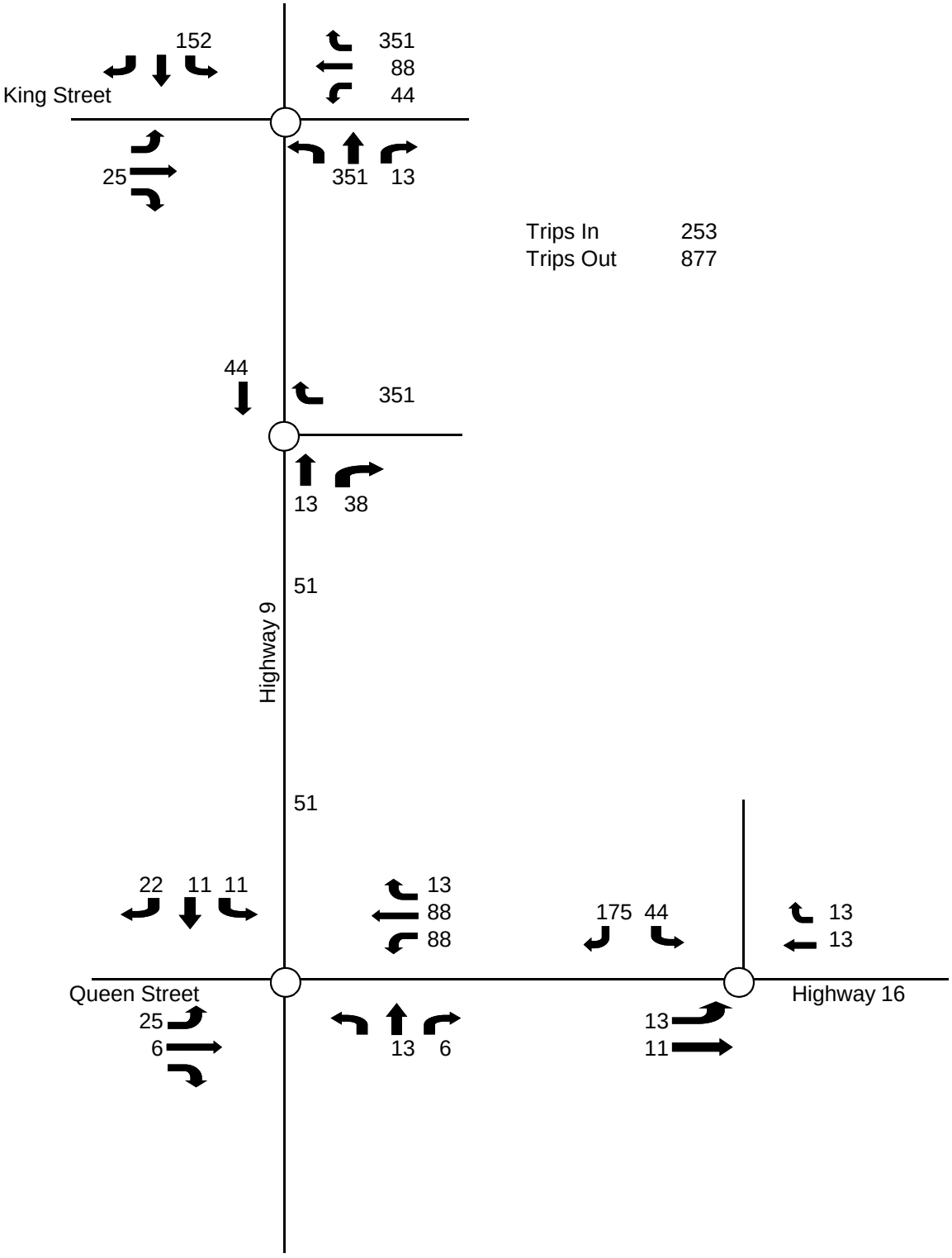


Figure 4
Scenario 1 First Phase - Development Traffic

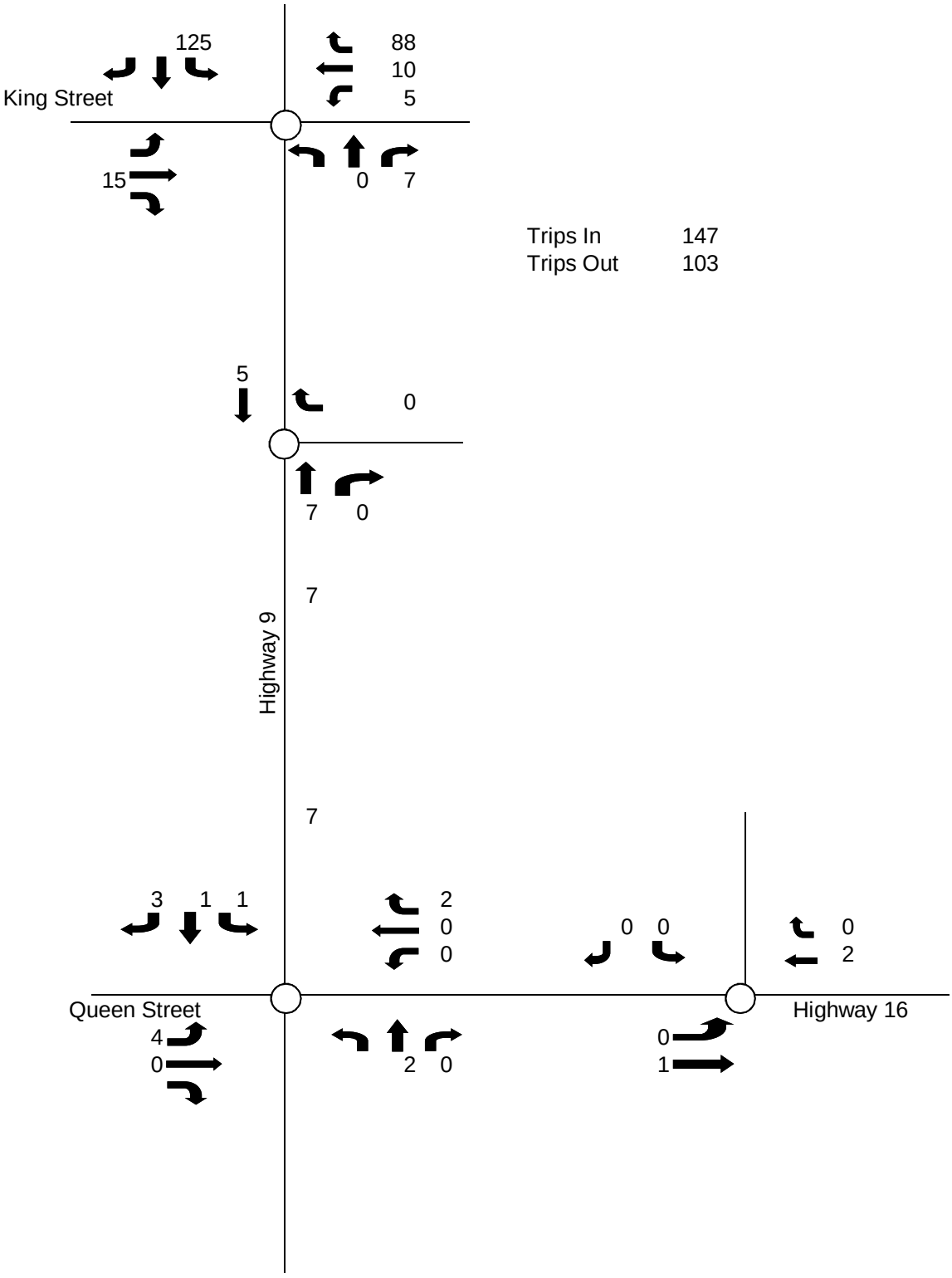


Figure 5
Scenario 2 Higher Trip Generator - 2015 Development Traffic

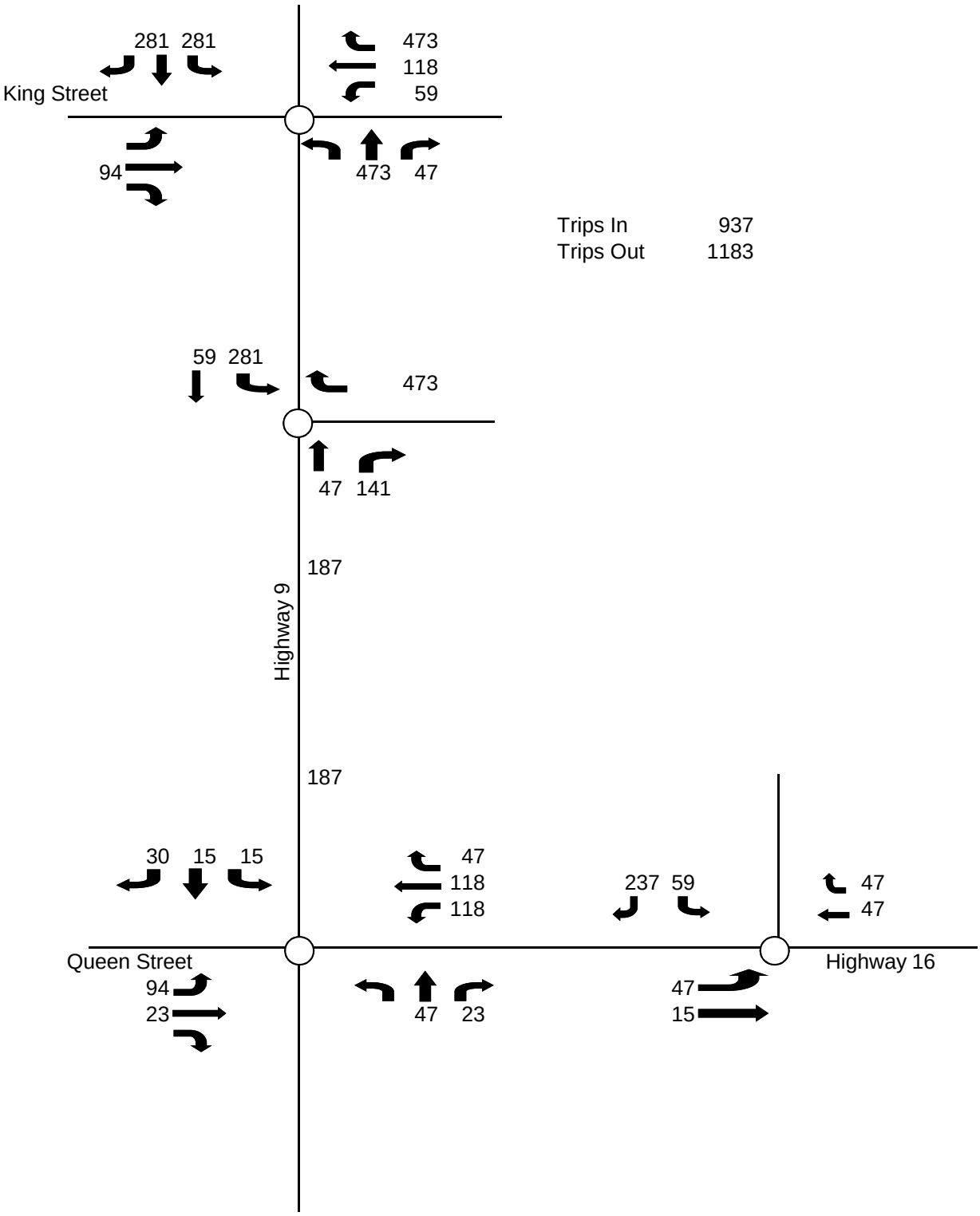


Figure 6
Scenario 1 - 2015 Development Traffic Plus Background Traffic

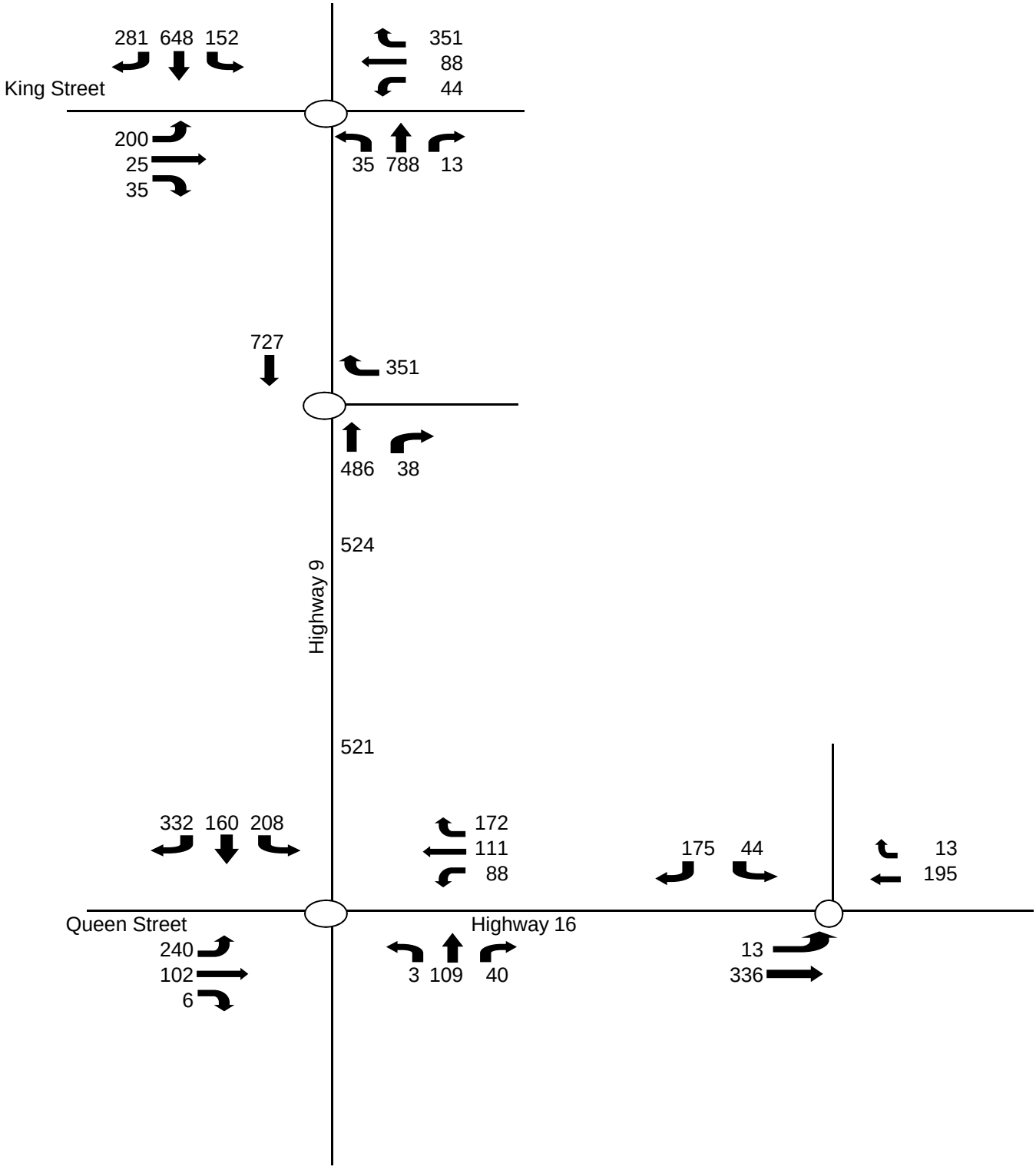


Figure 7
Scenario 1 First Phase - 2015 Total Traffic

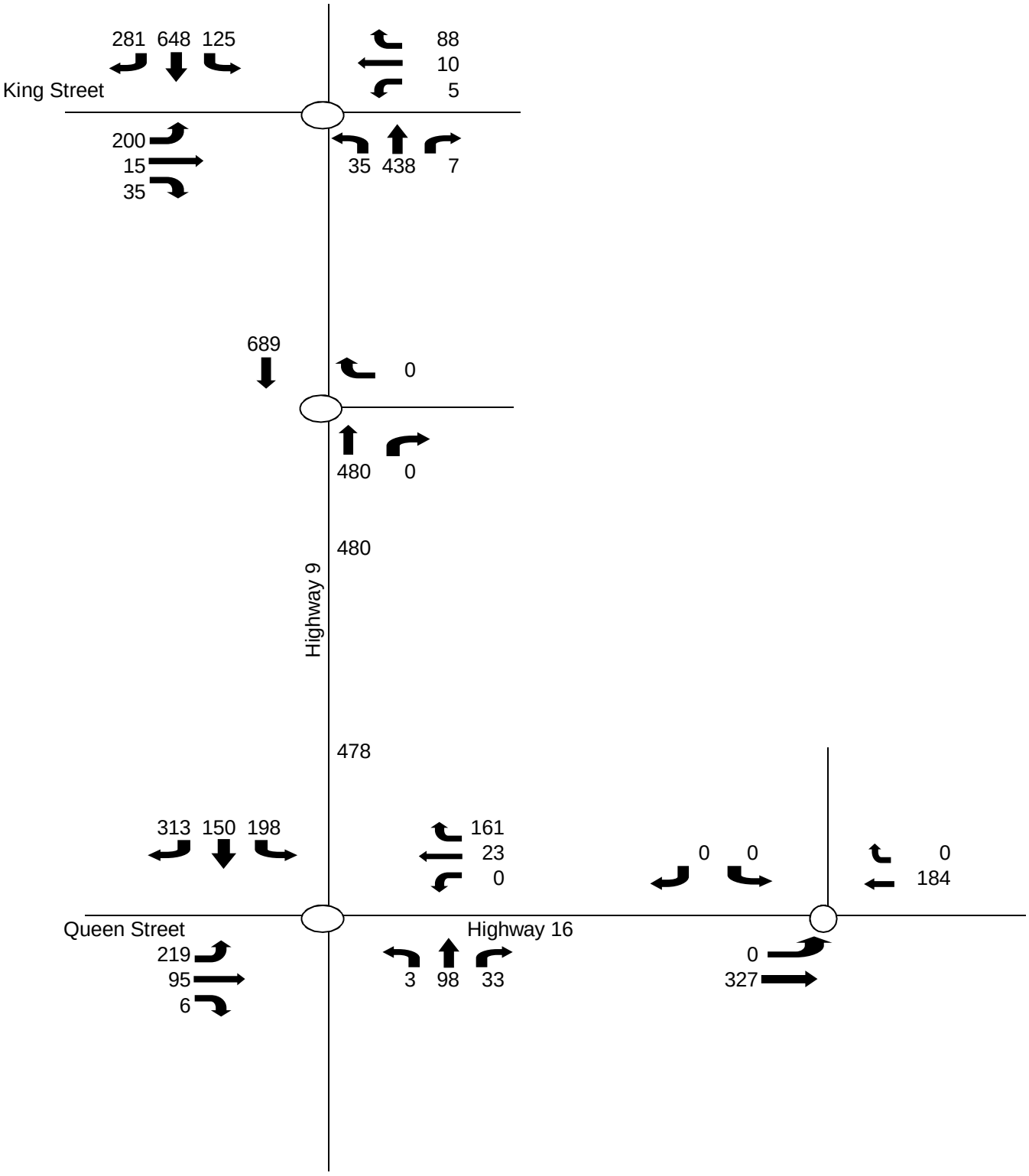


Figure 8
Scenario 2 Higher Trip Generator - 2015 Total Traffic

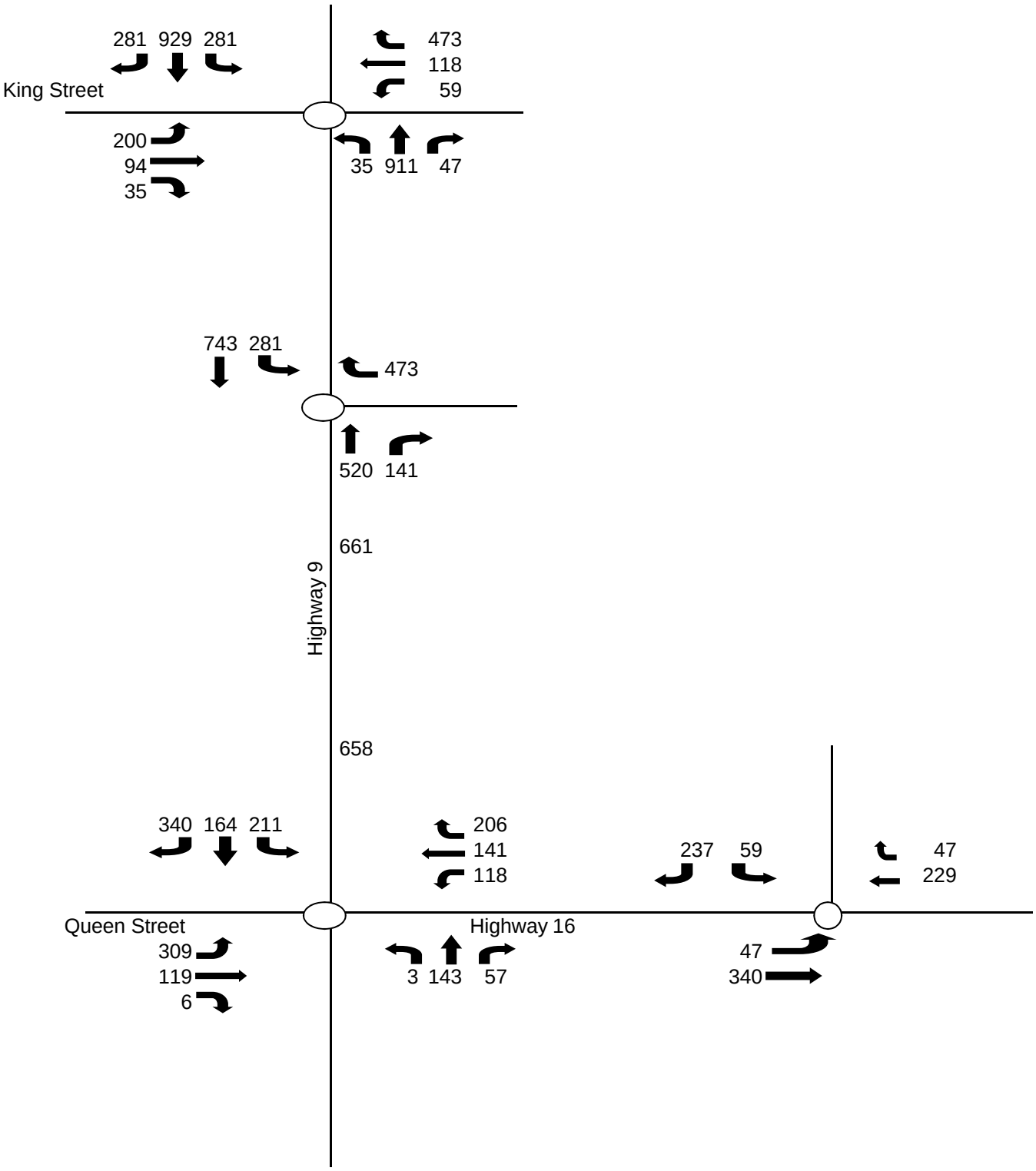


Table 1
Scenario 1 - Lower Trip Generators

Parcel	Land Use	Trip Rate[2]	Parcel Size (Acres)	Floor Area Ratio (Site Coverage)	Occupied Land (Acres)	Occupied Land (Sq. ft.)	Occupied Land (Sq. ft.)	Total Trips	Generated Trips In (%)	Generated Trips Out (%)	Total In	Total Out
A1	Light Industrial	0.97	2.7	40%	1.08	47045	47000	46	12%	88%	5	40
A2	Hotel (100 Rooms)	0.61	3.5			0		61	58%	42%	35	26
A3	Car Dealership	2.72	4.0	40%	1.60	69696	69700	190	59%	41%	112	78
B1	Light Industrial	0.97	4.4	40%	1.76	76666	76700	74	12%	88%	9	65
B2	Light Industrial	0.97	2.9	40%	1.16	50530	50500	49	12%	88%	6	43
B3	Light Industrial	0.97	3.6	40%	1.44	62726	62700	61	12%	88%	7	54
C1	Light Industrial	0.97	3.3	40%	1.32	57499	57500	56	12%	88%	7	49
C2	Light Industrial	0.97	5.3	40%	2.12	92347	92300	90	12%	88%	11	79
C3	Light Industrial	0.97	2.4	40%	0.96	41818	41800	41	12%	88%	5	36
D1	Light Industrial	0.97	4.1	40%	1.64	71438	71400	69	12%	88%	8	61
D2	Light Industrial	0.97	3.9	40%	1.56	67954	68000	66	12%	88%	8	58
E1	Light Industrial	0.97	3.0	40%	1.20	52272	52300	51	12%	88%	6	45
E2	Light Industrial	0.97	4.0	40%	1.60	69696	69700	68	12%	88%	8	59
E3	Light Industrial	0.97	2.6	40%	1.04	45302	45300	44	12%	88%	5	39
E4	Light Industrial	0.97	6.2	40%	2.48	108029	108000	105	12%	88%	13	92
E5	Light Industrial	0.97	3.6	40%	1.44	62726	62700	61	12%	88%	7	54
Total			**59.5**					**1129**			**253**	**877**

Table 2
Scenario 2 - Higher Trip Generators

Parcel	Land Use (ITE Code)	Probable Trip Rate[4]	Parcel Size (Acres)	Floor Area Ratio (Site Coverage)	Occupied Land (Acres)	Occupied Land (Sq. ft.)	Occupied Land (Sq. ft.)	Total Trips	Generated Trips In (%)	Generated Trips Out (%)	Total In	Total Out
A1	Shopping Centre (820)	3.73	2.7	30%	0.81	35284	35300	132	49%	51%	65	67
A2	100 Room Hotel	0.61	3.5			0		61	58%	42%	35	26
A3	Car Dealership	2.72	4.0	30%	1.20	52272	52300	142	59%	41%	84	58
B1	Shopping Centre (820)	3.73	4.4	30%	1.32	57499	57500	214	49%	51%	105	109
B2	Shopping Centre (820)	3.73	2.9	30%	0.87	37897	37900	141	49%	51%	69	72
B3	Shopping Centre (820)	3.73	3.6	30%	1.08	47045	47000	175	49%	51%	86	89
C1	Shopping Centre (820)	3.73	3.3	30%	0.99	43124	43100	161	49%	51%	79	82
C2	Shopping Centre (820)	3.73	5.3	30%	1.59	69260	69300	258	49%	51%	127	132
C3	Shopping Centre (820)	3.73	2.4	30%	0.72	31363	31400	117	49%	51%	57	60
D1	Shopping Centre (820)	3.73	4.1	30%	1.23	53579	53600	200	49%	51%	98	102
D2	Shopping Centre (820)	3.73	3.9	30%	1.17	50965	51000	190	49%	51%	93	97
E1	Light Industrial (110)	0.97	3.0	40%	1.20	52272	52300	51	12%	88%	6	45
E2	Light Industrial (110)	0.97	4.0	40%	1.60	69696	69700	68	12%	88%	8	59
E3	Light Industrial (110)	0.97	2.6	40%	1.04	45302	45300	44	12%	88%	5	39
E4	Light Industrial (110)	0.97	6.2	40%	2.48	108029	108000	105	12%	88%	13	92
E5	Light Industrial (110)	0.97	3.6	40%	1.44	62726	62700	61	12%	88%	7	54
Total			**59.5**					**2120**			**937**	**1183**