TITLE: GEOTECHNICAL INVESTIGATION
PROPOSED EXTENSION OF
ASSINIBOIA PARK RESIDENTIAL SUBDIVISION
WEYBURN, SASKATCHEWAN

CLIENT: CITY OF WEYBURN

FILE NO: GE-0603 DATE: MAY 2, 2012

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GROUND ENGINEERING CONSULTANTS LTD.

CIVIL & GEOENVIRONMENTAL ENGINEERS

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FILE: GE-0603 May 2, 2012

City of Weyburn
P.O. Box 370
WEYBURN, Saskatchewan
S4H 2K6

ATTENTION: MR. RENÉ RICHARD, P. ENG., DIRECTOR OF ENGINEERING

Dear Sir:

SUBJECT: GEOTECHNICAL INVESTIGATION
PROPOSED EXTENTION OF
ASSINIBOIA PARK RESIDENTIAL SUBDIVISION
WEBYURN, SASKATCHEWAN

1.0 INTRODUCTION

This report presents the results of a site specific subsurface soils investigation and geotechnical analysis carried out at the site of the above captioned proposed subdivision development located in the City of Weyburn, Saskatchewan. It is understood that the proposed Assiniboia Park extension includes an additional 57 residential lots and associated subdivision infrastructure.

.1 To define the subsurface soil stratigraphy and engineering properties of the foundation soils;

.2 To provide foundation design recommendations for the proposed residential buildings;

.3 To comment on possible excavation and construction problems related to foundation construction, with particular reference to groundwater conditions;

.4 To provide recommendations with regard to the type of cement to use for concrete in contact with native soils;

.5 To provide recommendations for floor slab design and construction;

.6 To provide recommendations on pertinent geotechnical issues identified during the subsurface investigation.

Authorization to proceed with this work was received in your email dated January 25, 2011.

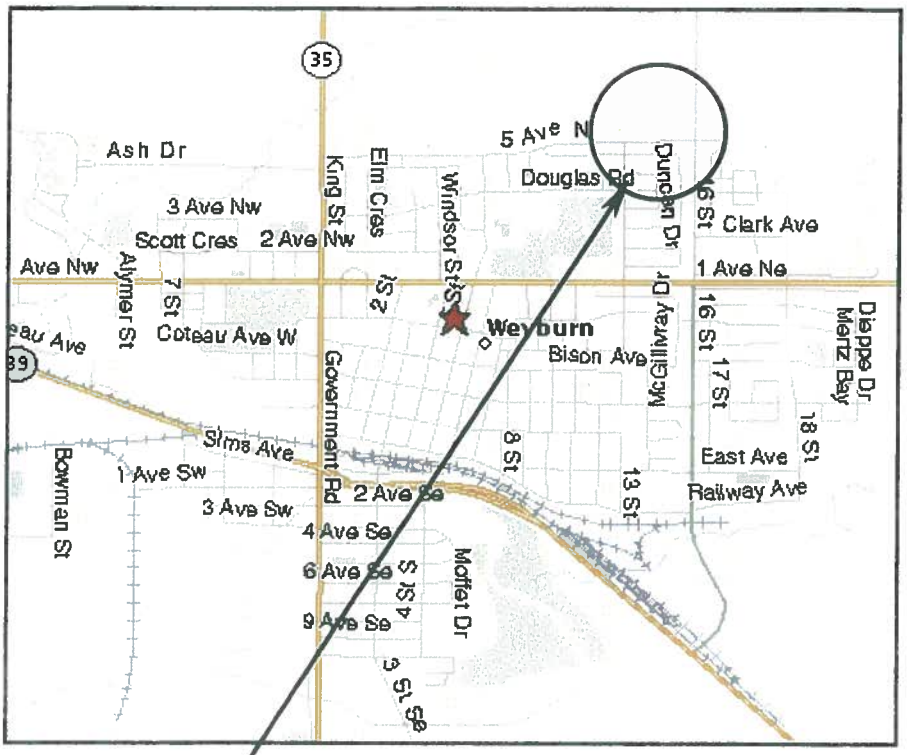
2.0 DESCRIPTION OF SITE

The study area shown in Figure 1 is located in the City of Weyburn, Saskatchewan. The proposed Assiniboia Park subdivision extension is located at the north side of 5th Avenue N.E. and west of 16th Street. The site has recently been graded and serviced for residential lots. The topography is now relatively flat. Ground surface elevations vary up to 1.2 metres between the test hole locations.

3.0 FIELD AND LABORATORY INVESTIGATION

The subsurface conditions were investigated by drilling 14 test holes at the locations shown on Drawing No. GE-0603-1. The test holes were drilled on February 7 and 8, 2011, using a truck-mounted, Brat 22 digger equipped with a 150 mm diameter continuous flight auger. The test holes were drilled to a depth of 6.1 metres below existing ground surface.

Representative disturbed auger samples and undisturbed Shelby tube soil samples were recovered from the test borings at selected intervals and were taken to our laboratory for analysis. Each soil sample was visually examined to determine its textural classification and



STUDY AREA

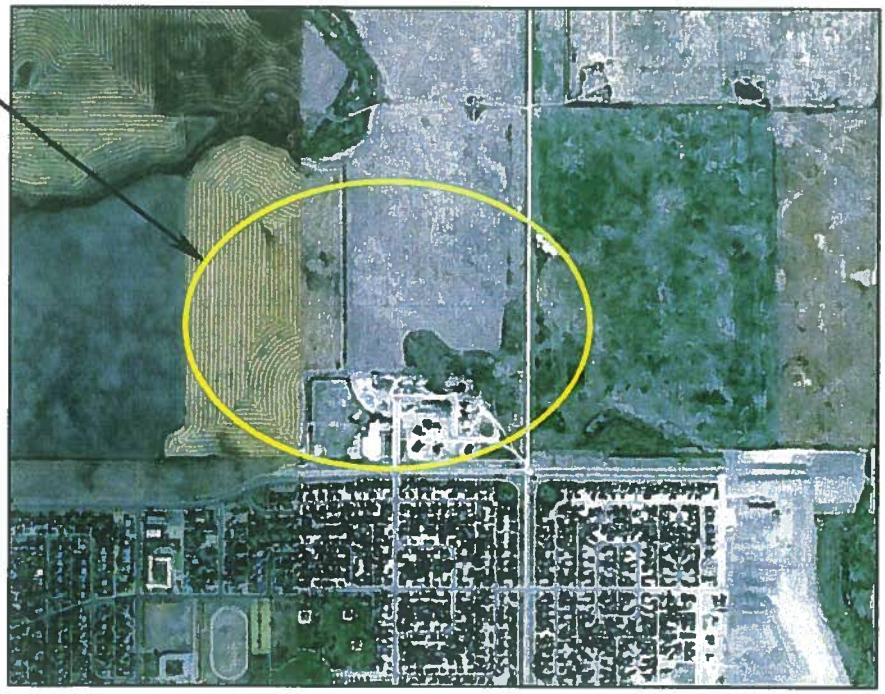


FIGURE 1

LOCATION OF STUDY AREA

natural moisture content tests were performed on each soil sample. In addition, Atterberg Limits, sulphate content, unconfined compressive strength and dry density tests were performed on selected soil samples. Estimates of the undrained shear strength were made using both a pocket penetrometer and a laboratory vane shear apparatus. Details of the soil profile, samples taken, laboratory test results and stratigraphic interpretations of the subsoils are presented on Drawing Nos. GE-0603-5 to -20, inclusive.

The ground surface elevations at the test hole locations were estimated from topographic survey plans prepared by Stantec Consulting Ltd.

4.0 GEOTECHNICAL ANALYSIS

4.1 Stratigraphy

The drilling information indicates that the majority of the site is overlain by fill materials which extend to depths of 0.45 to 1.2 metres below existing ground surface. Fill was encountered in Test Holes 201, 202, 205, 206, 207, 208, 209, 212, 213 and 214. The fill consists of silty clay with trace amounts of sand. In Test Hole 212 the fill consists predominantly of topsoil (strippings). The fill in Test Hole 206 is underlain by a 6 inch thick layer of topsoil.

The surficial fill and/or topsoil is underlain by a stratified drift unit which extends to depths ranging from 1.8 to 4.9 metres below existing ground surface. The drift unit is comprised of interbedded clay, silt and sand layers. The drift sediments generally become coarser with depth.

The stratified drift unit is underlain by a till stratigraphic unit which extends to depths ranging from 3.8 to 5.8 metres below existing grade. The till is a heterogeneous mixture of clay, silt, sand and gravel with occasional sand lenses and cobblestones.

The till stratigraphic unit is underlain by the Pierre Shale Formation (shale bedrock) which extends to the maximum depth penetrated in the test holes (6.1 metres). The shale consists of non-calcareous, highly plastic clay of marine origin which contains interbedded silt and bentonitic layers.

4.2 Groundwater

The drilling information indicates that there is a shallow water table at this site. Standpipe piezometers were installed in Test Holes 201, 203, 208, 210, 212 and 214, to monitor the long term groundwater levels. Water levels in the piezometers were measured by our technologist on February 7 and 8, 2011 and again on March 21, 2011, as shown in Table 1, below:

TABLE 1

PIEZOMETRIC SURFACE MEASUREMENTS

STANDPIPE PIEZOMETER NO.	DATE MEASURED	DEPTH TO BASE OF WELL FROM GROUND SURFACE (m)	GROUNDWATER LEVEL BELOW GRADE (m)	PIEZOMETRIC SURFACE ELEVATION (m)
TH 201	February 7, 2011	4.3	Dry	-
	February 8, 2011		4.1	570.5
	March 21, 2011		2.6	572.0
TH 203	February 7, 2011	4.9	4.7	570.7
	February 8, 2011		3.0	572.4
	March 21, 2011		2.6	572.8
TH 208	February 7, 2011	3.6	2.0	572.9
	February 8, 2011		2.0	572.9
	March 21, 2011		2.3	572.6
TH 210	February 7, 2011	5.2	Dry	-
	February 8, 2011		2.1	572.3
	March 21, 2011		2.3	572.1
TH 212	February 8, 2011	4.6	Dry	-
	March 21, 2011		3.3	570.9
TH 214	February 8, 2011	4.6	Dry	-
	March 21, 2011		Dry	-

During periods of heavy rainfall or spring runoff the water table could be higher.

5.0 DISCUSSION

5.1 Fill Material

The fill material encountered consists predominantly of silty clay. It is understood that the fill was placed during rough grading in 2009. The fill is medium to highly plastic with a Liquid Limit ranging from 41 to 58 percent and a Plasticity Index ranging from 30 to 42 percent.

5.2 Stratified Drift Unit

The surficial stratified drift unit consists predominantly of interbedded layers of silty clay and clayey silt which are stiff to soft in consistency depending on moisture content. Undrained shear strengths in the drift unit range from 20 to 100 kPa based on unconfined compression tests. The surficial clay layers are generally medium plastic with a Liquid Limit ranging from 33 to 43 percent and a Plasticity Index ranging from 15 to 30 percent. The dry density of the clay ranges from 1.40 to 1.62 tonnes per cubic metre, depending on silt content.

5.3 Till Stratigraphic Unit

The till is medium plastic with an average Liquid Limit of 41 percent and an average Plasticity Index of 28 percent. The till is stiff to hard in consistency with undrained shear strengths ranging from 80 to 220 kPa based on unconfined compression tests. The till has a dry density in the order of 1.82 tonnes per cubic metre. The term till on the borehole logs indicates that the material originates from geological processes associated with glaciation. These processes produce a material that is heterogeneous in composition and as such, the till may contain pockets and/or seams of material such as sand, gravel, silt or clay. A wet sand lens was encountered in Test Hole 206 at depths of 4.0 to 4.3 metres below grade. Cobblestones were encountered in Test Holes 201, 204, 209 and 214.

5.4 Bearpaw Shale Formation

The shale bedrock is very stiff to hard in consistency. The variable composition of the shale results in a wide variation of engineering properties. The dry density of the shale ranges from 1.53 to 1.61 tonnes per cubic metre. Atterberg Limits test results indicate that the shale has an average Liquid Limit 76 percent and an average Plasticity Index of 55 percent.

6.0 FOUNDATION CONSIDERATIONS

It is anticipated that foundation loads from the proposed residential buildings will be relatively light, however, the surficial soils generally consist of stratified drift (clay and silt) which are very moist to wet and weak foundation soils. In the south portion of the site (Test

Holes 201, 213 and 214) the till unit was encountered at a depth of 1.8 metres. Shallow footing foundations may be constructed within the till unit in these areas of the site (south end). Bored concrete piles are recommended in the remainder of the site to transfer building loads through the weak surficial soils and into the underlying till and shale units. Our specific recommendations for construction of these types of foundation system are presented below:

6.1 Bored Concrete Piles

.1 The relatively light column loads for the residential buildings may be supported by straight shaft piles designed to develop load carrying capacity on the basis of side friction only. An average allowable skin friction value of 12.0 kPa (250 psf) based on the contact area between the pile surface and the surrounding undisturbed soil may be used in the drift unit below a depth of 2.0 metres. Below elevation 570.5 metres, Geodetic, the side friction value may be increased to 35.9 kPa (750 psf) in the underlying till and shale units.

.2 The upper two (2) metres of pile length below the final ground surface should be discounted insofar as side friction carrying capacity is concerned. It is recommended that the minimum pile shaft diameter be 300 mm to ensure that an adequate pile cross-section is maintained for the full drilled depth. A minimum pile length of 5.5 metres is also recommended.

.3 Given the shallow water table at this site, temporary sleeves will probably be required in order to maintain an open hole during excavation. It is recommended that the steel reinforcement and concrete be placed immediately following completion of the pile excavations in order to minimize the potential for sloughing and/or ingress of groundwater into the pile holes.

.4 Pile shafts carrying little or no bending moment should be reinforced with nominal vertical reinforcement in the form of intermediate grade deformed bars, composing about one-half (1/2) of one (1) percent of the cross-sectional area. The steel reinforcing cage should be projected or dowels set into the top of the caisson to tie into the foundation walls and/or columns.

.5 Concrete used for constructing piles may be placed using the free fall method and the slump should be specified as being not less than 100 mm. This will insure that voids do not exist in the finished pile foundation units. The concrete should remain fluid in the hole until the shaft is completely full in order to take advantage of the fluid pressure in the column of concrete which will develop high pressure against the soil and maximize the shaft's capacity.

.6 For heated buildings with no basement, a minimum of 75 mm of rigid insulation should be placed on the inside of all perimeter grade beams to reduce the heat losses and to prevent drying of the soils.

6.2 Spread Footing and/or Post and Pad Type Foundation System

.1 Properly constructed shallow spread footings bearing on the undisturbed native till unit may be designed for a safe net bearing pressure of 120 kPa (2,500 psf). Footings bearing on top of fill materials or stratified drift soils (clay and silt) are not recommended. Maximum toe pressure under wind loading may exceed the average pressure by no more than one-third (1/3). Regardless of footing pressure considerations, the minimum width of footings should be 450 mm.

.2 The footings should be placed at a minimum depth of 2.0 metres below finished grade elevation for frost protection and to ensure the footings are bearing on soils with adequate bearing capacity. All footings should be adequately reinforced to resist localized stresses.

.3 Every effort should be made to pour the footings as soon as possible after excavation is completed. The steel reinforcing mats should be made up in advance to minimize the possibility of soil disturbance during placement.

.4 All loose or disturbed material at the base of the footing excavations should be compacted prior to placement of forms, reinforcing steel and concrete.

7.0 EXCAVATION CONSIDERATIONS

Excavations will be in the surficial fill, stratified drift and till units. Conventional excavation procedures should therefore be applicable to the soils at this site. Piling contractors should be aware that difficulties may be encountered due to cobblestones and boulders in the till.

Occupational Health and Safety Regulations require that any trench or excavation in which persons must work must be cut back at least one (1) horizontal to one (1) vertical or a temporary shoring system must be used to support the sides of the excavation.

Dewatering may be required for any excavations which extend below Elevation 572.5 metres, geodetic. It should be possible to dewater deep excavations by using sumps.

8.0 FLOOR SLAB CONSIDERATIONS

The soil conditions are suitable for either grade supported floor slabs or structurally supported floors constructed over a crawl space. The following recommendations are provided for both types of floor systems.

8.1 Structurally Supported Floor Systems

A structural floor system would be the most positive way to ensure satisfactory long term performance of the floor. We recommend the following items of work for preparation of the subgrade in the crawl space area beneath the floor slab.

.1 The crawl space should be covered with a Permalon Ply X-150 vapour barrier to reduce the humidity in the crawl space and prevent drying of the subgrade soils.

.2 The ground surface in the crawl space should be graded to slope towards a positive outlet in order to drain any water that may enter the crawl space area.

.3 Provisions should be made to ventilate the crawl space area.

8.2 Grade Supported Floor Slabs

.1 The subgrade under a grade supported slab should be as uniform as possible. The surficial topsoil should be stripped from the site and the exposed subgrade should be proof-rolled with a heavy sheepsfoot or vibratory padfoot roller for till soil and a vibratory smooth drum roller for sand soil. Any soft or spongy areas should be excavated and filled with compacted granular material. The final 200 mm below underside of the basement floor slab should be radon rock.

.2 The concrete slab in areas where only light floor loads are to be supported may have a minimum thickness of 100 mm. The minimum 28 day concrete compressive strength should be specified as 25 MPa.

.3 A generous amount of reinforcing steel running both ways in the slab is desirable.

.4 A layer of robust polyethylene sheeting should be placed between the granular base and the concrete slab to deter the migration of moisture through the floor.

9.0 UNDERGROUND WALLS AND DRAINAGE PROVISIONS

The underground walls should be damp-proofed and designed to withstand the lateral earth pressure (p) at any depth (H) in metres as estimated by the following expression:

$$p = k(\gamma H + q) \text{ kPa}$$

WHERE:

k = 0.4 (the coefficient of earth pressure considered appropriate for the design condition).

γ = the unit weight of the drained granular backfill, approximately 19.0 kN/m^3.

q = the equivalent uniform vertical pressure, in kPa of any surcharge acting at the ground surface near the wall.

The expression assumes that the backfill is free-draining and drains to an efficient perimeter drainage system (as described below), thus preventing the build-up of hydrostatic pressure

on walls. If effective drainage facilities are not provided, the full hydrostatic pressure which could act on the walls must be considered in design.

Perimeter drainage facilities should be provided around the perimeter of the basement. Drain tile with a minimum diameter of 100 mm, or pipe equivalent should be installed below the level of the lowest floor slab. The tile should be wrapped in filter cloth and encased in a graded, granular filter consisting of at least 100 mm of pea gravel which is in turn surrounded top and sides by 300 mm of concrete sand. The tile must drain to a positive frost-free sump or outlet from which the water is removed.

Free-draining backfill material should be placed adjacent to the exterior underground walls. A concrete sand is suitable for this purpose. The upper 600 mm of the backfill may consist of compacted native clay. The ground surface should be contoured away from the building at 3 to 5% grade to discourage the entry of surface runoff into the backfill.

10.0 PAVEMENT STRUCTURE

We recommend the following items of work for design of the pavement structure:

.1 To ensure fast runoff, the surface of the pavement should have a slope of at least two (2) percent, either to the outer perimeter of the paved areas, or to suitable located catch basins leading to underground drains. The contour of the finished pavement at all points should prevent water from standing on the surface, and surface water should not be permitted to seep back under the outer edges of the pavement. Subsurface drains should be installed in locations where subsurface water may accumulate within the pavement structure or where its necessary to intercept water that would tend to make its way into the pavement structure.

.2 The subgrade in the roadway areas should be compacted to a minimum of 95% Standard Proctor density with a heavy sheepsfoot or vibratory padfoot type compactor and any soft or spongy areas should be replaced with granular material before placing the base or subbase. A non-woven geotextile (Geotex 1201 or equivalent) should be placed on top of the finished subgrade.

.3 Pavement structures have been analyzed for heavy truck loading, i.e. 34,000 pound tandem axles, and for light service areas such as parking lots for automobiles. These are given in Table 2.

TABLE 2

RECOMMENDED PAVEMENT STRUCTURE FOR RESIDENTIAL STREETS

	ASPHALT CONCRETE SURFACE COURSE (mm)	TYPE 33 BASE COURSE THICKNESS (mm)	TYPE 8 SUBBASE THICKNESS (mm)
Residential Traffic	60	150	300

.4 Suggested specifications for asphaltic concrete and base course materials are included in Appendix A.

11.0 OTHER

.1 Adequate drainage away from the buildings should be provided and maintained to minimize infiltration of water into the subgrade. The building sites should be set at as high an elevation as possible in relation to the surrounding area.

.2 Test results on selected samples indicate that the soluble sulphate contents in the soil range from 0.25 to 1.45 percent by dry soil weight. Exposure Class S-2 is considered appropriate for design of concrete in contact with the native soil, as specified in CSA Standard CAN3-A23.1-09. Minimum requirements for Exposure Class S-2 are as follows:

- .1 Cement Type: HS or HSb
- .2 Maximum water to cementing materials ratio: 0.45
- .3 Air Content: as per CSA CAN-A23.1-09 Tables 2 and 4
- .4 Minimum specified Compressive Strength: 32 MPa at 56 days

.3 In the event that changes are made in the design, location or nature of the project, the conclusions and recommendations included in this report would not be deemed valid unless the changes in the project were reviewed by our firm. Modification to this report would then be made if necessary. Furthermore, it is recommended that this firm be allowed an opportunity for a general review of the final design plans and specifications in order to ensure that the recommendations made in this report are

properly interpreted and implemented. If this firm is not allowed the opportunity for this review, we assume no responsibility for the misinterpretation of any of the recommendations.

.4 It is recommended that Ground Engineering Consultants Ltd. be retained to provide inspection services during construction of this project. This is to observe compliance with the design concepts, specifications and recommendations and to allow design changes in the event that the subsurface conditions differ from what was anticipated.

.5 This report has been prepared for the City of Weyburn and intended for the specific application to the design and construction of the proposed Assiniboia Park residential subdivision extension located in the City of Weyburn, Saskatchewan. The analysis and recommendations are based in part on the data obtained from the test hole logs. The boundaries between soil strata have been established at bore hole locations. Between the bore holes, the boundaries are assumed from geological evidence and may be subject to considerable error. Contractors bidding on the project works are particularly advised against reviewing the report without realizing the limitations of the subsurface information. It is recommended that Contractors should make such tests, inspections and other on-site investigations as is considered necessary to satisfy themselves as to the nature of the conditions to be encountered.

.6 It is recommended that the geotechnical workscope include the following services:

i) geotechnical review of other design professionals' plans relative to their interpretation of geotechnical findings and recommendations, and;

ii) construction monitoring to observe construction activities in light of plans and specifications, and to help assure that unforeseen conditions are detected quickly to permit prompt corrective action and thus prevent minor problems from growing to major proportion.

.7 The soil samples from this site will be retained in our laboratory for 90 days following the date of this report. Should no instructions be received to the contrary, these samples will then be discarded.

12.0 CLOSURE

We trust that this report is satisfactory for your purposes. If you have any questions or require additional information, please contact this office.

Yours very truly
Ground Engineering Consultants Ltd.

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
Ground Engineering Consultants Ltd.
Number C0008
Permission to Consult held by:
Discipline Sk. Reg. No. Signature
GEOTECHNICAL 6307

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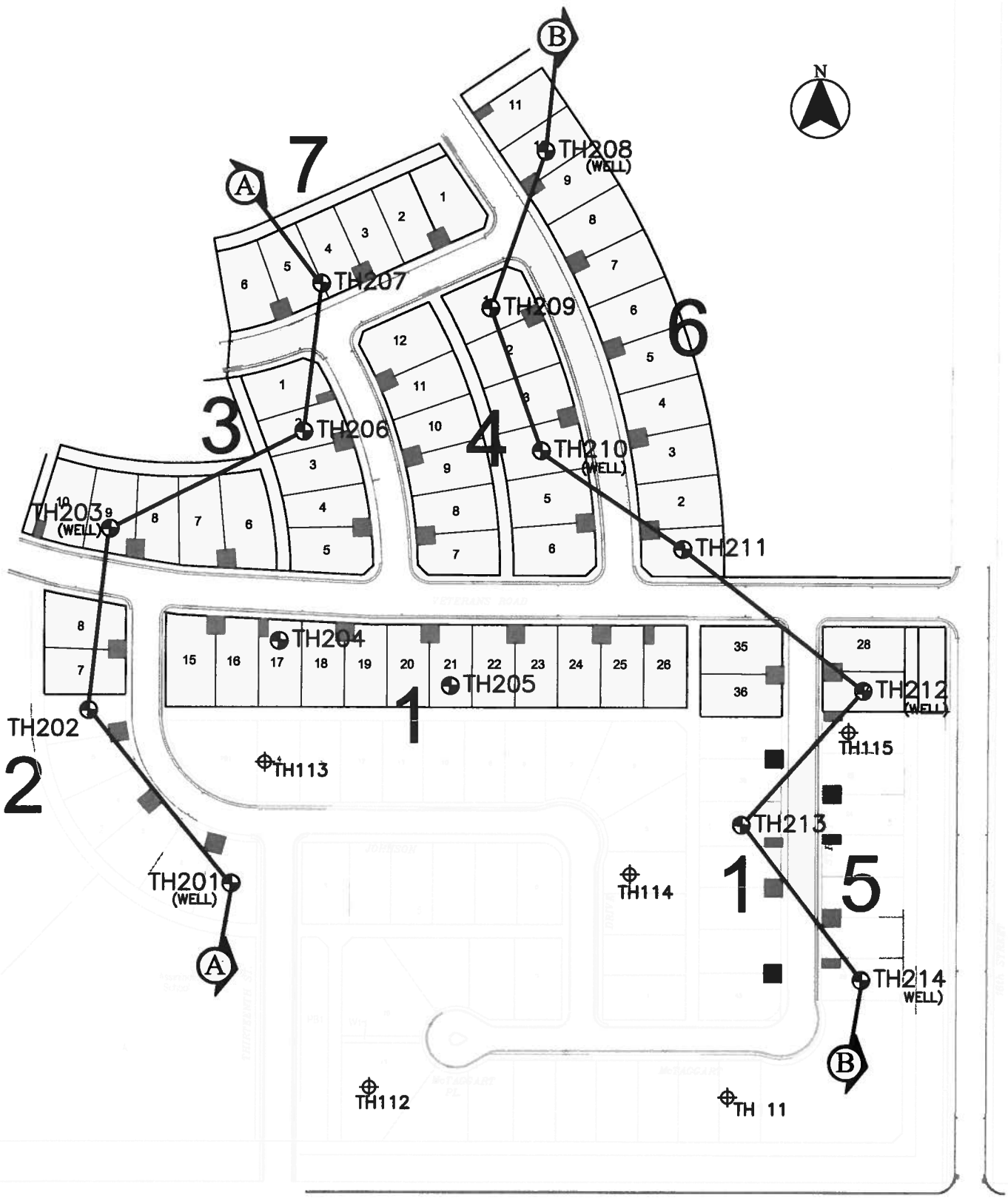
DRAWINGS



NOTE:
1. SITE PLAN PROVIDED BY STANTEC CONSULTING LTD.
2. TEST HOLES 111 to 115 EXCAVATED BY GE GROUND ENGINEERING LTD., JANUARY 14, 2006.

SCALE: 1:2500

GROUND ENGINEERING CONSULTANTS LTD.
CIVIL & GEOENVIRONMENTAL ENGINEERS
415–7th AVENUE
REGINA, SASKATCHEWAN, CANADA

SITE PLAN SHOWING LOCATION OF TEST HOLES
PROPOSED ASSINIBOIA PARK SUBDIVISION EXTENSION
16th STREET and VETERANS ROAD
WEYBURN, SASKATCHEWAN

CLIENT:	APPROVED:	DATE:	DWG. No.:
CITY OF WEYBURN		MAY 2, 2012	GE–0603–1

ARCHIVE: 2006 FILES\2006 ENG.FILES\GE-0603\2011 GEOTECH\DRAWINGS\0603 2011 SITE PLAN.DWG

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 - 69 AND D 2488 - 69

(Unified Soil Classification System)

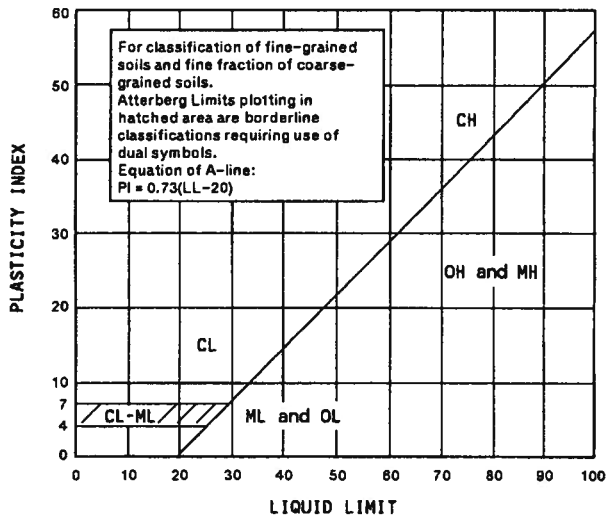
Major Divisions			Group Symbols	Typical Names	Classification Criteria
Coarse-grained soils: More than 50% retained on No. 200 sieve *	Gravels: 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7
	Sands: More than 50% of coarse fraction passes No. 4 sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW
		Sands with fines	SM	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7

Classification on basis of percentage of fines
Less than 5% pass No. 200 sieve ..... GW, GP, SW, SP
More than 12% pass No. 200 sieve ..... GM, GC, SM, SC
5 to 12% pass No. 200 sieve ..... Borderline classifications requiring use of dual symbols

Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols

Major Divisions		Group Symbols	Typical Names
Fine-grained soils: 50% or more passes No. 200 sieve *	Silts and clays: Liquid limit 50% or less	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	Silts and clays: Liquid limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity
Highly organic soils		Pt	Peat, muck and other highly organic soils

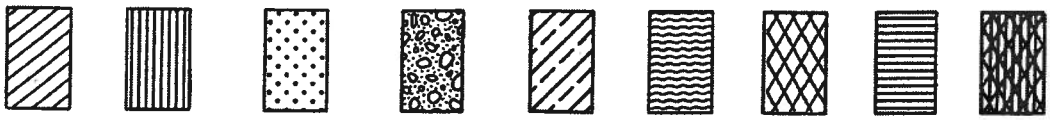
PLASTICITY CHART



*Based on the material passing the 75mm (3in) sieve.

SYMBOLS AND TERMS USED IN THE REPORT

CLAY SILT SAND GRAVEL ORGANIC PEAT TILL SHALE FILL



The symbols may be combined to denote various soil combinations, the predominate soil being heavier.

RELATIVE PROPORTIONS

TERM	RANGE
Trace	0 - 5%
A Little	5 - 15%
Some	15 - 30%
With	30 - 50%

ASTM CLASSIFICATION BY PARTICLE SIZE

Boulder		> 300 mm
Cobble		300 mm - 75 mm
Gravel		75 mm - 4.75 mm
Sand		
	coarse	4.75 mm - 2 mm
	medium	2 mm - 425 um
	fine	425 um - 75 um
Silt		75 um - 5 um
Clay		< 5 um

DENSITY OF SANDS AND GRAVELS

DESCRIPTIVE TERM	RELATIVE DENSITY [1]	N VALUE STANDARD PENETRATION TEST [2]
Very loose	0 - 15%	0 - 4 Blows per 300mm
Loose	15 - 35%	4 - 10 Blows per 300mm
Medium Dense	35 - 65%	10 - 30 Blows per 300mm
Dense	65 - 85%	30 - 50 Blows per 300mm
Very Dense	85 - 100%	> 50 Blows per 300mm

CONSISTENCY OF CLAYS AND SILTS

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa) (CFEM, 2nd Edt., 1985)	N VALUE STANDARD PENETRATION TEST [2]	FIELD IDENTIFICATION (ASTM D 2488-84)
Very Soft	<12	< 2 Blows per 300mm	Thumb will penetrate soil more than 25 mm
Soft	12 - 25	2 - 4 Blows per 300mm	Thumb will penetrate soil about 25 mm
Firm	25 - 50	4 - 8 Blows per 300mm	Thumb will indent soil about 6 mm
Stiff	50 - 100	8 - 15 Blows per 300mm	Thumb will indent, but only with great effort (CFEM)
Very Stiff	100 - 200	15 - 30 Blows per 300mm	Readily indented by thumbnail (CFEM)
Hard	>200	> 30 Blows per 300mm	Thumb will not indent soil but readily indented with thumbnail

NOTES: 1. Relative Density determined by standard laboratory tests.
2. N Value - Blows/300mm of a 620N hammer falling 762mm on a 50mm O.D. Split Spoon.

SYMBOLS AND TERMS USED IN THE REPORT (continued)

GROUNDWATER

▼ Water level measured in the borings at the time and under the conditions indicated. In sand, the indicated levels can be considered reliable groundwater levels. In clay soil, it is not possible to determine the groundwater level within the normal scope of a test boring investigation, except where lenses or layers of more pervious waterbearing soil are present and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed texture soils may not indicate the true level of the groundwater table. The available water level information is given at the bottom of the log sheet.

▽ Water level determined by piezometer installation – In all soils the levels can be considered reliable groundwater levels.

DESCRIPTIVE SOIL TERMS

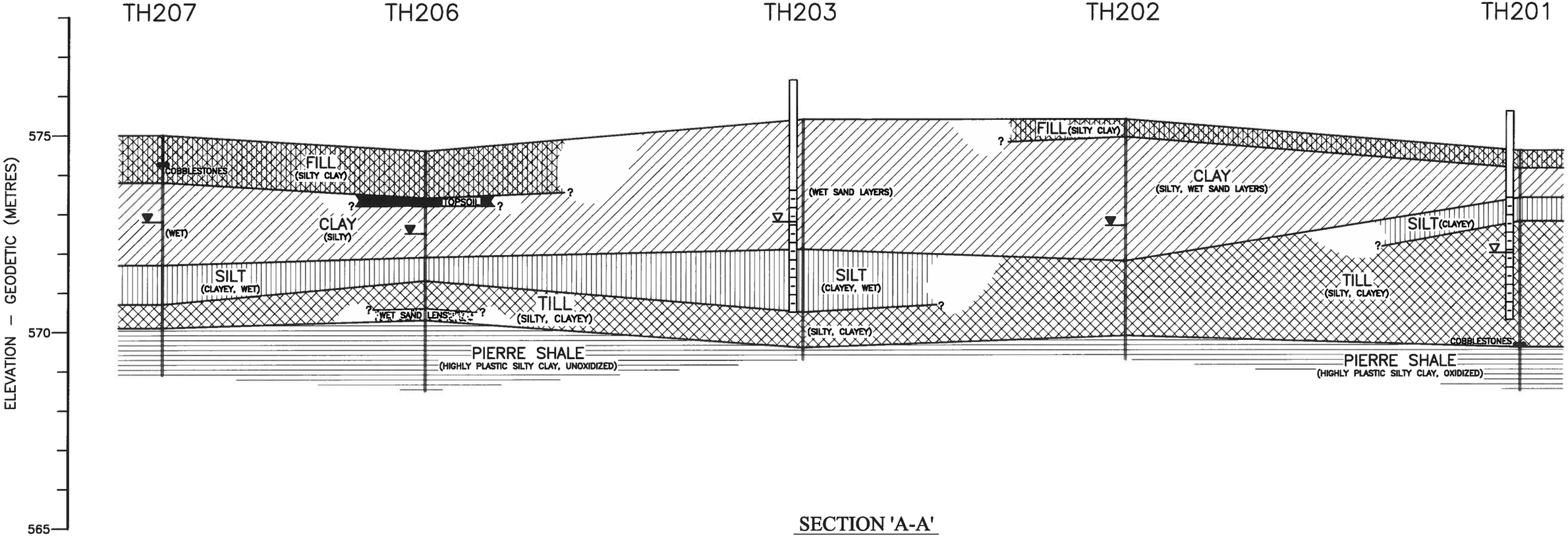
WELL GRADED	Having wide range of grain sizes and substantial amounts of all intermediate sizes.
POORLY GRADED	Predominantly of one grain size.
SLICKENSIDES	Refers to a clay that has planes that are slick and glossy in appearance; slickensides are caused by shear movements.
SENSITIVE	Exhibiting loss of strength on remolding.
FISSURED	Containing cracks, usually attributable to shrinkage. Fissured clays are sometimes described as having a nuggetty structure.
STRATIFIED	Containing layers of different soil types.
ORGANIC	Containing organic matter; may be decomposed or fibrous.
PEAT	A fibrous mass of organic matter in various stages of decomposition. Generally dark brown to black in color and of spongy consistency.
BEDROCK	Preglacial material.
DRIFT	Material deposited directly by glaciers or glacial melt-water.
ALLUVIAL	Soils that have been deposited from suspension from moving water.
LACUSTRINE	Soils that have been deposited from suspension in fresh water lakes.

DRILLING AND SAMPLING TERMS

SYMBOL	DEFINITION
C.S.	Continuous Sampling
Sy	75mm Thin Wall Tube Sample
Sy (2)	50mm Thin Wall Tube Sample
SPT (SS)	50mm O.D. Split Spoon Sample
BLOWS / 300mm	"N" Value – Standard Penetration Test
Bag	Disturbed Bag Sample
No.	Sample Identification Number
——→	Piezometer Tip
S.I.	Slope Indicator
SPG —→	Observed Seepage

LABORATORY TEST SYMBOLS

SYMBOL	DEFINITION
●	Moisture Content – Percent of Dry Weight
⊢→	Plastic and Liquid Limit determined in accordance with ASTM D-423 and D-424
◆	Dry Density – t/m^3
■	Shear Strength – As determined by Unconfined Compression Test
▲	Shear Strength – As determined by Field Vane
▲	Shear Strength – As determined by Pocket Penetrometer Test
$\%SO_4$	Water Soluable Sulphates – Percent of Dry Weight
M.A.	Grain Size Analysis



SECTION 'A-A'

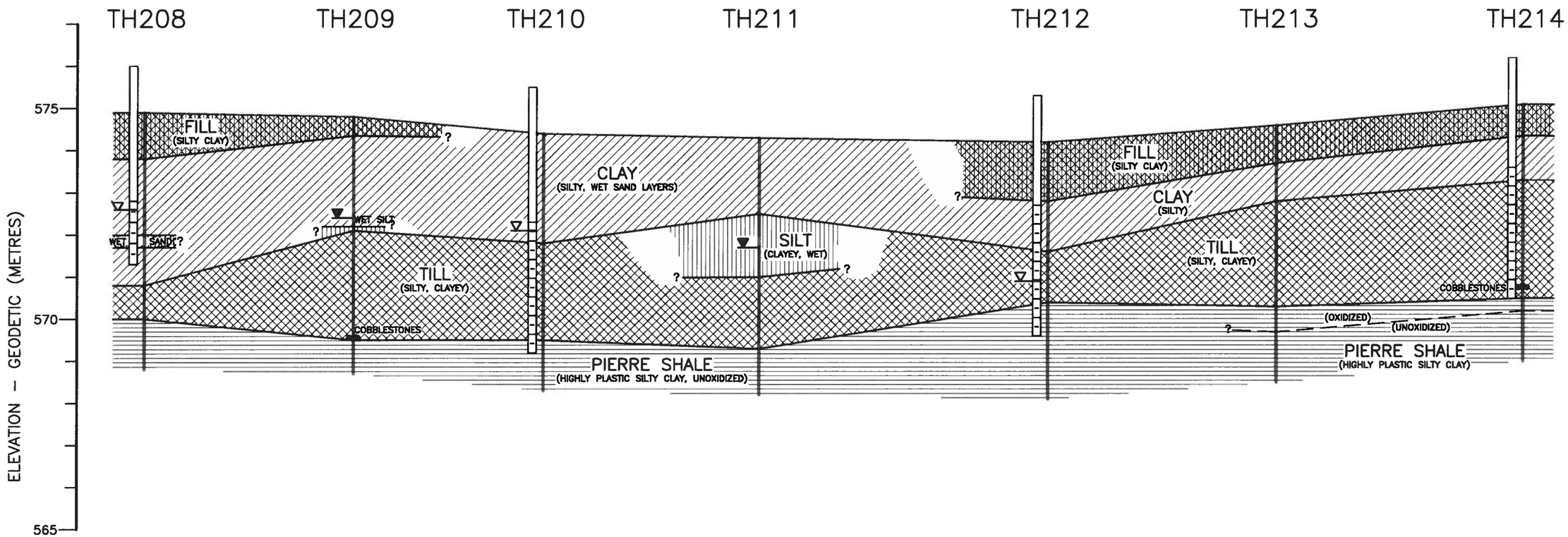
SCALE: HOR. 1:1000
VERT. 1:100

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes, the boundaries are interpolated and may be subject to considerable error.

GROUND ENGINEERING CONSULTANTS LTD.
CIVIL & GEOENVIRONMENTAL ENGINEERS
415–7th AVENUE
REGINA, SASKATCHEWAN, CANADA

STRATIGRAPHIC CROSS SECTION 'A–A'
PROPOSED ASSINIBOIA PARK SUBDIVISION EXTENSION
16th STREET and VETERANS ROAD
WEYBURN, SASKATCHEWAN

CLIENT:	APPROVED:	DATE:	DWG. No.:
CITY OF WEYBURN		MAY 2, 2012	GE–0603–5



SECTION 'B-B'

SCALE: HOR. 1:1500
VERT. 1:100

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes, the boundaries are interpolated and may be subject to considerable error.

GROUND ENGINEERING CONSULTANTS LTD.
CIVIL & GEOENVIRONMENTAL ENGINEERS
415–7th AVENUE
REGINA, SASKATCHEWAN, CANADA

STRATIGRAPHIC CROSS SECTION 'B–B'
PROPOSED ASSINIBOIA PARK SUBDIVISION EXTENSION
16th STREET and VETERANS ROAD
WEYBURN, SASKATCHEWAN

CLIENT:	APPROVED:	DATE:	DWG. No.:
CITY OF WEYBURN		MAY 2, 2012	GE–0603–6

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575244.9 N; 13523492.7 E	TEST HOLE NO: 0603-TH201
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 574.6 metres (GEODETIC)	ELEVATION: 574.60 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	▲POCKET PEN (kPa)▲ 60 120 180 240 ■SULPHATE CONTENT (%)■ 0.2 0.4 0.6 0.8 PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	●BLOW COUNT● 20 40 60 80 ▲VANE SHEAR (kPa)▲ 60 120 180 240 ■UNCONFINED (kPa)■ 60 120 180 240 ◆DRY DENSITY (t/m3)◆ 0.4 0.8 1.2 1.6	SLOTTED PIEZOMETER	PIEZOMETER BACKFILL	DEPTH (ft)
0.0						FILL – silty clay – trace sand – very moist – very dark grayish brown (2.5Y 3/2)			Top of pipe 1.0 metres above grade. GRANULAR BENTONITE	0.0
1.0	N	1				450mm 1.5ft			1.1m 1.2m	5.0
2.0	N	2				CLAY – silty – silt layers – very moist, soft to firm – oxidized, iron stains – dark grayish brown (2.5Y 4/2)			SIL-8 SAND	
3.0		3	CL			1.2m 4.0ft				10.0
4.0	N	4				SILT – clayey – fine sand layers – moist to wet, soft – oxidized – olive brown (2.5Y 4/4)			4.3m DRILL CUTTINGS	15.0
5.0		5				1.8m 6.0ft				
6.0						TILL – silty, clayey – moist, stiff to very stiff – salt crystals – oxidized, iron stains – cobblestones at 4.9 metres – olive brown (2.5Y 4/4)			6.1m Top of pipe Elev.= 575.6m	20.0
7.0						5.0m 16.5ft				25.0
8.0						PIERRE SHALE – silty clay, highly plastic – moist, very stiff to hard – oxidized, iron stains – very dark grayish brown (2.5Y 3/2)				
9.0						6.1m END OF HOLE 20.0ft				30.0
10.0										
11.0										35.0
12.0										40.0
13.0									WATER LEVELS: (from top of pipe) February 7, 2011 Depth: Dry February 8, 2011 Depth: 5.1m Elev.= 570.5m March 21, 2011 Depth: 3.8m Elev.= 572.0m	45.0
14.0										
15.0										50.0
16.0										
17.0									TYPE OF PIPE: 50mm PVC, Schedule 40 TYPE OF PIEZOMETER: Standpipe PIEZOMETER TIP: PVC slotted, 3.1m	55.0
18.0										60.0
19.0										
20.0										65.0

NOTES:
1. Test hole was excavated on February 7, 2011 using a 150 mm dia. continuous flight auger.
2. Piezometer was installed.

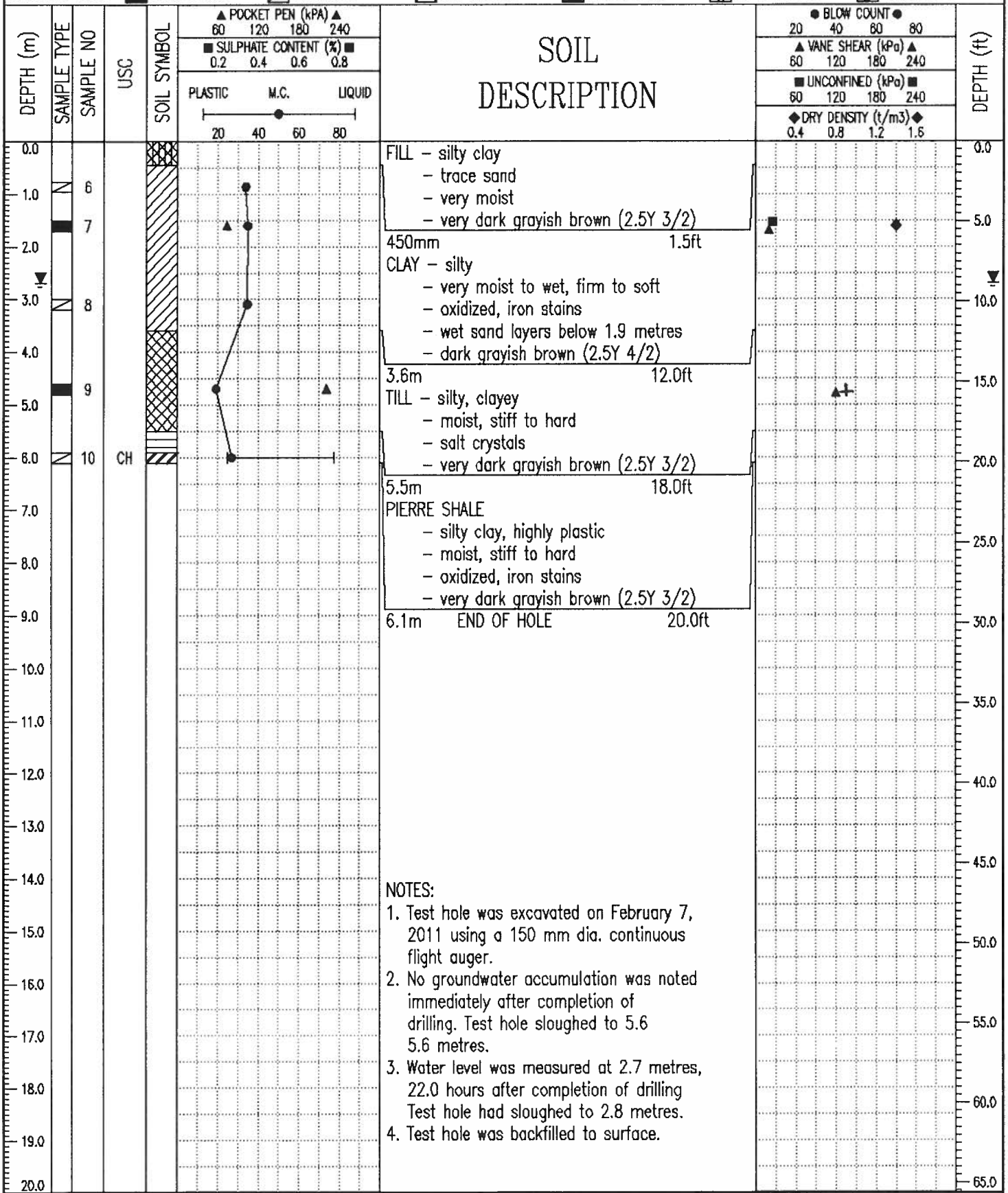
GROUND ENGINEERING LTD.
Regina, Saskatchewan

LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
REVIEWED BY: PW	COMPLETE: 11/02/07
Fig. No: GE-0603-7	Page 1 of 1

12/05/02 11:42AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575322.4 N; 13523429.2 E	TEST HOLE NO: 0603-TH202
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 575.4 metres (GEODETIC)	ELEVATION: 575.40 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE



FILL – silty clay
- trace sand
- very moist
- very dark grayish brown (2.5Y 3/2)

450mm 1.5ft

CLAY – silty
- very moist to wet, firm to soft
- oxidized, iron stains
- wet sand layers below 1.9 metres
- dark grayish brown (2.5Y 4/2)

3.6m 12.0ft

TILL – silty, clayey
- moist, stiff to hard
- salt crystals
- very dark grayish brown (2.5Y 3/2)

5.5m 18.0ft

PIERRE SHALE
- silty clay, highly plastic
- moist, stiff to hard
- oxidized, iron stains
- very dark grayish brown (2.5Y 3/2)

6.1m END OF HOLE 20.0ft

NOTES:
1. Test hole was excavated on February 7, 2011 using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 5.6 5.6 metres.
3. Water level was measured at 2.7 metres, 22.0 hours after completion of drilling Test hole had sloughed to 2.8 metres.
4. Test hole was backfilled to surface.

GROUND ENGINEERING LTD. Regina, Saskatchewan	LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: PW	COMPLETE: 11/02/07
	Fig. No: GE-0603-8	Page 1 of 1

12/05/02 11:44AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575403.7 N; 13523438.5 E	TEST HOLE NO: 0603-TH203
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 575.4 metres (GEODETIC)	ELEVATION: 575.40 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	▲POCKET PEN (kPa)▲ 60 120 180 240 ■SULPHATE CONTENT (%)■ 0.2 0.4 0.6 0.8 PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	●BLOW COUNT● 20 40 60 80 ▲VANE SHEAR (kPa)▲ 60 120 180 240 ■UNCONFINED (kPa)■ 60 120 180 240 ◆DRY DENSITY (t/m3)◆ 0.4 0.8 1.2 1.6	SLOTTED PIEZOMETER	PIEZOMETER BACKFILL	DEPTH (ft)
0.0	N	11			▲	CLAY – silty – moist to very moist, firm to soft – oxidized, iron stains – wet sand layers below 1.2 metres – dark grayish brown (2.5Y 4/2)	■		Top of pipe 1.0 metres above grade. GRANULAR BENTONITE	0.0
1.0	N	12							1.3m	5.0
2.0									1.8m SIL-9 SAND	
3.0		13				3.3m 11.0ft SILT – clayey – laminated with wet sand layers – very moist to wet, soft – oxidized – olive brown (2.5Y 4/4)	■		3.3m SLOUGH	10.0
4.0										
5.0	N	14				4.9m 16.0ft TILL – silty, clayey – moist, stiff to very stiff – salt crystals – oxidized, iron stains – olive brown (2.5Y 4/4) to dark grayish brown (2.5Y 4/2)			4.9m	15.0
	N	14A								
6.0	N	15				5.8m 19.0ft PIERRE SHALE – silty clay, highly plastic – moist, stiff to hard – unoxidized – very dark gray (5Y 3/1)			6.1m Top of pipe Elev.= 576.4m	20.0
7.0										
8.0										25.0
9.0										30.0
10.0						6.1m END OF HOLE 20.0ft				
11.0										35.0
12.0										40.0
13.0									WATER LEVELS: (from top of pipe)	
14.0									February 7, 2011 Depth: 5.7m Elev.= 570.7m	45.0
15.0									February 8, 2011 Depth: 4.0m Elev.= 572.4m	
16.0						NOTES: 1. Test hole was excavated on February 7, 2011 using a 150 mm dia. continuous flight auger. 2. Piezometer was installed.			March 21, 2011 Depth: 3.8m Elev.= 572.8m	50.0
17.0									TYPE OF PIPE: 50mm PVC, Schedule 40	55.0
18.0									TYPE OF PIEZOMETER: Standpipe	60.0
19.0									PIEZOMETER TIP: PVC slotted, 3.1m	
20.0										65.0

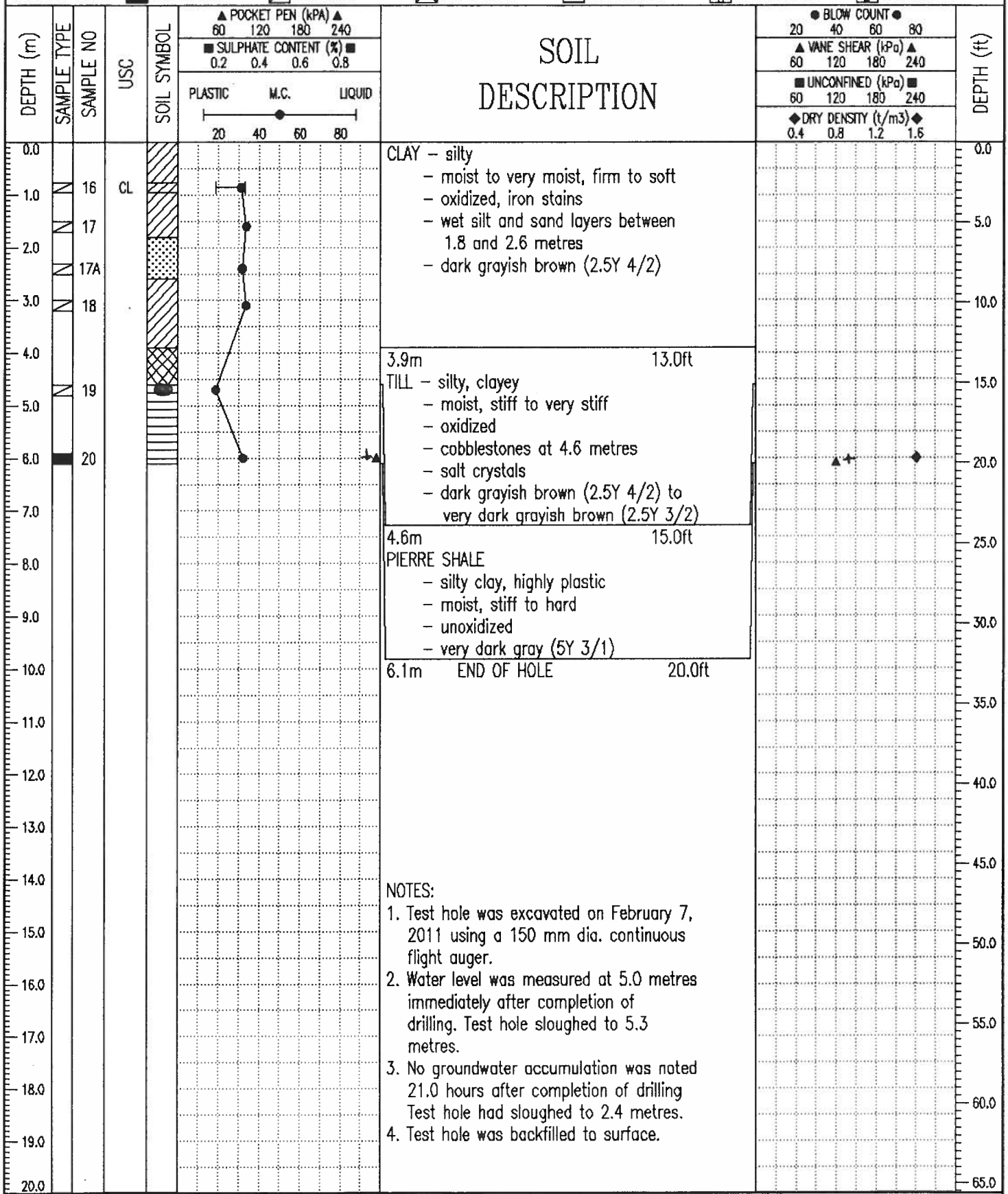
GROUND ENGINEERING LTD.
Regina, Saskatchewan

LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
REVIEWED BY: PW	COMPLETE: 11/02/07
Fig. No: GE-0603-9	Page 1 of 1

12/05/02 11:45AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575353.5 N; 13523513.6 E	TEST HOLE NO: 0603-TH204
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 574.5 metres (GEODETIC)	ELEVATION: 574.50 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE



CLAY – silty
- moist to very moist, firm to soft
- oxidized, iron stains
- wet silt and sand layers between 1.8 and 2.6 metres
- dark grayish brown (2.5Y 4/2)

3.9m 13.0ft

TILL – silty, clayey
- moist, stiff to very stiff
- oxidized
- cobblestones at 4.6 metres
- salt crystals
- dark grayish brown (2.5Y 4/2) to very dark grayish brown (2.5Y 3/2)

4.6m 15.0ft

PIERRE SHALE
- silty clay, highly plastic
- moist, stiff to hard
- unoxidized
- very dark gray (5Y 3/1)

6.1m END OF HOLE 20.0ft

NOTES:
1. Test hole was excavated on February 7, 2011 using a 150 mm dia. continuous flight auger.
2. Water level was measured at 5.0 metres immediately after completion of drilling. Test hole sloughed to 5.3 metres.
3. No groundwater accumulation was noted 21.0 hours after completion of drilling Test hole had sloughed to 2.4 metres.
4. Test hole was backfilled to surface.

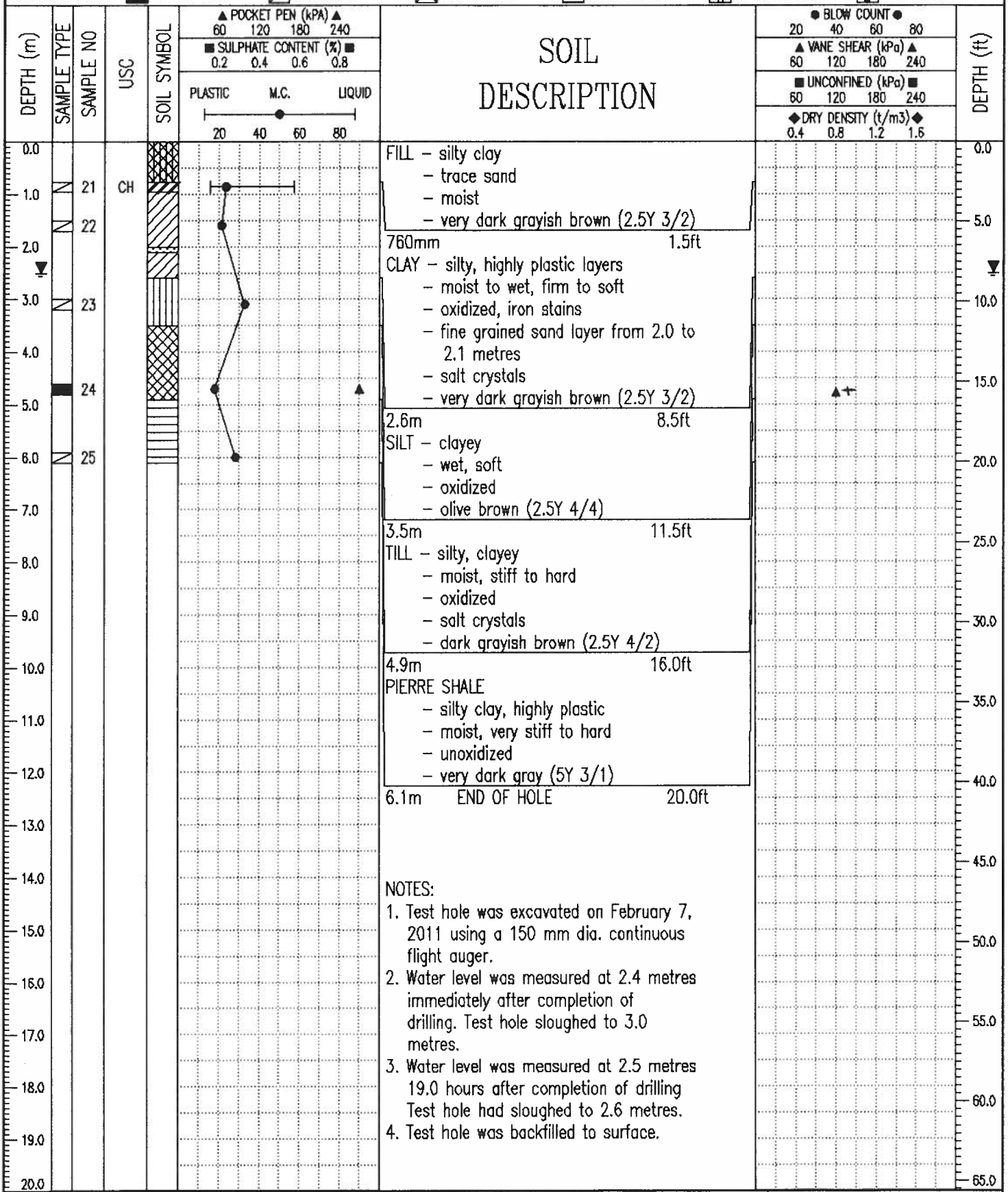
GROUND ENGINEERING LTD.
Regina, Saskatchewan

LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
REVIEWED BY: PW	COMPLETE: 11/02/07
Fig. No: GE-0603-10	Page 1 of 1

12/05/02 11:48AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575333.4 N; 13523589.6 E	TEST HOLE NO: 0603-TH205
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 574.4 metres (GEODETIC)	ELEVATION: 574.40 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE



FILL – silty clay
- trace sand
- moist
- very dark grayish brown (2.5Y 3/2)

760mm 1.5ft

CLAY – silty, highly plastic layers
- moist to wet, firm to soft
- oxidized, iron stains
- fine grained sand layer from 2.0 to 2.1 metres
- salt crystals
- very dark grayish brown (2.5Y 3/2)

2.6m 8.5ft

SILT – clayey
- wet, soft
- oxidized
- olive brown (2.5Y 4/4)

3.5m 11.5ft

TILL – silty, clayey
- moist, stiff to hard
- oxidized
- salt crystals
- dark grayish brown (2.5Y 4/2)

4.9m 16.0ft

PIERRE SHALE
- silty clay, highly plastic
- moist, very stiff to hard
- unoxidized
- very dark gray (5Y 3/1)

6.1m END OF HOLE 20.0ft

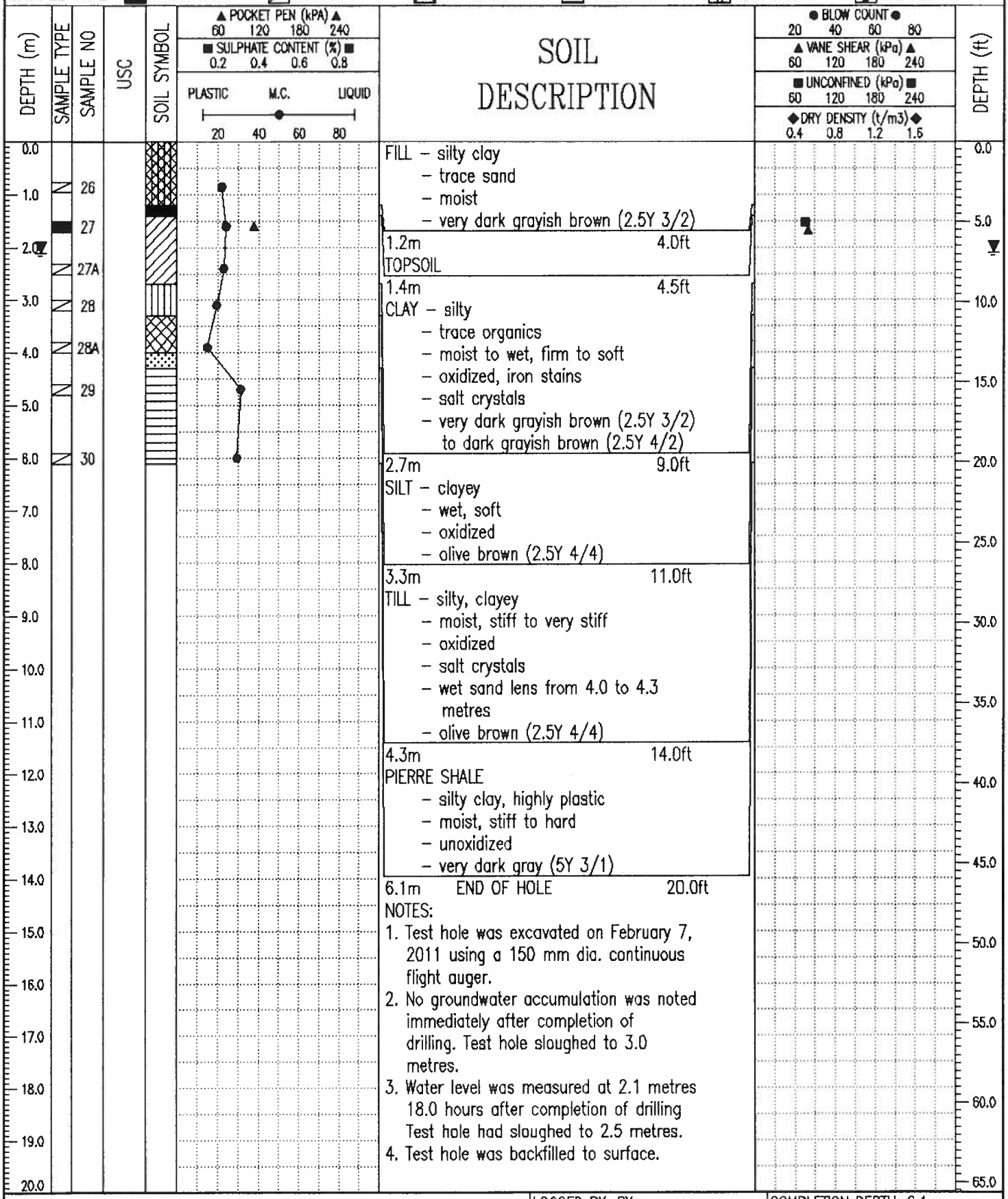
NOTES:
1. Test hole was excavated on February 7, 2011 using a 150 mm dia. continuous flight auger.
2. Water level was measured at 2.4 metres immediately after completion of drilling. Test hole sloughed to 3.0 metres.
3. Water level was measured at 2.5 metres 19.0 hours after completion of drilling Test hole had sloughed to 2.6 metres.
4. Test hole was backfilled to surface.

GROUND ENGINEERING LTD. Regina, Saskatchewan	LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: PW	COMPLETE: 11/02/07
	Fig. No: GE-0603-11	Page 1 of 1

12/05/02 11:49AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575447.1 N; 13523523.9 E	TEST HOLE NO: 0603-TH206
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 574.6 metres (GEODETIC)	ELEVATION: 574.60 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE



FILL – silty clay
- trace sand
- moist
- very dark grayish brown (2.5Y 3/2)

1.2m 4.0ft
TOPSOIL

1.4m 4.5ft
CLAY – silty
- trace organics
- moist to wet, firm to soft
- oxidized, iron stains
- salt crystals
- very dark grayish brown (2.5Y 3/2) to dark grayish brown (2.5Y 4/2)

2.7m 9.0ft
SILT – clayey
- wet, soft
- oxidized
- olive brown (2.5Y 4/4)

3.3m 11.0ft
TILL – silty, clayey
- moist, stiff to very stiff
- oxidized
- salt crystals
- wet sand lens from 4.0 to 4.3 metres
- olive brown (2.5Y 4/4)

4.3m 14.0ft
PIERRE SHALE
- silty clay, highly plastic
- moist, stiff to hard
- unoxidized
- very dark gray (5Y 3/1)

6.1m END OF HOLE 20.0ft

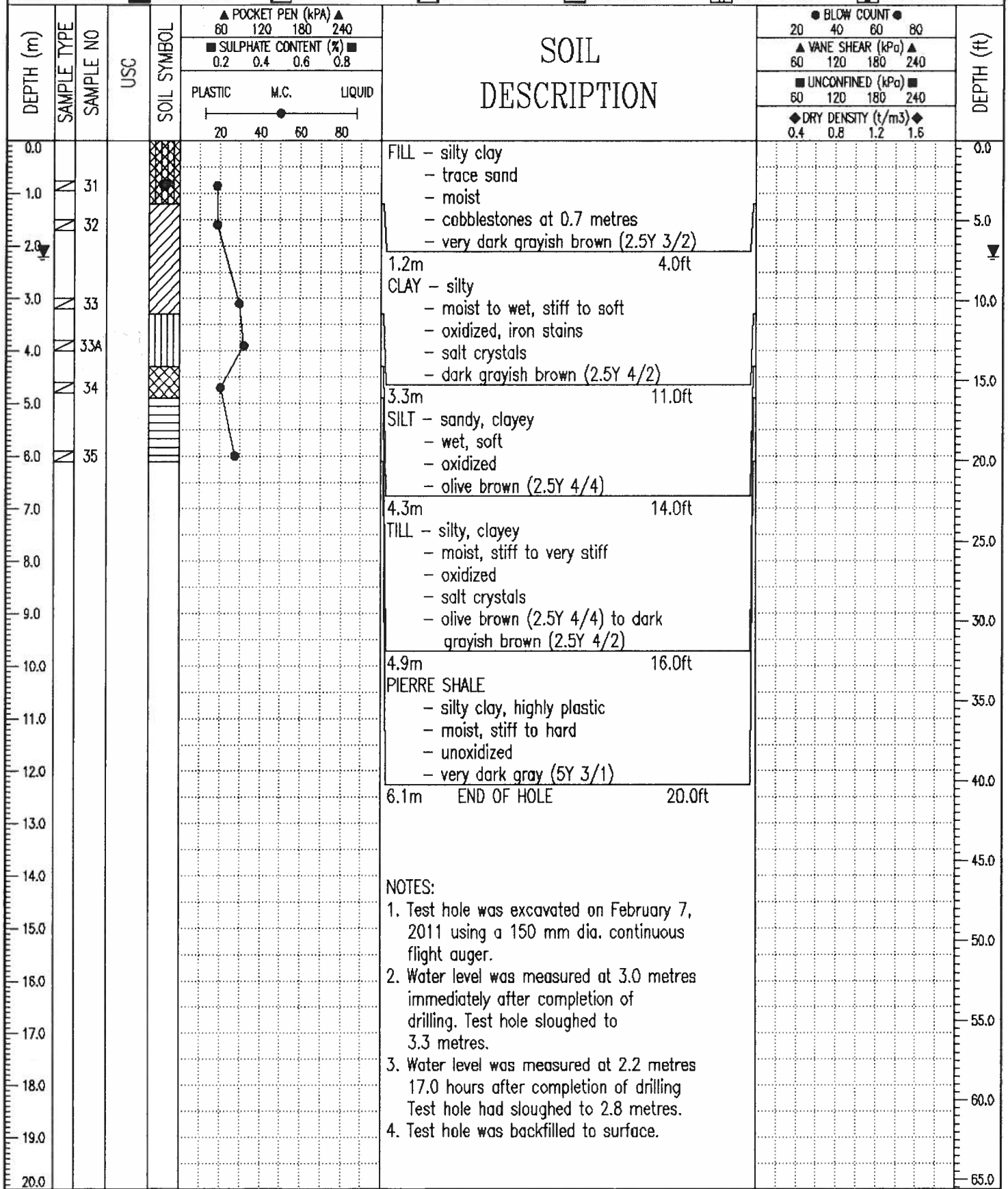
NOTES:
1. Test hole was excavated on February 7, 2011 using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 3.0 metres.
3. Water level was measured at 2.1 metres 18.0 hours after completion of drilling Test hole had sloughed to 2.5 metres.
4. Test hole was backfilled to surface.

GROUND ENGINEERING LTD. Regina, Saskatchewan	LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: PW	COMPLETE: 11/02/07
	Fig. No: GE-0603-12	Page 1 of 1

12/05/02 11:51AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575513.1 N; 13523531.5 E	TEST HOLE NO: 0603-TH207
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 575.0 metres (GEODETIC)	ELEVATION: 575.00 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE



FILL – silty clay
- trace sand
- moist
- cobblestones at 0.7 metres
- very dark grayish brown (2.5Y 3/2)

1.2m 4.0ft

CLAY – silty
- moist to wet, stiff to soft
- oxidized, iron stains
- salt crystals
- dark grayish brown (2.5Y 4/2)

3.3m 11.0ft

SILT – sandy, clayey
- wet, soft
- oxidized
- olive brown (2.5Y 4/4)

4.3m 14.0ft

TILL – silty, clayey
- moist, stiff to very stiff
- oxidized
- salt crystals
- olive brown (2.5Y 4/4) to dark grayish brown (2.5Y 4/2)

4.9m 16.0ft

PIERRE SHALE
- silty clay, highly plastic
- moist, stiff to hard
- unoxidized
- very dark gray (5Y 3/1)

6.1m END OF HOLE 20.0ft

NOTES:
1. Test hole was excavated on February 7, 2011 using a 150 mm dia. continuous flight auger.
2. Water level was measured at 3.0 metres immediately after completion of drilling. Test hole sloughed to 3.3 metres.
3. Water level was measured at 2.2 metres 17.0 hours after completion of drilling Test hole had sloughed to 2.8 metres.
4. Test hole was backfilled to surface.

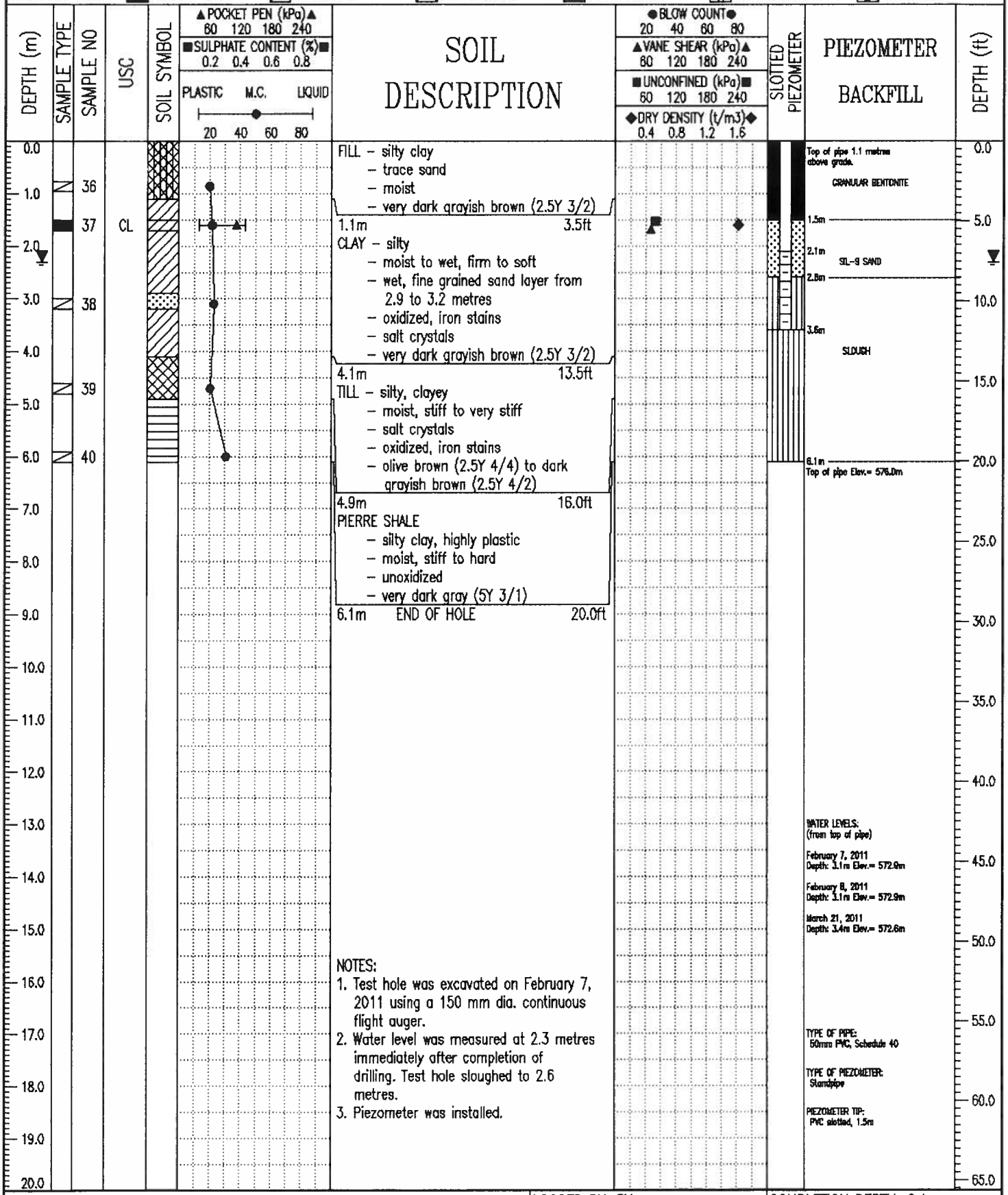
GROUND ENGINEERING LTD.
Regina, Saskatchewan

LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
REVIEWED BY: PW	COMPLETE: 11/02/07
Fig. No: GE-0603-13	Page 1 of 1

12/05/02 11:51AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575572.1 N; 13523631.1 E	TEST HOLE NO: 0603-TH208
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 574.9 metres (GEODETIC)	ELEVATION: 574.90 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE



NOTES:
1. Test hole was excavated on February 7, 2011 using a 150 mm dia. continuous flight auger.
2. Water level was measured at 2.3 metres immediately after completion of drilling. Test hole sloughed to 2.6 metres.
3. Piezometer was installed.

WATER LEVELS: (from top of pipe)
February 7, 2011 Depth: 3.1m Elev.= 572.9m
February 8, 2011 Depth: 3.1m Elev.= 572.9m
March 21, 2011 Depth: 3.4m Elev.= 572.6m

TYPE OF PIPE: 50mm PVC, Schedule 40

TYPE OF PIEZOMETER: Standpipe

PIEZOMETER TIP: PVC slotted, 1.5m

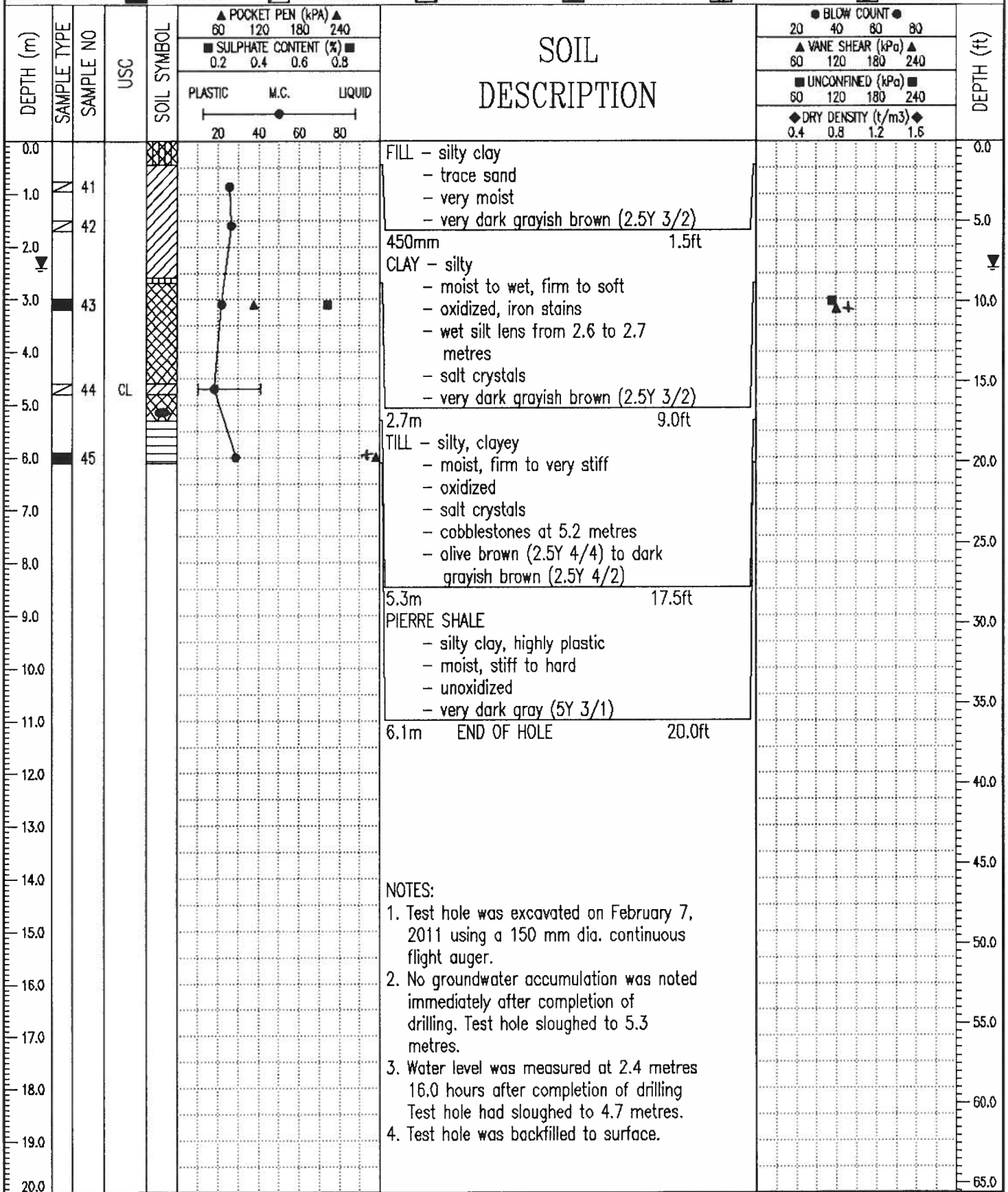
GROUND ENGINEERING LTD.
Regina, Saskatchewan

LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
REVIEWED BY: PW	COMPLETE: 11/02/07
Fig. No: GE-0603-14	Page 1 of 1

12/05/02 11:53AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575502.1 N; 13523606.9 E	TEST HOLE NO: 0603-TH209
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 574.8 metres (GEODETIC)	ELEVATION: 574.80 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE



FILL – silty clay
- trace sand
- very moist
- very dark grayish brown (2.5Y 3/2)

450mm 1.5ft

CLAY – silty
- moist to wet, firm to soft
- oxidized, iron stains
- wet silt lens from 2.6 to 2.7 metres
- salt crystals
- very dark grayish brown (2.5Y 3/2)

2.7m 9.0ft

TILL – silty, clayey
- moist, firm to very stiff
- oxidized
- salt crystals
- cobblestones at 5.2 metres
- olive brown (2.5Y 4/4) to dark grayish brown (2.5Y 4/2)

5.3m 17.5ft

PIERRE SHALE
- silty clay, highly plastic
- moist, stiff to hard
- unoxidized
- very dark gray (5Y 3/1)

6.1m END OF HOLE 20.0ft

NOTES:
1. Test hole was excavated on February 7, 2011 using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 5.3 metres.
3. Water level was measured at 2.4 metres 16.0 hours after completion of drilling Test hole had sloughed to 4.7 metres.
4. Test hole was backfilled to surface.

GROUND ENGINEERING LTD.
Regina, Saskatchewan

LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
REVIEWED BY: PW	COMPLETE: 11/02/07
Fig. No: GE-0603-15	Page 1 of 1

12/05/02 11:55AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575438.5 N; 13523629.6 E	TEST HOLE NO: 0603-TH210
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 574.4 metres (GEODETIC)	ELEVATION: 574.40 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE

SOIL DESCRIPTION

▲POCKET PEN (kPa)▲ 60 120 180 240
■SULPHATE CONTENT (%)■ 0.2 0.4 0.6 0.8
PLASTIC M.C. LIQUID 20 40 60 80
●BLOW COUNT● 20 40 60 80
▲VANE SHEAR (kPa)▲ 60 120 180 240
■UNCONFINED (kPa)■ 60 120 180 240
◆DRY DENSITY (t/m3)◆ 0.4 0.8 1.2 1.6

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL
0.0				
1.0	N	46		
2.0		47		
3.0	N	48		
4.0				
5.0		49		
6.0	N	50		
7.0				
8.0				
9.0				
10.0				
11.0				
12.0				
13.0				
14.0				
15.0				
16.0				
17.0				
18.0				
19.0				
20.0				

CLAY – silty
- moist to wet, firm to soft
- oxidized, iron stains
- salt crystals
- wet sand layers below 2.0 metres
- very dark grayish brown (2.5Y 3/2)

2.6m 8.5ft

TILL – silty, clayey
- moist, firm to very stiff
- salt crystals
- oxidized, iron stains
- coal inclusions
- olive brown (2.5Y 4/4)

4.9m 16.0ft

PIERRE SHALE
- silty clay, highly plastic
- moist, stiff to hard
- gypsum crystals
- unoxidized
- very dark gray (5Y 3/1)

6.1m END OF HOLE 20.0ft

NOTES:
1. Test hole was excavated on February 7, 2011 using a 150 mm dia. continuous flight auger.
2. Piezometer was installed.

SLOTTED PIEZOMETER

PIEZOMETER BACKFILL

Top of pipe 1.1 metres above grade.
GRANULAR BENTONITE
1.8m
2.1m
SIL-9 SAND
5.2m
SLOUGH
6.1m
Top of pipe Elev.= 575.5m

WATER LEVELS: (from top of pipe)
February 7, 2011 Depth: Dry
February 8, 2011 Depth: 3.2m Elev.= 572.3m
March 21, 2011 Depth: 3.4m Elev.= 572.1m

TYPE OF PIPE: 50mm PVC, Schedule 40
TYPE OF PIEZOMETER: Standpipe
PIEZOMETER TIP: PVC slotted, 3.1m

DEPTH (ft)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0

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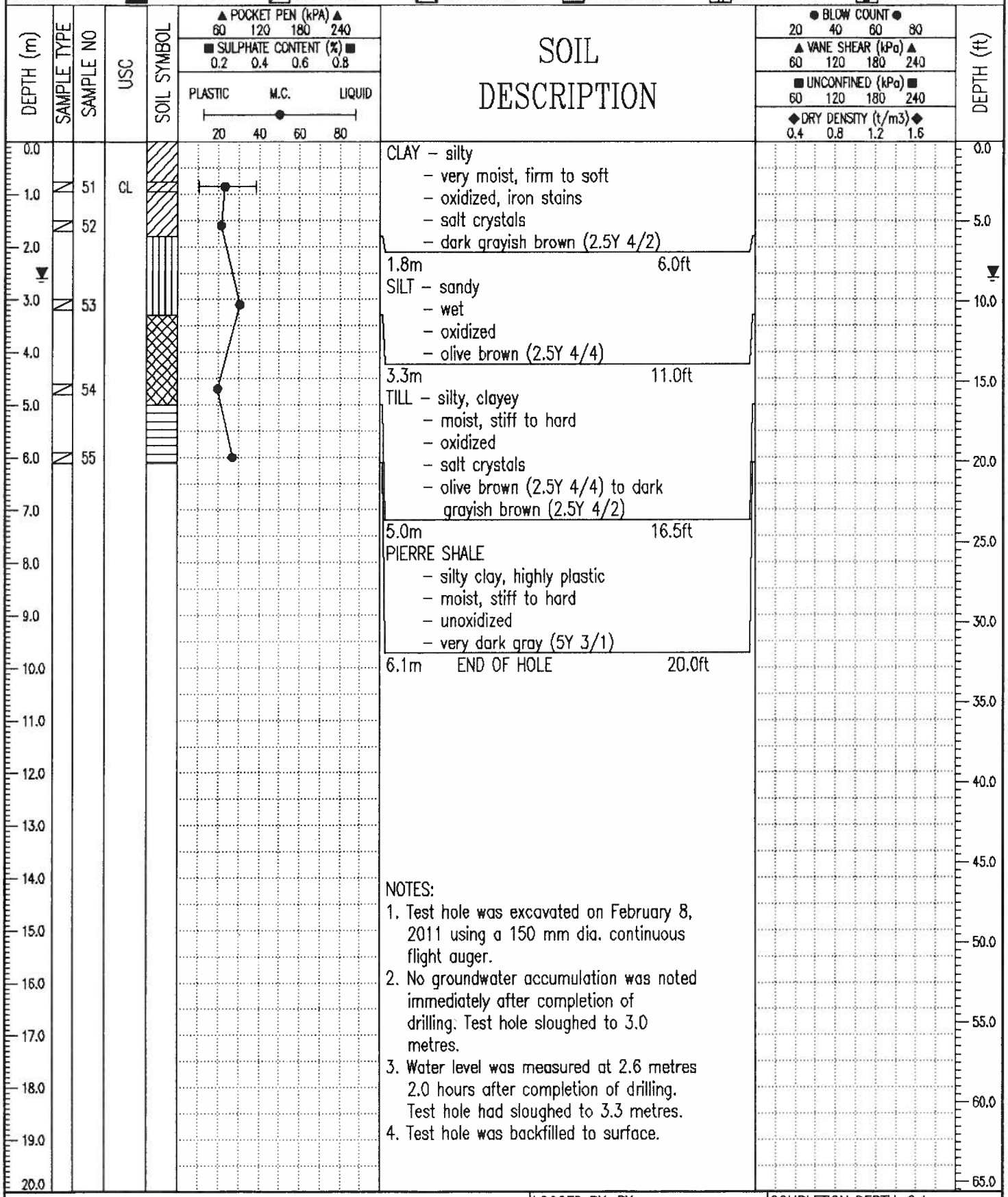
Regina, Saskatchewan

LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
REVIEWED BY: PW	COMPLETE: 11/02/07
Fig. No: GE-0603-16	Page 1 of 1

12/05/02 11:56AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575394.5 N; 13523692.2 E	TEST HOLE NO: 0603-TH211
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 574.3 metres (GEODETIC)	ELEVATION: 574.30 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE



CLAY – silty
- very moist, firm to soft
- oxidized, iron stains
- salt crystals
- dark grayish brown (2.5Y 4/2)

1.8m 6.0ft

SILT – sandy
- wet
- oxidized
- olive brown (2.5Y 4/4)

3.3m 11.0ft

TILL – silty, clayey
- moist, stiff to hard
- oxidized
- salt crystals
- olive brown (2.5Y 4/4) to dark grayish brown (2.5Y 4/2)

5.0m 16.5ft

PIERRE SHALE
- silty clay, highly plastic
- moist, stiff to hard
- unoxidized
- very dark gray (5Y 3/1)

6.1m END OF HOLE 20.0ft

NOTES:
1. Test hole was excavated on February 8, 2011 using a 150 mm dia. continuous flight auger.
2. No groundwater accumulation was noted immediately after completion of drilling. Test hole sloughed to 3.0 metres.
3. Water level was measured at 2.6 metres 2.0 hours after completion of drilling. Test hole had sloughed to 3.3 metres.
4. Test hole was backfilled to surface.

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Regina, Saskatchewan

LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
REVIEWED BY: PW	COMPLETE: 11/02/08
Fig. No: GE-0603-17	Page 1 of 1

12/05/02 11:58AM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575331.2 N; 13523772.9 E	TEST HOLE NO: 0603-TH212
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 574.2 metres (GEODETIC)	ELEVATION: 574.20 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	▲POCKET PEN (kPa)▲ 60 120 180 240 / ■SULPHATE CONTENT (%)■ 0.2 0.4 0.6 0.8 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	●BLOW COUNT● 20 40 60 80 / ▲VANE SHEAR (kPa)▲ 60 120 180 240 / ■UNCONFINED (kPa)■ 60 120 180 240 / ◆DRY DENSITY (t/m3)◆ 0.4 0.8 1.2 1.6	SLOTTED PIEZOMETER	PIEZOMETER BACKFILL	DEPTH (ft)
0.0						FILL – topsoil, strippings – moist – black (2.5Y 2/0) to very dark grayish brown (2.5Y 3/2)			Top of pipe 1.1 metres above grade. GRANULAR BENTONITE 0.9m	0.0
1.0	N	56								
		57				1.4m 4.5ft CLAY – silty – moist, stiff to firm – oxidized, iron stains – salt crystals – dark grayish brown (2.5Y 4/2)			1.5m SIL-8 SAND	5.0
2.0										
3.0		58				2.6m 8.5ft TILL – silty, clayey – moist, stiff to very stiff – salt crystals – oxidized, iron stains – olive brown (2.5Y 4/4)				10.0
4.0										
5.0		59				3.8m 12.5ft PIERRE SHALE – silty clay, highly plastic – moist, stiff to hard – unoxidized – very dark gray (5Y 3/1)			4.8m DRILL CUTTINGS	15.0
6.0	N	60				6.1m END OF HOLE 20.0ft			6.1m Top of pipe Elev.= 575.3m	20.0
7.0										25.0
8.0										
9.0										30.0
10.0										
11.0										35.0
12.0										
13.0									WATER LEVELS: (from top of pipe) February 8, 2011 Depth: Dry March 21, 2011 Depth: 4.4m Elev.= 570.9m	40.0
14.0										45.0
15.0										50.0
16.0						NOTES: 1. Test hole was excavated on February 8, 2011 using a 150 mm dia. continuous flight auger. 2. Piezometer was installed.				
17.0									TYPE OF PIPE: 50mm PVC, Schedule 40	55.0
18.0									TYPE OF PIEZOMETER: Standpipe	60.0
19.0									PIEZOMETER TIP: PVC slotted, 3.1m	
20.0										65.0

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LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
REVIEWED BY: PW	COMPLETE: 11/02/08
Fig. No: GE-0603-18	Page 1 of 1

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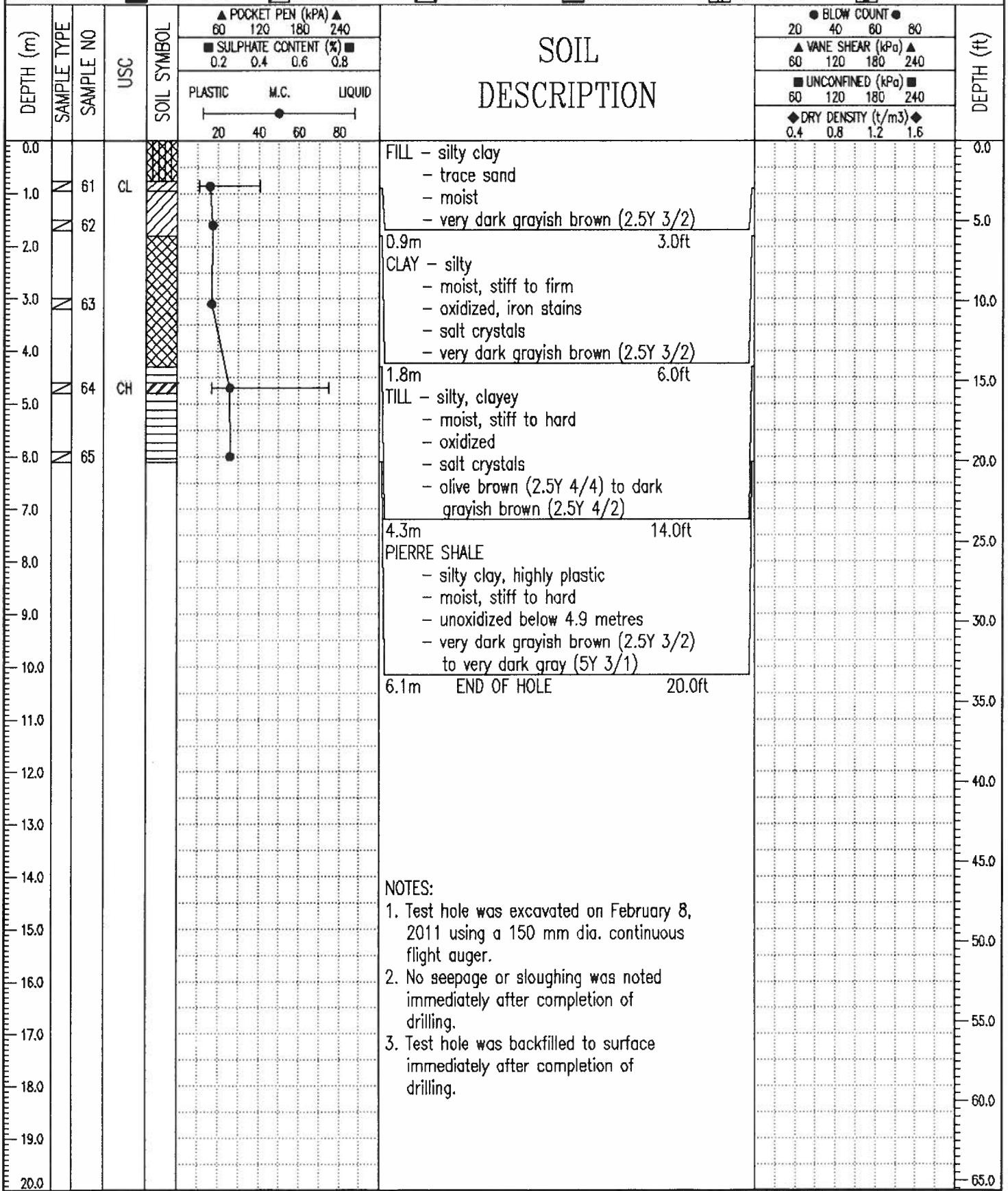
PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575271.1 N; 13523718.5 E	TEST HOLE NO: 0603-TH213
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 574.6 metres (GEODETIC)	ELEVATION: 574.60 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE



FILL – silty clay
- trace sand
- moist
- very dark grayish brown (2.5Y 3/2)

0.9m 3.0ft

CLAY – silty
- moist, stiff to firm
- oxidized, iron stains
- salt crystals
- very dark grayish brown (2.5Y 3/2)

1.8m 6.0ft

TILL – silty, clayey
- moist, stiff to hard
- oxidized
- salt crystals
- olive brown (2.5Y 4/4) to dark grayish brown (2.5Y 4/2)

4.3m 14.0ft

PIERRE SHALE
- silty clay, highly plastic
- moist, stiff to hard
- unoxidized below 4.9 metres
- very dark grayish brown (2.5Y 3/2) to very dark gray (5Y 3/1)

6.1m END OF HOLE 20.0ft

NOTES:
1. Test hole was excavated on February 8, 2011 using a 150 mm dia. continuous flight auger.
2. No seepage or sloughing was noted immediately after completion of drilling.
3. Test hole was backfilled to surface immediately after completion of drilling.

GROUND ENGINEERING LTD. Regina, Saskatchewan	LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: PW	COMPLETE: 11/02/08
	Fig. No: GE-0603-19	Page 1 of 1

12/05/02 12:01PM

PROJECT: PROP. SUBDIVISION EXTENSION	LOCATION: 575201.7 N; 13523772.2 E	TEST HOLE NO: 0603-TH214
CLIENT: CITY OF WEYBURN	LOCATION: WEYBURN, SASKATCHEWAN	PROJECT NO: GE-0603
DRILL RIG: BRAT 22 DIGGER	ELEVATION: 575.1 metres (GEODETIC)	ELEVATION: 575.10 (m)

SAMPLE TYPE: SHELBY TUBE | DISTURBED | SPT SAMPLE | PAIL SAMPLE | NO RECOVERY | JAR SAMPLE

DEPTH (m)	SAMPLE TYPE	SAMPLE NO	USC	SOIL SYMBOL	▲POCKET PEN (kPa)▲ 60 120 180 240 / ■SULPHATE CONTENT (%)■ 0.2 0.4 0.6 0.8 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	●BLOW COUNT● 20 40 60 80 / ▲VANE SHEAR (kPa)▲ 60 120 180 240 / ■UNCONFINED (kPa)■ 60 120 180 240 / ◆DRY DENSITY (t/m3)◆ 0.4 0.8 1.2 1.6	SLOTTED PIEZOMETER	PIEZOMETER BACKFILL	DEPTH (ft)
0.0						FILL – silty clay – trace sand – very moist – very dark grayish brown (2.5Y 3/2)			Top of pipe 1.1 metres above grade. GRANULAR BENTONITE	0.0
1.0	N	66							1.2m	5.0
		67				760mm 2.5ft CLAY – silty – moist, firm to stiff – oxidized, iron stains – salt crystals – very dark grayish brown (2.5Y 3/2)			1.5m SIL-9 SAND	
2.0										
3.0		68								10.0
4.0						1.8m 6.0ft TILL – silty, clayey – moist, stiff to hard – salt crystals – oxidized, iron stains – cobblestones at 4.3 metres – olive brown (2.5Y 4/4)			4.6m	
5.0		69							DRILL CUTTINGS	15.0
6.0	N	70				4.4m 14.5ft PIERRE SHALE – silty clay, highly plastic – moist, stiff to hard – unoxidized below 4.9 metres – very dark grayish brown (2.5Y 3/2) to very dark gray (5Y 3/1)			6.1m Top of pipe Elev.= 576.2m	20.0
7.0										25.0
8.0										
9.0										30.0
10.0										
11.0										35.0
12.0										40.0
13.0									WATER LEVELS: (from top of pipe) February 8, 2011 Depth: Dry March 21, 2011 Depth: Dry	45.0
14.0										
15.0										50.0
16.0						NOTES: 1. Test hole was excavated on February 8, 2011 using a 150 mm dia. continuous flight auger. 2. Piezometer was installed.				
17.0									TYPE OF PIPE: 50mm PVC, Schedule 40	55.0
18.0									TYPE OF PIEZOMETER: Standpipe	60.0
19.0									PIEZOMETER TIP: PVC slotted, 3.1m	
20.0										65.0

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Regina, Saskatchewan

LOGGED BY: RY	COMPLETION DEPTH: 6.1 m
REVIEWED BY: PW	COMPLETE: 11/02/08
Fig. No: GE-0603-20	Page 1 of 1

12/05/02 12:01PM

APPENDIX A

3300 - 1 DESCRIPTION

1.01 The work shall consist of spreading and compacting screened or crushed aggregate on a prepared surface.

1.02 The following definitions shall apply for this specification:

(a) Mean:

The arithmetic average of a set of 'n' test results constituting the sample.

(b) Moving average:

The arithmetic mean of 3 consecutive test results.

(c) Sub-base aggregate:

The aggregate before mixing, when binder is to be added or the aggregate before spreading and compacting, when no binder is to be added.

(d) Sub-base mix:

The sub-base aggregate after mixing with binder and water but before spreading and compacting.

(e) Sub-base course:

The sub-base aggregate or sub-base mix in place on the road during and after spreading and compacting.

3300 - 2 MATERIALS

Aggregate

2.01 Sub-base aggregate shall be composed of sound, hard, and durable particles of sand, gravel and rock free from injurious quantities of soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.

3300 - 3 CONSTRUCTION

General

3.01 (a) Sub-base course shall comply with the requirements listed in Table 1:

TABLE 1

Sieve Designation	Percent By Weight Passing Canadian Metric Sieve Series		
	TYPE		
	6	8	10
50.0 mm	100.0	100.0	100.0
2.0 mm	0 - 80.0	0 - 90.0	
400 um	0 - 45.0	0 - 60.0	
160 um	0 - 20.0	0- 25.0	
71 um	0 - 6.0	0 - 15.0	0 - 20.0
Plasticity Index (all types)	0 - 6.0		

(b) A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 63.0 mm sieve.

3.02 The following shall apply to Department owned or controlled aggregate sources shown on the plans or as described in the Special Provisions:

(a) Overburden shall be removed from material deposits in accordance with Specification 2260 For Removal Of Overburden.

(b) Stockpiles shall be constructed in accordance with Specification 3600 For Stockpiling Aggregates.

3.03 Binder, filler and blender sand shall be provided in accordance with Specification 3400 For Binder, Filler And Blender Sand.

3.04 Sub-base aggregate shall be pushed to a trap or into a stockpile prior to screening.

Processing

3.05 The production of sub-base course shall comply with the following:

(a) The Contractor shall cease operations if the moving average for any sieve does not comply with the specified requirements listed in Table 1.

(b) Operations shall not recommence until the specified requirements are met.

(c) Upon recommencement of operations, the specified requirements shall be met on each of the initial 2 tests.

(d) Failure to cease operations shall subject all subsequent materials to the requirements of General Provision 1400-7 (Unacceptable and Unauthorized Work).

Spreading and Compacting

3.06 The thickness of a compacted lift of sub-base course shall not exceed 120 mm. The lift thickness may be increased if the Contractor can demonstrate that with the use of vibratory compaction equipment and construction procedures, the compaction requirements can be achieved for lifts greater than 120 mm.

3.07 Sub-base courses shall be compacted until no further settlement is apparent and the particles are well keyed into place. The sub-base course shall be free from any rutting or deformations before the placement of the next course.

3.08 If excess moisture originating from external causes including but not limited to precipitation and/or Contractor's operation is present in the sub-base course and/or underlying material prior to the acceptance of the completed surfacing structure; the Contractor shall dry the sub-base course and/or the underlying material to the optimum moisture content and compact the sub-base and/or the underlying material to not less than the specified density or the optimum density in accordance with the requirements for Moisture-Density Proctor (STP 205-5).

Stabilizing

3.09 If the sub-base course proves to be unstable, the Engineer shall require the Contractor to stabilize the sub-base aggregate by one or a combination of the following methods:

(a) By the addition of binder or filler at the aggregate source or at the screening plant. The binder or filler shall be added and thoroughly distributed throughout the aggregate until a homogeneous mixture is obtained.

(b) By the addition of crushed aggregate on the road.

(c) By the addition of emulsified asphalt to the compaction water in the proportions designated by the Engineer. The Department shall supply the asphalt.

(d) Any other method proposed by the Contractor and approved by the Engineer.

Seasonal Shutdown

3.10 If work must be carried over from one construction season to the next, there shall be no exposed sub-base aggregate, mix or sub-base course remaining on the road unless covered by a lift of base course.

3300-4 SAMPLING AND TESTING

General

4.01 Unless otherwise specified, test procedures shall be in accordance with Saskatchewan Highways and Transportation's Standard Test Procedures Manual.

4.02 The test procedures in effect on the closing date of the tenders shall apply.

3300 - 5 MEASUREMENT

5.01 Sub-base course shall be measured in tonnes.

3300 - 6 PAYMENT

6.01 Payment for Sub-base Course shall be at the contract unit price per tonne. The contract unit price shall be full compensation for completing the work except for those activities for which specific provision for payment is made in this section.

6.02 If the contract includes a bid item for:

(a) Hauling Sub-base Course and Hauling Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

(b) Watering; payment shall be made in accordance with Specification 2500 For Watering.

(c) Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 3400 For Binder, Filler And Blender Sand.

(d) Granular Base Course; payment for Granular Base Course used as stabilizing agent shall be at the contract unit price For Granular Base Course.

(e) Prime, Tack or Flush Coat; payment for emulsified asphalt used as stabilizing agent shall be the contract unit price for Prime, Tack and Flush Coat.

3505 - SPECIFICATION FOR GRANULAR BASE COURSE

3505 - 1 DESCRIPTION

1.01 The work shall consist of spreading and compacting crushed and pugmilled aggregate on a prepared surface.

1.02 The following definitions shall apply:

(a) Acceptance limit:

The maximum or minimum value for a test result above or below which the section of roadway shall be rejected.

(b) Acceptance testing:

The testing performed to determine compliance with the specification regarding certain requirements, limits and tolerances for the quality of materials and workmanship to be supplied.

(c) Base aggregate:

The aggregate before pugmilling.

(d) Base mix:

The mix after pugmilling, but before spreading.

(e) Base course:

The mix in place on the road during and after spreading and compacting.

(f) Mean:

The arithmetic average of a set of 'n' test results constituting the sample.

(g) Moving average:

The arithmetic mean of 3 consecutive test results.

(h) Surface defects:

Surface defects that are due to the Contractor's operation shall include but shall not be limited to the following:

(i) Potholing.

(ii) Surface failures.

(iii) Ravelling.

(iv) Rutting.

(v) Bumps or dips.

(vi) Irregular cross slopes.

(vii) Segregation.

3505 - 2 MATERIALS

Aggregate

2.01 Base aggregate shall be composed of sound, hard and durable particles of sand, gravel and rock free from injurious quantities of elongated, soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.

3505 - 3 CONSTRUCTION

General

3.01 (a) Base course shall comply with the requirements listed in Table 1.

TABLE 1

SIEVE DESIGNATION	PERCENT BY WEIGHT PASSING CANADIAN METRIC SIEVE SERIES		
	TYPE		
	31	33	35
31.5 mm	100.0		
18.0 mm	75.0 - 90.0	100.0	100.0
12.5 mm	65.0 - 83.0	75.0 - 100.0	81.0 - 100.0
5.0 mm	40.0 - 69.0	50.0 - 75.0	50.0 - 85.0
2.0 mm	26.0 - 47.0	32.0 - 52.0	32.0 - 65.0
900 um	17.0 - 32.0	20.0 - 35.0	20.0 - 43.0
400 um	12.0 - 22.0	15.0 - 25.0	15.0 - 30.0
160 um	7.0 - 14.0	8.0 - 15.0	8.0 - 18.0
71 um	6.0 - 11.0	6.0 - 11.0	7.0 - 12.0
Plasticity Index	0 - 7.0	0 - 6.0	0 - 5.0
Fractured Face %	50.0 Minimum		
Light Weight Pieces %	5.0 Maximum		

(b) A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 40.0 mm sieve for Type 31 base course and the 22.4 mm sieve for Types 33 and 35 base course.

3.02 The following shall apply to Department owned or controlled aggregate sources shown on the plans or as described in the Special Provisions:

(a) Overburden shall be removed from material deposits in accordance with Specification 2260 For Removal Of Overburden.

(b) Rock passing a 450 mm square opening screen and larger than the maximum specified size shall be crushed and incorporated simultaneously throughout the crushing operation.

(c) Stockpiles shall be constructed in accordance with Specification 3600 For Stockpiling Aggregates.

3.03 Binder, filler, and blender sand shall be provided in accordance with Specification 3400 For Binder, Filler And Blender Sand.

3.04 Binder, filler and blender sand shall be added using a separate conveyor system.

3.05 Binder, filler and blender sand feeds shall be accurately controlled and coordinated.

Reject Aggregate

3.06 If the Contractor is required to reject a fraction of the raw aggregate to meet the aggregate requirements in Table 1, the following shall apply:

(a) The raw aggregate shall be screened over a maximum 9.0 mm square opening screen or a 5.0 mm slotted screen prior to crushing.

(b) The Contractor shall be responsible for the rejected material up to a maximum of 10% of the raw aggregate by weight.

(c) The quantity of raw aggregate shall be calculated as follows:

Raw aggregate = (Granular base course less binder, filler and blender sand) x 1.11

Processing

3.07 Base mix production shall comply with the following requirements during the pugmilling stage:

(a) The Contractor shall cease operations if the moving average for any sieve does not comply with the specified requirements listed in Table 1.

(b) Operations shall not recommence until the specified requirements are met.

(c) Upon recommencement of operations, the specified requirements shall be met on each of the initial 2 tests.

(d) Failure to cease operations shall subject all subsequent materials to the requirements of General Provision 1400-7 (Unacceptable and Unauthorized Work).

3.08 Base aggregate shall be stockpiled after the crushing operation and prior to the pugmilling.

3.09 During pugmilling operations, the Contractor shall have sufficient base aggregate in stockpile for at least 24 h of pugmilling operation until crushing is completed.

3.10 Pugmilling shall be performed in a stationary mixing plant. The mixing unit shall be designed to ensure complete mixing of the materials.

3.11 The pugmill shall be equipped with spray bars for the addition of water.

3.12 The moisture content of the base mix shall not be greater than 5 % by weight when it leaves the pugmill.

Spreading And Compacting

3.13 Base mix shall be spread on dry and unfrozen surfaces.

3.14 Base mix shall not be compacted if the atmospheric temperature is less than 2 °C.

3.15 Base course spilled on new asphalt concrete shall be removed immediately.

3.16 The finished surface of the base course shall be true to grade and cross section and free of any surface defects.

3.17 If specified in the Special Provisions or shown on the plans, a prime coat shall be placed on the finished final lift of base course in accordance with Specification 4000 For Bituminous Prime, Tack, And Flush Coat. Prime coat shall be placed within 24 h, weather permitting, after receiving written authorization from the Engineer.

3.18 If a seal coat is specified for shoulder base course, the surface of the final lift of shoulder base course shall be constructed 10 mm below the surface of the final lift of the wearing course.

3.19 If excess moisture originating from external causes including but not limited to precipitation and/or Contractor's operation is present in the subgrade and/or sub-base course and/or base course prior to the acceptance of the completed surfacing structure; the Contractor shall dry the subgrade and/or sub-base course and/or base course to the optimum moisture content and compact the subgrade and/or sub-base course and/or base course to not less than the specified density or the optimum density in accordance with the requirements for Moisture-Density Proctor (STP 205-5).

Seasonal Shutdown

3.20 If work must be carried over from one construction season to the next and the number of working days/completion date have not expired, the following shall apply:

(a) For accepted final lift of base course on which a wearing course has not been placed, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Department shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course up to a maximum length of 1.5 km.

(iii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course on all other sections outside the 1.5 km limit. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iv) When work resumes, the Department shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on the 1.5 km limit.

(v) When work resumes, the Contractor shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all other sections outside the 1.5 km limit.

(b) For unaccepted base course and accepted lower lifts of base course, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Department shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course up to a maximum length of 1.5 km.

(iii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course on all other sections outside the 1.5 km limit. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iv) When work resumes, the Department shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on the 1.5 km limit.

(v) When work resumes, the Contractor shall bear the cost of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all other sections outside the 1.5 km limit.

3.21 If work must be carried over from one construction season to the next and the number of working days/completion date have expired, the following shall apply:

(a) For accepted final lift of base course on which a wearing course has not been placed, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Department shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course up to a maximum length of 1.0 km.

(iii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course on all other sections outside the 1.0 km limit. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iv) When work resumes, the Contractor shall bear the costs of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all sections of base course.

(b) For unaccepted base course and accepted lower lifts of base course, the following shall apply:

(i) At the time seasonal operations cease, a prime coat, seal coat, or asphalt concrete shall be placed on the full width of base course as directed by the Engineer.

(ii) The Contractor shall bear all the costs including materials for placing the prime coat, seal coat, and asphalt concrete on the full width of base course. The Contractor may remove the base course in lieu of placing a prime coat, seal coat or asphalt concrete on it.

(iii) When work resumes, the Contractor shall bear the costs of removing the prime coat, seal coat, and asphalt concrete if required and remedying unacceptable base course including replacing the prime and prime materials on all sections of base course.

3.22 The Contractor shall bear the cost of maintenance, except snow and ice removal, on sections of roadway where the road surface has been disturbed by the construction operations.

3505 - 4 SAMPLING AND TESTING

General

4.01 Unless otherwise specified, test procedures shall be in accordance with Saskatchewan Highways and Transportation's Standard Test Procedures Manual.

4.02 The test procedures in effect on the closing date of the tenders shall apply.

Acceptance Testing

4.03 Upon notification from the Contractor that a section of the roadway has been inspected and is ready for acceptance testing, the Engineer shall carry out the required tests for density and surface defects.

Acceptance Testing for Density

4.04 The maximum density value and the corresponding optimum moisture content shall be determined in accordance with the requirements for Moisture-Density Proctor (STP 205-5).

4.05 Densities shall not be taken at locations within 0.5 m of an unsupported edge and 0.1 m of a supported edge.

4.06 Acceptance testing for density of the base course on the road shall be determined in accordance with the requirements for Density-In-Place By Nuclear Gauge (STP 205-7).

4.07 Frequency and locations of testing on any section shall be at the discretion of the Engineer.

3505 - 5 ACCEPTANCE OR REJECTION

5.01 The section of base course shall be considered acceptable if it contains no surface defects and if:

(a) The average density meets or exceeds 100 % of maximum density.

(b) All individual test results are greater than 98 % of maximum density.

(c) The moisture content is less than or equal to the optimum moisture content.

5.02 If shoulder base course is placed in a separate operation and shoulder base course is the final wearing course; the section of shoulder base course shall be considered acceptable if it contains no surface defects and if:

(a) The average density meets or exceeds 95.0 % of maximum density.

(b) All individual test results are greater than 93.0 % of maximum density.

(c) The moisture content is less than or equal to the optimum moisture content.

Product Rejection

5.03 If the densities for any section of the roadway are outside the acceptance limits outlined in Sections 5.01 and 5.02, the section shall be rejected as unacceptable work and the following shall apply:

(a) The Contractor shall have the opportunity to remedy existing base course by rerolling or by any other method suggested by the Contractor and approved by the Engineer. The Contractor may request that the section of the roadway be retested during or after the completion of the remedial attempts.

(b) The section shall be tested a total of 3 times free of cost to the Contractor. The Contractor shall pay the cost of any additional testing. The rate for the Department testing shall be as designated in the Special Provisions.

(c) If the base course in the section remains outside the acceptance limits after the remedial attempts, the Contractor shall remove and replace all the base course in that section. The Engineer may approve a base course overlay of equal thickness in lieu of removing and replacing the base course.

5.04 Any section with surface defects shall be rejected as unacceptable work.

Repairs

5.05 Surface defects shall be repaired in a manner acceptable to the Engineer.

3505 - 6 MEASUREMENT

6.01 Granular base course shall be measured in tonnes.

6.02 Reject aggregate shall be measured by the cross section method. The volume of reject shall be multiplied by 1.7 to calculate tonnes.

3505 - 7 PAYMENT

7.01 Payment for Granular Base Course and Granular Shoulder Base Course shall be at the contract unit price per tonne. The unit price shall be full compensation for completing the work except for those activities for which specific provision for payment is made in this section.

7.02 The rate that the Department shall pay for rejecting aggregate in excess of 10% shall be as designated in the Special Provisions of the contract.

7.03 If the contract includes a bid item for:

(a) Hauling Granular Base Course, Hauling Granular Shoulder Base Course and/or Hauling Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

(b) Watering; payment shall be made in accordance with Specification 2500 For Watering.

(c) Binder, Filler And Blender Sand; payment shall be made in accordance with Specification 3400 For Binder, Filler And Blender Sand.

(d) Prime, Tack or Flush Coat; payment shall be made in accordance with Specification 4000 For Bituminous Prime, Tack And Flush Coat.

7.04 All remedial work shall be performed at the Contractor's expense including the cost of materials.

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Transportation

4100 – SPECIFICATION FOR ASPHALT CONCRETE

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TABLES

4100.1 GENERAL

4100.1.1 Description

4100.1.1.1 The work shall consist of mixing crushed aggregates, or a combination of crushed aggregates and reclaimed asphalt concrete, blender sand material as required, additives as required, and asphalt in a hot mix plant; and spreading and compacting the mixture on a prepared surface.

4100.1.2 Definitions

4100.1.2.1 The following definitions shall apply for this specification:

4100.1.2.1.1 Acceptance Limit is the maximum or minimum value for a test result above or below which the block and/or lot will be rejected.

4100.1.2.1.2 Acceptance Testing is the testing performed by the Engineer to determine compliance with the specifications regarding specified requirements, limits and tolerances for the quality of materials and workmanship supplied.

4100.1.2.1.3 Adjusted PrI is the adjusted profile results for smoothness in a block in which individual bumps and dips greater than 12 mm have been removed. The adjusted PrI in a block will be recalculated by removing the individual PrI results corresponding to the location of individual bumps and dips that are greater than 12 mm.

4100.1.2.1.4 Asphalt is the asphalt material being added as bituminous binder.

4100.1.2.1.5 Asphalt Concrete is the asphalt mix in place on the road including levelling and surface courses during and after spreading and compacting.

4100.1.2.1.6 Asphalt Mix is the mix after the asphalt mix aggregate and asphalt have been blended together.

4100.1.2.1.7 Asphalt Mix Aggregate is the aggregate after combining all virgin aggregates, additives and reclaimed asphalt concrete aggregate.

4100.1.2.1.8 Asphalt Mix Design is the laboratory determination of the precise proportions of asphalt, reclaimed asphalt concrete, additives, and all virgin aggregates to be blended together to meet the specified properties for the asphalt mix.

4100.1.2.1.9 Asphalt Mix Formula is the field determination during the plant calibration process of the precise proportions of asphalt, reclaimed asphalt concrete, additives, and all virgin aggregates to be blended together to meet the specified properties for the asphalt mix as produced at the plant.

4100.1.2.1.10 Block is the unit of measurement for assessing smoothness and individual bumps and dips. A block is a portion of the final lift of asphalt concrete that is one paver width wide and 100 m long. The first and last block on a construction section may be less than 100 m long.

4100.1.2.1.11 Density

4100.1.2.1.11.1 Asphalt Mix Design Density is the Marshall density for the compacted Asphalt Mix Design specimen (see 4100.1.2.1.8 above).

4100.1.2.1.11.2 Asphalt Mix Formula Density is the Marshall density for the compacted Asphalt Mix Formula specimen (see 4100.1.2.1.9 above).

4100.1.2.1.11.3 Field Density is the density of the Asphalt Concrete as determined by STP 204 – 6, Density-In-Place By Nuclear Gauge.

4100.1.2.1.11.4 Job Mix Formula Density is the Marshall density for the compacted Job Mix Formula specimen (see 4100.1.2.1.13 below).

4100.1.2.1.11.5 Specified Marshall Density is 97% of the 3-point moving average Marshall Density established for the Asphalt Mix Formula or the Job Mix Formula, whichever is in use.

4100.1.2.1.11.6 Target Density is the density established through the rolling pattern strip when the Specified Marshall Density is not achievable.

4100.1.2.1.12 Individual Bump And/Or Dip is a bump or dip measured in the vertical direction that exceeds 12 mm.

4100.1.2.1.13 Job Mix Formula is the field determination of the precise proportions of asphalt, reclaimed asphalt concrete, additives, and all virgin aggregates to be blended together to meet the specified properties for the asphalt mix as produced at the plant.

4100.1.2.1.14 Lot is approximately 200 tonnes of asphalt concrete which is assessed as a unit for the purpose of payment and selected to represent work produced by essentially the same process and materials. The final lot on a project may vary in mass from 101 t to 300 t.

4100.1.2.1.15 Mean is the arithmetic average of the test results within a lot.

4100.1.2.1.16 Moving Average is the arithmetic mean of 3 consecutive test results.

4100.1.2.1.17 Profile Index (PrI) is the sum of the vertical deviations, in millimetres, outside the 5 mm null band that a roadway deviates from a perfectly flat surface over a horizontal distance of 100 m. The PrI categories are as follows:

4100.1.2.1.17.1 Category I PrI applies to all blocks not identified below as Category II PrI.

4100.1.2.1.17.2 Category II PrI applies to the following circumstances:

4100.1.2.1.17.2.1 Curves with radius less than 600 m;

4100.1.2.1.17.2.2 Blocks within 50 m of a bridge or railway crossing;

4100.1.2.1.17.2.3 Single lift rehabilitation projects where the total thickness of asphalt concrete being placed is 50 mm or less, with the exception of profiled-milled sections;

4100.1.2.1.17.2.4 Areas where there is curb and gutter; and

4100.1.2.1.17.2.5 The block at each construction limit.

4100.1.2.1.18 Reclaimed Asphalt Concrete is asphalt concrete reclaimed from the roadway.

4100.1.2.1.19 Reclaimed Asphalt Concrete Aggregate is the aggregate remaining after the asphalt has been extracted from the Reclaimed Asphalt Concrete.

4100.1.2.1.20 Repair

4100.1.2.1.20.1 Class I Repair is a corrective improvement that removes and replaces, or overlays the defective or damaged block(s) or lot(s) and restores the block(s) or lot(s) to the specified standard.

4100.1.2.1.20.2 Class II Repair is a surface treatment that mends or corrects a structural defect to restore the surface to an acceptable standard (e.g. slurry seal).

4100.1.2.1.20.3 Class III Repair is a surface treatment that mends or corrects a surface defect but does not restore the surface to an acceptable standard (e.g. flush coat).

4100.1.2.1.20.4 Class IV Repair is a corrective improvement to the ride by reducing bump(s) and/or dip(s). An acceptable Class IV repair is one which removes or reduces the bump(s) and/or dip(s) through a smooth transition to the surrounding asphalt concrete without impairing the functionality and/or structural characteristics in the area of the bump(s) and/or dip(s).

4100.1.2.1.21 Segregated Area is an area 0.1 m^2 or greater where the surface texture is either too stony or lacking in continuous matrix of asphalt, fine aggregate and coarse aggregate in relation to the surrounding acceptable asphalt concrete.

4100.1.2.1.22 Segregation Severity

4100.1.2.1.22.1 None means a completely uniform surface texture. The matrix of asphalt and fine aggregate is in place between the coarse aggregate.

4100.1.2.1.22.2 Minor means significantly more stone is visible than in the surrounding acceptable asphalt concrete, usually with a lack of continuous contact with the surrounding matrix.

4100.1.2.1.22.3 Severe means areas that usually appear as very stony mix, with stone against stone, and may be missing matrix.

4100.1.2.1.23 Smoothness means the surface profile of the asphalt concrete with the Profile Index (PrI) as the measured output. Individual bumps and/or dips of 12 mm or less are considered a part of smoothness.

4100.1.2.1.24 Surface Defects that are due to the Contractor's operation shall include, but shall not be limited to the following:

4100.1.2.1.24.1 Areas of segregation less than 0.1 m^2;

4100.1.2.1.24.2 Areas containing excess or insufficient asphalt;

4100.1.2.1.24.3 Areas of open texture;

4100.1.2.1.24.4 Improper matching of longitudinal and transverse joints on final lift of asphalt concrete;

4100.1.2.1.24.5 Roller marks on final lift of asphalt concrete;

4100.1.2.1.24.6 Cracking or tearing;

4100.1.2.1.24.7 Contamination by diesel, hydraulic fluids, detergent or other harmful products;

4100.1.2.1.24.8 Foreign objects or materials that are detrimental to the asphalt concrete; and

4100.1.2.1.24.9 Clay balls or oversized materials.

4100.2 MATERIALS

4100.2.1 Asphalt

4100.2.1.1 The Department will supply and pay for the asphalt.

4100.2.2 Aggregate

4100.2.2.1 Virgin aggregate shall be composed of sound, hard and durable particles of sand, gravel and rock, free from injurious quantities of elongated, soft or flaky particles, shale, clay, loam, ironstone, coal and organic or other deleterious material.

4100.2.3 Anti-Stripping Agents

4100.2.3.1 The Department will supply and pay for the anti-stripping agents.

4100.3 CONSTRUCTION

4100.3.1 Department Owned or Controlled Aggregate Sources

4100.3.1.1 The following shall apply to Department owned or controlled aggregate sources shown on the plans or as described in the Special Provisions:

4100.3.1.1.1 Overburden shall be removed from material deposits in accordance with Specification 2260 For The Removal Of Overburden.

4100.3.1.1.2 Rock passing a 610 mm square opening screen and larger than the maximum specified size shall be crushed and incorporated simultaneously throughout the crushing operation.

4100.3.1.1.3 Aggregate stockpiles shall be constructed in accordance with Specification 3600 For Stockpiling Aggregates.

4100.3.2 Binder, Filler and Blender Sand

4100.3.2.1 Filler and blender shall be provided in accordance with Specification 3400 For Binder, Filler And Blender Sand.

4100.3.3 Anti-Stripping Agents

4100.3.3.1 The Department will determine whether or not anti-stripping agent is required.

4100.3.3.2 When the Department has determined that anti-stripping agent is required, the Engineer will determine if hydrated lime or liquid anti-stripping agent shall be used.

4100.3.3.3 Hydrated Lime

4100.3.3.3.1 When hydrated lime is used, the following shall apply:

4100.3.3.3.1.1 The Contractor shall supply the equipment necessary to add the lime.

4100.3.3.3.1.2 The hydrated lime shall be blended by a pugmill into the cold aggregate feed.

4100.3.3.3.1.3 Sufficient water shall be added at the pugmill to ensure a minimum of 3% moisture content in the aggregate.

4100.3.3.3.1.4 The amount of hydrated lime added shall be approximately 1% of the total dry aggregate by weight, or as designated by the Engineer, for the Job Mix Formula.

4100.3.3.3.1.5 The Contractor shall ensure the procedures and equipment used for the addition of hydrated lime anti-stripping agent are adequate to ensure that the hydrated lime is added at a uniform consistent rate.

4100.3.3.3.1.6 The Contractor shall maintain records containing bills of lading, estimated quantities on hand, estimated quantities used, and at the completion of the project, the estimated unused quantity. The record of estimated usage shall be provided to the Engineer on a daily basis.

4100.3.3.3.1.7 At the end of the project the bulk measurement of the hydrated lime used on the project shall not deviate by more than 25% from the specified percentage designated by the Job Mix Formula. If the final amount of hydrated lime used on the project exceeds 125% of the specified percentage designated by the Job Mix Formula, the Department will deduct the cost of the hydrated lime used in excess of 125% from the Final Progressive Estimate. If the final amount of hydrated lime used on the project is less than 75% of the specified percentage designated by the Job Mix Formula, the Contractor shall perform at his expense a Class I repair on the asphalt concrete in a manner acceptable to the Engineer.

4100.3.3.4 Liquid Anti-Stripping Agent:

4100.3.3.4.1 When a liquid anti-stripping agent is used, the following shall apply:

4100.3.3.4.1.1 The Contractor shall supply the equipment necessary to add a liquid anti-stripping agent.

4100.3.3.4.1.2 The addition of liquid anti-stripping agent shall be accomplished through the use of a liquid anti-strip injection system containing a positive displacement pump with a variable speed motor, a totalizing flow meter, a sampling valve, a system check valve, a system isolation valve and an inline check valve. The injector pump motor shall be regulated by a signal from the asphalt flow meter.

4100.3.3.4.1.3 Liquid anti-stripping agent will be injected into the plant asphalt line just prior to entry into the drum mixer.

4100.3.3.4.1.4 The system shall be capable of regulating the flow rate resulting in consistent flow rate of liquid anti-stripping agent.

4100.3.3.4.1.5 The system shall be capable of re-circulating the liquid anti-stripping agent to the storage tank until the asphalt plant bypass valve is actuated.

4100.3.3.4.1.6 Liquid anti-stripping agent shall be added at a rate of approximately 1.0% of the weight of liquid asphalt added, or as designated by the Engineer, for the Job Mix Formula.

4100.3.3.4.1.7 The Contractor shall maintain records containing bills of lading, estimated quantities on hand, estimated quantities used, damaged barrels, and at the completion of the project, any estimated quantities of unused anti-stripping agent. The Contractor shall provide the record of estimated usage to the Engineer on a daily basis.

4100.3.3.4.1.8 At the end of the project the bulk measurement of the liquid anti-stripping agent used on the project shall not deviate by more than 10% from the specified percentage designated by the Job Mix Formula. If the final amount of liquid anti-stripping agent used on the project exceeds 110% of the specified percentage designated by the Job Mix Formula, the Department will deduct the cost of the liquid anti-stripping agent used in excess of 110% from the Final Progressive Estimate. If the final amount of liquid anti-stripping agent used on the project is less than 90% of the specified percentage designated by the Job Mix Formula, the Contractor shall perform at his expense a Class I repair on the asphalt concrete.

4100.3.3.4.1.9 The Contractor shall handle all barrels of liquid anti-stripping agent in such a manner that they can be returned to the supplier. The full cost of any barrels damaged such that they cannot be returned to the supplier, or any environmental clean-up required, will be charged back to the Contractor, and deducted from the Final Progressive Estimate. If the Contractor uses liquid anti-stripping in bulk, the full cost of any environmental clean-up required will be charged back to the Contractor and deducted from the Final Progressive Estimate.

4100.3.4 Aggregate

4100.3.4.1 The Contractor shall split the aggregate into 3 separate stockpiles in accordance with the following:

4100.3.4.1.1 The natural fines stockpile shall be produced by screening the raw aggregate over a maximum 9.0 mm square opening screen or 5.0 mm slotted screen prior to crushing.

4100.3.4.1.2 The aggregate retained on the screen shall be crushed and split into crushed coarse and crushed fine stockpiles.

4100.3.4.1.3 The crushed coarse stockpile shall contain no more than 10% of the material passing the 5.0 mm square opening sieve.

4100.3.4.1.4 The crushed fine stockpile shall contain no less than 90% of the material passing the 5.0 mm square opening sieve.

4100.3.4.1.5 The Contractor shall provide accurate measurements of quantities and percentages of aggregate being placed in each stockpile after producing 50% of the aggregate or 10 000 t, whichever is greater; or when all the aggregate is produced if the total quantity is less than 10 000 t. If the splits provided by the Contractor prove to be inaccurate and result in an aggregate shortage, securing additional equivalent aggregate shall be at the Contractor's expense.

4100.3.4.2 The crushed coarse, crushed fines, and natural fines stockpiles shall be mathematically recombined at the percentages provided by the Contractor. If the resulting aggregate does not meet the requirements of Table 4100.3.T1, the Contractor shall be required to reject a fraction of the material in the natural fines stockpile in accordance with General Provision 1500.2.8.

4100.3.4.3 If recycled asphalt concrete is designated in the contract, the following shall apply:

4100.3.4.3.1 The reclaimed asphalt concrete shall not exceed 40 mm when measured in any direction before entering the plant.

4100.3.4.3.2 The crushed coarse, crushed fines, natural fines and reclaimed asphalt concrete stockpiles shall be mathematically recombined at the percentages provided by the Contractor. If the resulting aggregate does not meet the requirements of Table 4100.3.T1, the Contractor shall be required to reject a fraction of the material in the natural fines stockpile in accordance with General Provision 1500.2.8.

4100.3.5 Asphalt Mix Design

4100.3.5.1 The asphalt mix design will be established by the Engineer in accordance with the requirements for Marshall Mix Design (STP 204-10) within 10 calendar days after 50% of the aggregate has been produced or 10 000 t, whichever is greater, and provided that the Contractor has complied with Section 4100.3.4.1.5.

4100.3.5.2 Further to Section 4100.3.4.1.5, if the Department is required to do an additional mix design because the splits provided by the Contractor prove to be inaccurate, the Contractor will be assessed the rate specified in the Special Provisions.

4100.3.5.3 The asphalt mix design type will be specified in the Special Provisions. The asphalt mix characteristics shall meet the requirements in Table 4100.3.T1.

TABLE 4100.3.T1

ASPHALT CONCRETE MIX DESIGN TYPES AND CHARACTERISTICS

Mix Design Type/ Design Factors -Mix Characteristics	1	2	3	4	5	6
Asphalt Type	150-200 A or 200-300 A			150-200 A or 200-300 A		
Marshall Blows	50 blows			75 blows		
Aggregate Type/Sieve Designation*	70 or 70 R	71 or 71 R	72 or 72 R	70 or 70 R	71 or 71 R	72 or 72 R
18.0 mm	100.0			100.0		
16.0 mm	78.0 – 98.0	100.0		78.0-98.0	100.0	
12.5 mm	68.0 – 92.0	78.0 – 98.0	100.0	68.0 – 92.0	78.0 – 98.0	100.0
9.0 mm	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0
5.0 mm	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0
2.0 mm	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0
900 um	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0
400 um	5.0 – 25.0	10.0 -- 27.0	10.0 -- 27.0	5.0 – 25.0	10.0 – 27.0	10.0 – 27.0
160 um	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0
71 um	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0
Air Voids, %	3.0 – 5.0					
Air Voids (Field), %	4.0 – 9.0					
Deleterious Material, Maximum % **	2.0					
Film Thickness, Minimum um	7.5					
Flow, mm	1.5 – 3.5					
Fracture, Minimum % ***	60.0	70.0	80.0	75.0	85.0	95.0
Lightweight Aggregate, Maximum %	1.0					
Retained Stability, Minimum %	70.0					
Sand Equivalent, Minimum	45					
Stability, Minimum N	5500			7000		
Voids Filled, %	65.0 - 78.0					
V. M. A., %	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0

*A tolerance of 3% in the percent by weight retained on the maximum size sieve will be permitted providing 100% of the oversize passes the 22.4 mm sieve for Type 70 and Type 70 R aggregate, the 18.0 mm sieve for Type 71 and 71 R aggregate and the 16 mm sieve for Type 72 and 72 R aggregate.

**Deleterious material includes all other injurious material other than lightweight pieces.

** *The Fractured Face percentage will be calculated on the aggregate after combining all virgin aggregates and additives, excluding reclaim.

TABLE 4100.3.T1 *continued*

ASPHALT CONCRETE MIX DESIGN TYPES AND CHARACTERISTICS

Mix Design Type/ Design Factors - Mix Characteristics	**7**	**8**	**9**	**10**	**11**	**12**
Asphalt Type	300-400 A			300-400 A		
Marshall Blows	50 blows			75 blows		
Aggregate Type/Sieve Designation*	70 or 70 R	71 or 71 R	72 or 72 R	70 or 70 R	71 or 71 R	72 or 72 R
18.0 mm	100.0			100.0		
16.0 mm	78.0 – 98.0	100.0		78.0-98.0	100.0	
12.5 mm	68.0 – 92.0	78.0 – 98.0	100.0	68.0 – 92.0	78.0 – 98.0	100.0
9.0 mm	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0	54.0 – 80.0	66.0 – 90.0	66.0 – 90.0
5.0 mm	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0	38.0 – 65.0	46.0 – 72.0	46.0 – 72.0
2.0 mm	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0	18.0 – 46.0	23.0 – 51.0	23.0 – 51.0
900 um	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0	10.0 – 33.0	15.0 – 37.0	15.0 – 37.0
400 um	5.0 – 25.0	10.0 – 27.0	10.0 – 27.0	5.0 – 25.0	10.0 – 27.0	10.0 – 27.0
160 um	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0	3.0 – 13.0	3.0 – 14.0	3.0 – 14.0
71 um	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0	2.0 – 9.0
Air Voids, %	3.0 – 5.0					
Air Voids (Field), %	4.0 – 9.0					
Deleterious Material, Maximum % **	2.0					
Film Thickness, Minimum um	7.5					
Flow, mm	1.5 – 3.5					
Fracture, Minimum % ***	50.0	60.0	70.0	75.0	85.0	95.0
Lightweight Aggregate, Maximum %	1.0					
Retained Stability, Minimum %	70.0					
Sand Equivalent, Minimum	45.0					
Stability, Minimum N	5500			7000		
Voids Filled, %	65.0 - 78.0					
V. M. A., %	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0	13.5 – 15.5	14.0 – 16.0	14.0 – 16.0

*A tolerance of 3% in the percent by weight retained on the maximum size sieve will be permitted providing 100% of the oversize passes the 22.4 mm sieve for Type 70 and Type 70 R aggregate, the 18.0 mm sieve for Type 71 and 71 R aggregate and the 16 mm sieve for Type 72 and 72 R aggregate.

**Deleterious material includes all other injurious material other than lightweight pieces.

** *The Fractured Face percentage will be calculated on the aggregate after combining all virgin aggregates and additives, excluding reclaim.

4100.3.6 Plant Requirements

4100.3.6.1 A uniform mixture shall be produced in which all particles are thoroughly coated. Aggregate particles shall not be coated with residue from fuel combustion. The asphalt mix shall contain no more than 0.5% moisture by weight.

4100.3.6.2 If reclaimed asphalt concrete is added, the following shall apply:

4100.3.6.2.1 The plant shall contain equipment that will prevent the reclaimed asphalt concrete from coming into direct contact with the flame, thus minimizing oxidation of the asphalt in the reclaimed asphalt concrete.

4100.3.6.2.2 The Contractor shall undertake all the necessary adjustments to ensure proper heat transfer and breakdown of the reclaimed asphalt concrete to form a homogeneous end product. The plant shall be capable of heating the reclaimed asphalt concrete particles and blending them with virgin aggregate and any required asphalt to create a homogeneous mix at the plant discharge.

4100.3.7 Plant Calibration and Operation

4100.3.7.1 Plant Calibration:

4100.3.7.1.1 The Contractor shall provide the Engineer with at least three calendar days advance notice of when he plans to do the plant calibration.

4100.3.7.1.2 During plant calibration, the Engineer will assess the property variations of the asphalt mix produced during the calibration process against the asphalt mix design.

4100.3.7.1.3 If the asphalt mix meets the properties and/or characteristics as shown in Table 4100.3.T1, the Contractor may commence hauling to the road upon receiving written approval from the Engineer.

4100.3.7.1.4 The asphalt mix will be rejected if the requirements of Table 4100.3.T1 are not met, and no asphalt mix shall be hauled to the road. The Engineer will provide a modified or new asphalt mix design.

4100.3.7.1.5 After 24 hours of asphalt mix production, if the asphalt mix properties are consistent and meet all specified requirements, the Engineer will approve the Asphalt Mix Formula as the Job Mix Formula.

4100.3.7.2 Plant Operation

4100.3.7.2.1 For the initial 24 hours of plant production at each plant set-up, the asphalt added shall not vary by more than 0.5% from the design asphalt content. Full-scale plant production shall not commence until the percentage of asphalt added to trial batches of asphalt mix complies with the foregoing requirement.

4100.3.7.2.2 After the initial 24 hours of production, the Contractor shall cease operations if the moving average of asphalt added varies by more than 0.3% from the Job Mix Formula.

4100.3.7.2.3 After the Job Mix Formula aggregate gradation has been established, the following shall apply:

4100.3.7.2.3.1 The Contractor shall cease operations if the moving average for any sieve does not comply with the specified requirements listed below:

TABLE 4100.3.T2

MAXIMUM PERMISSIBLE SIEVE VARIATION

Maximum Permissible Variation from the Job Mix Formula	
Sieve Designation	Percent By Weight Passing Canadian Metric Sieve Series
16.0 mm	±5.0
12.5 mm	±5.0
9.0 mm	±5.0
5.0 mm	±5.0
2.0 mm	±4.0
900 um	±3.0
400 um	±3.0
160 um	±2.0
71 um	±1.5

4100.3.7.2.3.2 Road operations shall not recommence until the specified requirements are met.

4100.3.7.2.3.3 Upon re-commencement of operations, the specified requirements shall be met on each of the initial 2 tests.

4100.3.7.2.3.4 Failure to cease operations shall subject all subsequent materials to the requirements of General Provision 1400-7 (Unacceptable and Unauthorized Work).

4100.3.7.2.4 The Contractor shall immediately shut down the plant when:

4100.3.7.2.4.1 The stack emissions temperature exceeds the asphalt mix temperature at the mixer discharge by more than 20°C or;

4100.3.7.2.4.2 The temperatures exceed the limits outlined in the following table:

TABLE 4100.3.T3

TEMPERATURE LIMITS

Grade of Asphalt	Degrees Celsius		
	Maximum Temperature of Dry Aggregate	Asphalt Storage Temperature	Asphalt Mix Temperature at Mixer Discharge
150-200A	160	120-175	135-155
200-300A	160	120-175	130-150
300-400A	150	114-175	120-140
400-500A	140	110-175	110-130

4100.3.7.2.5 All material produced subsequent to the occurrence of an event specified in Section 4100.3.7.2.4 will be deemed to be unacceptable material for the purposes of General Provision 1400-7 (Unacceptable And Unauthorized Work).

4100.3.7.2.6 Plant operations shall not recommence until the temperature limits in Section 4100.3.7.2.4 are met.

4100.3.7.2.7 The Contractor shall dispose of any rejected asphalt mix or asphalt concrete in a manner that is acceptable by the Engineer.

4100.3.8 Delivering to the Road

4100.3.8.1 Truck boxes shall be clean and free from accumulations of asphalt mix and foreign materials. Excess truck box lubricants such as light oil, detergent, lime solutions, gasoline, kerosene, diesel or other similar products shall not be allowed to contaminate the asphalt mix, and shall be disposed of in an environmentally acceptable manner.

4100.3.8.2 Every truck used to transport the asphalt mix shall be equipped with a tarpaulin which is waterproof and can be securely fastened, when required, to protect the asphalt mix from precipitation and excessive heat loss.

4100.3.8.3 Prior to unloading into the paver, the temperature at a depth of 40 mm below the surface of the asphalt mix in the truck box shall not be less than 110°C.

4100.3.8.4 Trucks shall be turned around only at approaches.

4100.3.9 Pavers

4100.3.9.1 Pavers shall be self-propelled units capable of spreading and finishing the asphalt concrete to the specified typical cross section and thickness shown on the paving plans. For traffic lanes, pavers shall be operated using the following:

4100.3.9.1.1 Automatic screed controls, for the control of longitudinal and transverse slope and joint matching. The automatic control device shall be capable of being operated from either side of the paver.

4100.3.9.1.2 Vibrating screed

4100.3.10 Spreading

4100.3.10.1 If designated by the Engineer, a tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat.

4100.3.10.2 Asphalt mix shall be spread on dry, clean, and unfrozen surfaces.

4100.3.10.3 Asphalt concrete shall be placed in accordance with the following temperature limitations:

4100.3.10.3.1 Paving may begin, for other than the final lift, when the temperature is 0°C provided the temperature is forecast, by Environment Canada, for the closest location to the project, to reach at least 5°C that day.

4100.3.10.3.2 The final lift of asphalt concrete shall not be placed if:

4100.3.10.3.2.1 The atmospheric temperature is less than 5°C; or

4100.3.10.3.2.2 The surface temperature is less than 7°C.

4100.3.10.4 The minimum and maximum thickness of a compacted lift of asphalt concrete shall meet the following requirements:

TABLE 4100.3.T4

MINIMUM AND MAXIMUM LIFT THICKNESS

Lift	Type 70 or 70 R Aggregate		Type 71 or 71 R Aggregate		Type 72 or 72 R Aggregate	
	Minimum Thickness	Maximum Thickness	Minimum Thickness	Maximum Thickness	Minimum Thickness	Maximum Thickness
Top	40 mm	60 mm	35 mm	50 mm	30 mm	50 mm
Lower	30 mm	60 mm	30 mm	50 mm	25 mm	50 mm

4100.3.10.5 The following clause shall apply only when shimming and levelling are specified in the Special Provisions as being applicable to the Contract.

4100.3.10.5.1 The Contractor shall shim and level any pavement depressions designated by the Engineer. The use of a motor grader and hand raking will be permitted.

4100.3.10.5.2 All work involved with shimming and levelling will be paid for at the contract unit bid price(s) where applicable.

4100.3.10.5.3 The Contractor shall complete all shimming and levelling operations such that the material has cooled sufficiently before the placement of asphalt concrete.

4100.3.10.6 Longitudinal joints shall not be permitted in the lane. Longitudinal joints shall be vertical butt type, well bonded and sealed, and finished to provide a continuous, smooth profile across the joint.

4100.3.10.7 The asphalt mix temperature in the paver shall not be less than 110°C.

4100.3.10.8 Contact faces of curbs, gutters, manholes, and sidewalks shall be coated with asphalt using a hand applicator before placing the asphalt mix.

4100.3.10.9 When paving is discontinued on the roadway, the asphalt concrete shall be temporarily feathered to a slope of 10 horizontal to 1 vertical. When paving is resumed, the transverse joint shall be straight and have a vertical face when the taper is removed.

4100.3.10.10 Asphalt mix shall not be placed or allowed to fall on previously laid top lift asphalt concrete or the existing asphalt concrete.

4100.3.10.11 Transverse construction joints from one lift to the next shall be separated by at least 2 m.

4100.3.10.12 Road intersections and approaches shall be paved in accordance with the plans or as directed by the Engineer.

4100.3.10.13 If designated by the Engineer, a flush coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat.

4100.3.11 Compacting

4100.3.11.1 At the beginning of the work, the Contractor shall establish a rolling pattern for achieving the Specified Marshall Density. The rolling pattern strip shall comply with the following:

4100.3.11.1.1 The rolling pattern strip shall have a length of at least 250 m and shall be of the same thickness as the lift it represents.

4100.3.11.1.2 The material used shall conform to the requirements of the asphalt concrete stated in the contract or as specified by the Engineer.

4100.3.11.1.3 The Engineer and/or the Contractor at any time may order the construction of a new rolling pattern strip if there are reasons to indicate that the paving operation, the mix design or lift thickness have been altered.

4100.3.11.1.4 Compaction shall commence immediately and shall be completed before the temperature of the asphalt concrete falls below 55°C for 150-200 A and 200-300 A asphalt concrete mixes, and 40°C for 300-400 A and 400-500 A asphalt concrete mixes.

4100.3.11.1.5 Compaction shall continue until the Specified Marshall Density is achieved or until no appreciable increase in the Field Density can be achieved, even with the use of fully ballasted pneumatic tired rollers with a minimum tire pressure of 620 kPa and having the tire size and wheel load indicated in the table below:

TABLE 4100.3.T5

ROLLER TIRE SIZE AND MINIMUM LOAD

Tire Size (mm)	Minimum Load Per Tire (kg)
190.5 x 381.0	950
228.5 x 508.0	1 300
279.4 x 508.0	1 900

4100.3.11.1.6 The speed of steel rollers shall not exceed 5 km/h and the speed of pneumatic rollers shall not exceed 8 km/h.

4100.3.11.1.7 The rolling pattern strip, if accepted, shall remain in place and shall become part of the completed work.

4100.3.11.2 If the Specified Marshall Density is not achieved, then the value of the Field Density achieved after complying with Section 4100.3.11.1 will be used as the Target Density. Job Mix Formula Densities will continue to be taken, and should change occur in Field Density, lift thickness, or the lane being paved, the Engineer may direct that the Specified Marshall Density control procedure be re-established.

4100.3.11.3 Each lift of asphalt concrete shall be compacted to the Specified Marshall Density established for the lot in accordance with the following:

4100.3.11.3.1 The Specified Marshall Density for the lot will be established using a 3-point moving average.

4100.3.11.3.2 When a new moving average is initiated, it will include the entire lot where the sample is taken and will apply to subsequent lots until the next 3-point moving average is established.

4100.3.11.3.3 A new moving average will be initiated for each new asphalt mix design.

4100.3.11.4 Longitudinal joints shall be rolled directly behind the paver.

4100.3.11.5 All asphalt mix shall be thoroughly compacted, and after final rolling, the finished surface of the mat shall be free from segregation, waves, hairline cracks, and other obvious defects.

4100.3.11.6 Traffic shall not be allowed to travel on the finished surface until the surface has cooled to a temperature as to ensure that no deformation or other defects to the surface will occur.

4100.4 SAMPLING AND TESTING

4100.4.1 General

4100.4.1.1 The failure of the Engineer to provide test results within the time provided in this specification shall not relieve the Contractor of his obligation to remedy any defect, but the Department will be obligated to reimburse the Contractor for any additional costs incurred by the Contractor to remedy the defect, if the additional costs are attributable to the delay in receiving results.

4100.4.2 Acceptance Testing

4100.4.2.1 General

4100.4.2.1.1 Within this specification, certain requirements, limits and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements, where so specified, will be judged by testing as described in this section. These tests cannot be disputed on the grounds of statistical theory or a specified or implied Contractor's risk.

4100.4.2.1.2 The results of acceptance testing for Field Density, smoothness, individual bumps and dips, segregation and surface defects will be used for acceptance, rejection and pay adjustments for the block or lot.

4100.4.2.1.3 Initial acceptance testing will be performed free of cost to the Contractor.

4100.4.2.1.4 If the remedial work by the Contractor on a rejected block or lot involves a repair of the asphalt concrete in the block or lot, all test results from acceptance testing performed on the rejected block or lot prior to the remedial work will be discarded and new sampling and acceptance testing will be performed in accordance with Section 4100.4.2.2.

4100.4.2.2 Sampling and acceptance testing will be in accordance with the following:

4100.4.2.2.1 For **Field Density**:

4100.4.2.2.1.1 The Engineer will develop a correlation between the results of the nuclear gauge and the results of the asphalt concrete cores obtained from the compacted lift of asphalt concrete. The density results obtained from the cores will be used to correct the Field Density results obtained from the nuclear gauge.

4100.4.2.2.1.2 Testing will be conducted prior to the placement of the next lift of asphalt concrete.

4100.4.2.2.1.3 Upon notification from the Contractor that a lot has been inspected and is ready for acceptance testing, the Engineer will locate 3 test sites in the lot in accordance with the requirements for Sampling Location By Random Method (STP 107).

4100.4.2.2.1.4 The Engineer will measure the Field Density at 3 test sites for each lot in accordance with the requirements for Density-In-Place By Nuclear Gauge (STP 204-6).

4100.4.2.2.1.5 The Engineer will provide the Contractor with a copy of the results of acceptance tests within 2 calendar days of receiving notification from the Contractor that the lot is ready for acceptance testing.

4100.4.2.2.1.6 If the acceptance test results on a lot indicate a penalty for Field Density, the Contractor will be allowed one opportunity to re-roll the lot. The random sampling procedure for re-testing will exclude areas falling within traffic wheel paths.

4100.4.2.2.2 For **smoothness** and **individual bumps and dips**:

4100.4.2.2.2.1 The surface of the blocks will be profiled by the Engineer in accordance with the standard test procedures.

4100.4.2.2.2.2 If a block is located within a rejected lot, the surface of the block will not be profiled until the lot has been remedied.

4100.4.2.2.2.3 The Engineer will provide the Contractor with a copy of the results of acceptance tests for smoothness and individual bumps and dips within 12 calendar days of the placement of the asphalt concrete.

4100.4.2.2.2.4 When all the acceptance tests for a block are completed, the Engineer will advise the Contractor as to the acceptability of the block with respect to smoothness and individual bumps and dips.

4100.4.2.2.3 For **segregation**:

4100.4.2.2.3.1 Each lane-km, including the shoulder, will be inspected for areas of segregation.

4100.4.2.2.3.2 After receiving notification from the Contractor that the asphalt concrete is ready for acceptance testing, the Engineer will provide the Contractor with the locations of the visually identified segregation in accordance with the following:

4100.4.2.2.3.2.1 Within 12 calendar days during the course of the construction; and

4100.4.2.2.3.2.2 Within 4 calendar days after the completion of all the asphalt concrete.

4100.4.2.2.3.3 A segregated area will be categorized by the worst condition prevalent for 50% or more of the length of the segregated area.

4100.4.2.2.3.4 If the worst condition in a segregated area is not prevalent for at least 50% of the length of the area, then the area will be measured in relation to the length of minor and severe segregation.

4100.4.2.2.4 For **surface defects**:

4100.4.2.2.4.1 Each lane-km, including the shoulder, will be inspected for surface defects.

4100.4.2.2.4.2 After receiving notification from the Contractor that the asphalt concrete is ready for acceptance testing, the Engineer will provide the Contractor with the locations of the visually identified surface defects in accordance with the following:

4100.4.2.2.4.2.1 Within 12 calendar days during the course of the construction; and

4100.4.2.2.4.2.2 Within 4 calendar days after the completion of all the asphalt concrete.

4100.4.3 Exclusions to Random Sampling

4100.4.3.1 Random sampling methods will not apply to the following:

4100.4.3.1.1 Smoothness;

4100.4.3.1.2 Small areas such as approaches, tapers, areas of handwork and gores;

4100.4.3.1.3 Areas of visually identified segregation; and

4100.4.3.1.4 Areas of surface defect repair.

4100.4.4 Appeal of Acceptance Test Results and Appeal Testing

4100.4.4.1 General

4100.4.4.1.1 The Contractor cannot appeal test results that are within the full or bonus payment range.

4100.4.4.1.2 The Engineer will provide the Contractor with a copy of the results of appeal tests within 6 calendar days of delivery of the samples.

4100.4.4.1.3 Appeal testing will be performed by the Department, and the new results shall be binding on the Contractor and the Department.

4100.4.4.1.4 If the appeal testing does not result in a decrease of the pay adjustments, all testing costs incurred during the appeal procedures shall be paid by the Contractor. The rate for Department testing will be as designated in the Special Provisions.

4100.4.4.1.5 If the Engineer determines that certain test results are faulty due to testing equipment malfunction, improper testing procedures or calculations, re-testing will be performed at the expense of the Department.

4100.4.4.1.6 In the case of an appeal, the Department will not be responsible for any delays including but not limited to Contractor's downtime, or other costs as a result of awaiting the receipt of the appeal test results, or due to the nature and values of the appeal test results.

4100.4.4.2 Appeal of the acceptance test results shall be in accordance with the following:

4100.4.4.2.1 For **Field Density**:

4100.4.4.2.1.1 Within 2 calendar days of receipt of the acceptance test results for a lot, the Contractor may appeal the acceptance test results by requesting appeal tests. The following procedures shall apply:

4100.4.4.2.1.1.1 The Engineer will locate 2 appeal test sites in the lot in accordance with the requirements for Sampling Location By Random Method (STP 107).

4100.4.4.2.1.1.2 The Engineer will measure the Field Density at each appeal test site and in the vicinity of the original 3 acceptance test sites in accordance with the requirements for Density-In-Place By Nuclear Gauge (STP 204-6).

4100.4.4.2.1.1.3 The mean of the test results from the 5 referee sites will be used for the purpose of acceptance, rejection and determination of pay adjustments.

4100.4.4.2.2 For **smoothness** and **individual bumps and dips**:

4100.4.4.2.2.1 Within 2 calendar days of receipt of the acceptance test results for a block, the Contractor may appeal the test results by requesting appeal tests.

4100.4.4.2.2.2 The Engineer will re-test the entire block for smoothness and individual bumps and dips, if either is under appeal.

4100.4.4.2.3 For **segregation**:

4100.4.4.2.3.1 Within 6 calendar days of receipt of the locations of the visually identified segregation, the Contractor may appeal the acceptance test results by requesting appeal tests.

4100.4.4.2.3.2 The Engineer will obtain a core sample at a location that is representative of the area being considered. The core sample will be obtained in accordance with the requirements for Asphalt Concrete Samples Obtained By Coring (STP 204-5).

4100.4.4.2.3.3 The Engineer will determine the Field Density, asphalt content and the aggregate gradation of the sample.

4100.4.4.2.3.4 The area will be considered non-segregated if the aggregate gradation complies with requirements specified in section 4100.3.7.2.3.

4100.4.4.2.3.5 If the aggregate gradation does not comply with the requirements specified in section 4100.3.7.2.3:

4100.4.4.2.3.5.1 The area will be considered minor segregation if the test results indicate the Field Density of the asphalt concrete meets or exceeds 94% of the Marshall Density established for the Job Mix Formula or Asphalt Mix Formula, and the asphalt content deviates by not more than 0.6% from the asphalt content approved for the Job Mix Formula or Asphalt Mix Formula.

4100.4.4.2.3.5.2 The area will be considered severe segregation if the conditions in section 4100.4.4.2.3.5.1 are not met.

4100.5 ACCEPTANCE, REJECTION AND REPAIRS

4100.5.1 General

4100.5.1.1 The Contractor shall provide a finished product conforming in quality and accuracy of detail to the dimensional and tolerance requirements of the specifications and drawings. Where no tolerances are specified, the standard of workmanship shall be in accordance with normally accepted good practice.

4100.5.2 Rejection

4100.5.2.1 The block or lot will be rejected as unacceptable work if:

4100.5.2.1.1 The Field Density for the lot is outside the acceptance limits outlined in section 4100.7.2.1.1.

4100.5.2.1.2 The PrI for the Block is outside the acceptance limits outlined in section 4100.7.2.1.2.

4100.5.2.1.3 Any individual bumps and/or dips exceed 12 mm.

4100.5.2.2 Areas of segregation and surface defects will be considered unacceptable work until the areas are repaired and accepted by the Engineer.

4100.5.3 Repairs

4100.5.3.1 General

4100.5.3.1.1 The Contractor shall not undertake any repair on any defective work prior to notifying the Engineer. Any areas repaired prior to obtaining the Engineer's approval will not be considered for payment.

4100.5.3.1.2 Work on any block or lot which has been rejected shall be remedied within 30 calendar days of receipt of the acceptance test results.

4100.5.3.1.3 All remedial work shall be performed at the Contractor's expense, including the cost of materials.

4100.5.3.1.4 The Contractor shall pay the cost of all re-testing performed following the remedying of work in any block or lot that has been rejected. The rate for Department testing will be as designated in the Special Provisions.

4100.5.3.1.5 Repairs shall be subject to the approval of the Engineer.

4100.5.3.1.6 Alternate repair methods proposed by the Contractor shall be subject to approval of the Engineer. The nature of the deficiencies shall be taken into account in the consideration of the method of repair.

4100.5.3.1.7 Acceptable remedial measures to a rejected block or lot, or areas within a block or lot are as follows:

4100.5.3.1.7.1 A **Class I repair** either overlays or removes and replaces the asphalt concrete.

4100.5.3.1.7.1.1 If an overlay is used as the remedial measure, the following shall apply:

4100.5.3.1.7.1.1.1 A tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat unless otherwise directed by the Engineer.

4100.5.3.1.7.1.1.2 The minimum overlay thickness shall be as specified in Table 4100.3.T4 for top lift.

4100.5.3.1.7.1.1.3 Adjacent lanes and shoulders shall be overlaid to the same thickness and length.

4100.5.3.1.7.1.1.4 On all lifts of asphalt concrete below the final lift, the overlay shall be completed prior to the next lift being placed.

4100.5.3.1.7.1.2 If a removal and replace operation is used as the remedial measure, the following shall apply:

4100.5.3.1.7.1.2.1 The work shall be performed in accordance with Specification 4105 For Reclaiming Asphalt Concrete.

4100.5.3.1.7.1.2.2 The asphalt concrete shall be removed by cold milling to a minimum depth as specified in Table 4100.3.T4 for the lift being removed.

4100.5.3.1.7.1.2.3 A tack coat in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat, unless otherwise directed by the Engineer, shall be applied to the milled surface.

4100.5.3.1.7.1.2.4 The asphalt concrete material removed by the milling operation shall be the property of the Contractor.

4100.5.3.1.7.1.2.5 The asphalt concrete used for back-filling the milled area shall be subject to the same specifications as the original pavement.

4100.5.3.1.7.2 A **Class II repair** is typically either the placing of a slurry seal on the entire block or lot, or the placing of a spot slurry seal patch or patches within the block or lot.

4100.5.3.1.7.2.1 For slurry seals or slurry seal patches, the following shall apply:

4100.5.3.1.7.2.1.1 The seal shall be a mixture of a dry, non- plastic sand, an emulsified asphalt SS-1 (slurry), potable water, and, if needed, acceptable additives such as Portland Cement, and Carbon Black, for colour.

4100.5.3.1.7.2.1.2 The gradation of the sand shall be as follows:

TABLE 4100.3.T6

SLURRY SEAL SAND GRADATION

Sieve Designation	Percent by Weight Passing Canadian Metric Sieve Series
900 um	100.0
400 um	70.0 – 95.0
160 um	60.0 – 80.0
71 um	20.0 – 42.0
Plasticity Index	Non Plastic

4100.5.3.1.7.2.1.3 The mix proportions for a 1 000 litre batch of seal shall be as follows:

4100.5.3.1.7.2.1.3.1 360 litres of SS-1 (slurry);

4100.5.3.1.7.2.1.3.2 270 litres of potable water; and

4100.5.3.1.7.2.1.3.3 850 kg of dry, non-plastic sand.

4100.5.3.1.7.2.1.4 The Contractor shall add the water to the emulsified asphalt followed by the addition of the sand.

4100.5.3.1.7.2.1.5 The Contractor shall thoroughly mix the seal. If a mineral filler is used, it shall be blended into the mixture. A minimum amount of additional water may be added to obtain a fluid, homogeneous mixture.

4100.5.3.1.7.2.1.6 If a tack coat is required, the same asphalt chosen for the seal binder shall be used. The tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack And Flush Coat, unless otherwise directed by the Engineer.

4100.5.3.1.7.2.1.7 The seal shall be neat and square; and uniform and homogeneous with no uncovered areas, ridges or loose aggregate.

4100.5.3.1.7.2.1.8 Hand or mechanical squeegees may be used to spread the seal.

4100.5.3.1.7.2.1.9 The completed seal shall be kept free of all traffic until it has cured sufficiently to prevent pickup of aggregate particles.

4100.5.3.1.7.2.1.10 Any tests performed by the Engineer on the seal will be quality assurance tests and will not be considered as quality control tests.

4100.5.3.1.7.3 A **Class III repair** is typically a flush coat on the entire block or lot, or the placing of a spot flush coat(s) within the block or lot.

4100.5.3.1.7.3.1 A flush coat or spot flush coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat, unless otherwise directed by the Engineer.

4100.5.3.1.7.4 A **Class IV repair** is typically either a re-rolling operation to remove or reduce the bump(s) or a shim operation to remove or reduce dip(s). Other methods of Class IV repairs proposed by the Contractor shall be subject to the approval of the Engineer.

4100.5.3.1.7.4.1 For repairs to a bump(s), the following shall apply:

4100.5.3.1.7.4.1.1 The repair procedure shall not cause damage to the asphalt concrete such as, but not limited to, excessive crushing, pulverizing or displacing the asphalt concrete or its surface.

4100.5.3.1.7.4.1.2 The area repaired shall have a smooth transition to the surrounding pavement without impairing the functionality and/or structural characteristics of the service life of the area.

4100.5.3.1.7.4.2 For repairs to a dip(s), the following shall apply:

4100.5.3.1.7.4.2.1 If shimming is used, the area shimmed shall have a smooth transition to the surrounding pavement. The shim shall have sufficient thickness and be thoroughly compacted to prevent ravel of the shimmed area.

4100.5.3.1.7.4.2.2 If a tack coat is required, the tack coat shall be applied in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat, unless otherwise directed by the Engineer.

4100.5.3.2 Repairs shall be in accordance with the following:

4100.5.3.2.1 For **Field Density**:

4100.5.3.2.1.1 If after re-rolling, the Field Density of a lot remains outside the acceptance limit, the Contractor shall perform a Class I repair.

4100.5.3.2.1.2 If the area(s) requiring repairs appears to be isolated:

4100.5.3.2.1.2.1 The Engineer may identify the area(s) through additional testing.

4100.5.3.2.1.2.2 The Contractor shall perform a Class I repair for only the portion of the lot requiring repairs.

4100.5.3.2.1.2.3 If the isolated repair area continues into an adjacent lot, which is deemed acceptable through acceptance testing, that portion of the adjacent lot shall be repaired along with the portion of the unacceptable lot.

4100.5.3.2.2 For **smoothness**:

4100.5.3.2.2.1 If the acceptance test results on a block indicate a pay adjustment for smoothness, additional work to improve the smoothness will not be allowed except the Contractor will be allowed to perform a Class I or Class IV repair on individual bumps and dips that exceed 12 mm.

4100.5.3.2.2.2 If the smoothness of the final lift of asphalt concrete of a block is outside the acceptance limit outlined in Table 4100.7.T9, the block shall be repaired by a Class I repair.

4100.5.3.2.3 For **individual bumps and dips**:

4100.5.3.2.3.1 Individual bumps and dips that exceed 12 mm in the vertical direction shall be repaired by a Class I or Class IV repair.

4100.5.3.2.3.2 Work to repair individual bumps and dips $\leq$ 12 mm will not be permitted.

4100.5.3.2.4 For **segregation**:

4100.5.3.2.4.1 The Contractor shall repair all segregated areas, except for minor segregation on lower lifts, but including segregated areas with nil pay adjustment. These repairs will not affect the initial pay adjustments assessed in accordance with Tables 4100.7.T10 and 4100.7.T11 with the exception of a Class I repair.

4100.5.3.2.4.2 Severe segregation on lower lifts of asphalt concrete shall be repaired by a Class I repair.

4100.5.3.2.4.3 Segregated areas on the final lift of asphalt concrete shall be repaired in accordance with the following:

4100.5.3.2.4.3.1 Minor segregation on the lane or shoulder shall be repaired by a Class II repair. If the minor segregation is more than one half the lane width or is across the centre of the lane, the full width shall be repaired.

4100.5.3.2.4.3.2 Severe segregation:

4100.5.3.2.4.3.2.1 Individual areas less than 100 m in length shall be repaired with a Class II repair slurry seal patch over the full lane or shoulder width.

4100.5.3.2.4.3.2.2 Individual areas 100 m or greater in length shall be repaired over the full lane or shoulder by a Class II repair slurry seal or by a remove and replace Class I repair.

4100.5.3.2.5 For **surface defects**:

4100.5.3.2.5.1 On all lifts of asphalt concrete, surface defects shall be repaired with a Class I to Class IV repair, in a manner that is acceptable to the Engineer.

4100.5.3.3 Payment options in lieu of repairs:

4100.5.3.3.1 For smoothness and individual bumps and/or dips, the following shall apply, at the discretion of the Engineer, for the final lift of asphalt concrete in a block:

4100.5.3.3.1.1 If the Category I PrI is $\leq$ 23 or the Category II PrI is $\leq$ 28, and individual bumps and/or dips exceed 12 mm, a $2,000 penalty per bump and/or dip plus the adjusted PrI pay adjustment may apply, to a maximum of $6,000.

4100.5.3.3.1.2 If the Category I PrI is > 23 or the Category II PrI is > 28, and no individual bumps and/or dips exceed 12 mm, a $6,000 penalty may apply.

4100.5.3.3.1.3 If the Category I PrI is > 23 or the Category II PrI is > 28, and individual bumps and/or dips exceed 12 mm:

4100.5.3.3.1.3.1 A $6,000 penalty may apply if the adjusted PrI for the Category I PrI is > 23 or the Category II PrI is > 28.

4100.5.3.3.1.3.2 A $2,000 penalty per bump and/or dip plus the adjusted PrI pay adjustment may apply, if the adjusted PrI for the Category I PrI is $\leq$ 23 or the Category II PrI is $\leq$ 28.

4100.5.3.3.2 For segregation and surface defects requiring a Class II repair, the Contractor may, subject to the discretion of the Engineer, be charged a fee as shown in the Special Provisions to compensate the Department for having others make the repairs at a later date.

4100.6 MEASUREMENT

4100.6.1 Asphalt Concrete

4100.6.1.1 Asphalt concrete will be measured in tonnes.

4100.7 PAYMENT

4100.7.1 General

4100.7.1.1 Payment for Asphalt Concrete will be at the contract unit price per tonne with pay adjustments for Field Density, smoothness, severity of segregation, segregation frequency and final surface condition.

4100.7.1.2 The contract unit price will be full compensation for completing the work except for those activities for which specific provision for payment is made in this section.

4100.7.1.3 If it is stated in the Special Provisions that anti-stripping agent is required, the addition of hydrated lime or liquid anti-stripping agent shall be a subsidiary obligation of the Contractor. If it is determined during the contract that anti-stripping agent is required, the Contractor will be paid at the rate specified in the Special Provisions.

4100.7.1.4 If the shoulder is laid separately from the main lane, the pay adjustments for Field Density for asphalt concrete on the shoulder will be at 50% of the regular rates specified in Tables 4100.7.T7 or 4100.7.T8.

4100.7.1.5 Segregation and surface defects on the shoulder will be excluded from pay adjustments for segregation severity, segregation frequency and final surface condition. The Contractor shall repair segregation and surface defects on the shoulder in accordance with section 4100.5.3.

4100.7.1.6 If the contract includes a bid item for:

4100.7.1.6.1 Hauling Asphalt Concrete, payment will be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

4100.7.1.6.2 Reclaimed Asphalt Concrete, payment will be made in accordance with Specification 4105 For Reclaiming Asphalt Concrete.

4100.7.1.6.3 Hauling Reclaimed Asphalt Concrete, payment will be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

4100.7.1.6.4 Filler And Blender, payment will be made in accordance with Specification 3400 For Binder, Filler And Blender Sand.

4100.7.1.6.5 Hauling Filler And Blender, payment will be made in accordance with Specification 2405 For Hauling On The Basis Of The Kilometre.

4100.7.1.6.6 Tack Coat And Flush Coat, payment will be made in accordance with Specification 4000 For Asphalt Prime, Tack and Flush Coat.

4100.7.1.7 The rate the Department will pay for rejecting aggregate in excess of 10%, or for rejecting aggregate to improve the quality of the asphalt mix design, will be as designated in the Special Provisions of the contract.

4100.7.1.8 The Contractor will be charged at cost for the value of the asphalt and other additives in any asphalt mix that is rejected or wasted, in accordance with the following:

4100.7.1.8.1 The quantity of material rejected or wasted will be determined by the Engineer.

4100.7.1.8.2 The Contractor will not be charged for rejected or wasted material if it has been incorporated back into the work in a manner acceptable to the Engineer.

4100.7.1.8.3 For calculation purposes, the asphalt content will be that of the Job Mix Formula or Asphalt Mix Formula.

4100.7.1.9 When defects in rejected blocks or lots have been remedied, the pay adjustments for Field Density, smoothness, severity of segregation, segregation frequency and final surface condition will be based on testing of the repaired sections where applicable.

4100.7.1.10 The pay adjustments determined through testing of the remedial work will be applied to that quantity of material in the block or lot which was originally rejected.

4100.7.1.11 If any lot or block has been rejected under section 4100.5.2, payment will not be made for the asphalt concrete in the lot or block until the rejected work has been remedied.

4100.7.2 Pay Adjustments

4100.7.2.1 The dollar value of the pay adjustment will be as follows:

4100.7.2.1.1 For **Field Density**:

4100.7.2.1.1.1 The pay adjustment for each lot will be determined from Table 4100.7.T7. If the asphalt mix is a recycled mix with more than 10% reclaimed material, the pay adjustments will be at 50% of the values specified in Table 4100.7.T7.

TABLE 4100.7.T7

PAY ADJUSTMENTS FOR FIELD DENSITY

% of Marshall Density of Job Mix Formula	Pay Adjustment Dollars Per Tonne
≥ 99.0	+1.00
98.9	+0.90
98.8	+0.80
98.7	+0.70
98.6	+0.60
98.5	+0.50
98.4	+0.40
98.3	+0.30
98.2	+0.20
98.1	+0.10
98.0	0.00
97.9	0.00
97.8	0.00
97.7	0.00
97.6	0.00
97.5	0.00
97.4	0.00
97.3	0.00
97.2	0.00
97.1	0.00
97.0	0.00
96.9	-0.05
96.8	-0.10
96.7	-0.20
96.6	-0.30
96.5	-0.40
96.4	-0.50

Table 4100.7.T7 Continued

% of Marshall Density of Job Mix Formula	Pay Adjustment Dollars Per Tonne
96.3	-0.60
96.2	-0.70
96.1	-0.80
96.0	-0.90
95.9	-1.00
95.8	-1.50
95.7	-2.00
95.6	-2.50
95.5	-3.00
95.4	-3.50
95.3	-4.00
95.2	-4.50
95.1	-5.00
95.0	-5.50
94.9	-6.00
94.8	-7.00
94.7	-8.00
94.6	-9.00
94.5	-10.00
94.4	-11.00
94.3	-12.00
94.2	-13.00
94.1	-14.00
94.0	-15.00
92.5 – ≤ 93.9	No Payment
< 92.5	Reject

4100.7.2.1.1.2 If the Specified Marshall Density is not achieved and the Target Density of Section 4100.3.11.2 must be used, the pay adjustment for each lot will be determined from Table 4100.7.T8. If the asphalt mix is a recycled mix with more than 10% reclaimed material, the pay adjustments will be at 50% of the values specified in Table 4100.7.T8.

TABLE 4100.7.T8

PAY ADJUSTMENTS FOR TARGET DENSITY APPLICATIONS

% of Target Density	Pay Adjustment - Dollars Per Tonne
≥ 99.0	0.00
98.9	-0.10
98.8	-0.20
98.7	-0.30
98.6	-0.40
98.5	-0.50
98.4	-0.60
98.3	-0.70
98.2	-0.80
98.1	-0.90
98.0	-1.00
97.9	-1.10
97.8	-1.20
97.7	-1.30
97.6	-1.40
97.5	-1.50
97.4	-1.60
97.3	-1.70
97.2	-1.80
97.1	-1.90
97.0	-2.00

Table 4100.7.T8 Continued

% of Target Density	Pay Adjustment - Dollars Per Tonne
96.9	-2.50
96.8	-3.00
96.7	-3.50
96.6	-4.00
96.5	-4.50
96.4	-5.00
96.3	-5.50
96.2	-6.00
96.1	-6.50
96.0	-7.00
95.9	-7.50
95.8	-8.00
95.7	-8.50
95.6	-9.00
95.5	-10.00
95.4	-11.00
95.3	-12.00
95.2	-13.00
95.1	-14.00
95.0	-15.00
≤ 94.9	Reject

4100.7.2.1.2 For **smoothness**:

4100.7.2.1.2.1 The pay adjustment for each block in the final lift of asphalt concrete will be determined in accordance with Table 4100.7.T9:

TABLE 4100.7.T9

PAY ADJUSTMENTS FOR SMOOTHNESS

Category I PrI	Category II PrI	Pay Adjustment for Smoothness of Top Lift - Dollars per Block Lump Sum
0	0 – 1	+200
1 – 2	2 – 3	+150
3 – 4	4 – 6	+100
5 – 6	7 – 9	+50
7 – 10	10 – 15	0
11 – 12	16 – 17	-25
13	18	-50
14	19	-75
15	20	-100
16	21	-150
17	22	-200
18	23	-300
19	24	-400
20	25	-500
21	26	-600
22	27	-800
23	28	-1000
> 23	> 28	Reject

4100.7.2.1.2.2 The pay adjustment for smoothness will be prorated for blocks less than 100 metres in length.

4100.7.2.1.3 For **severity of segregation**:

4100.7.2.1.3.1 The pay adjustment will be determined from Table 4100.7.T10.

TABLE 4100.7.T10

PAY ADJUSTMENTS FOR SEVERITY OF SEGREGATION

Severity of Segregation	Pay Adjustment Dollars per Square Metre
None	0
Minor	- 3.00
Severe	- 6.00

4100.7.2.1.4 For **segregation frequency**:

4100.7.2.1.4.1 The pay adjustment will be determined from Table 4100.7.T11.

TABLE 4100.7.T11

PAY ADJUSTMENTS FOR SEGREGATION FREQUENCY

Segregation Frequency per Lane Kilometre	Pay Adjustment Dollars per Lane Kilometre
0 – 5	0
6 – 15	- 250
16 +	- 500

4100.7.2.1.5 For **final surface condition**:

4100.7.2.1.5.1 For each lane-kilometre of top lift meeting all of the requirements from Table 4100.7.T12, a bonus of $350 will be paid.

TABLE 4100.7.T12

REQUIREMENTS FOR FINAL SURFACE CONDITION BONUS

Number of Blocks with PrI > 10	Number of Individual Bumps/Dips > 8 mm	Number of Segregated Areas	Number of Surface Defects
0	0	0 – 2	0 – 5

4100.7.3 Maximum Pay Adjustment

4100.7.3.1 The sum of the pay adjustments for each lot will not exceed the maximum pay adjustment. The maximum pay adjustment will be calculated as follows:

Maximum Pay Adjustment per Lot	=	Contract Unit Price per Tonne	x	Tonnes of Asphalt Concrete in Lot