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GEOTECHNICAL INVESTIGATION AND SLOPE STABILITY STUDY PROPOSED RESIDENTIAL SUBDIVISION RESORT VILLAGE OF COCHIN, SASKATCHEWAN

PMEL FILE NO. S07-6301
DECEMBER 19, 2007

PREPARED FOR:

101105144 SASKATCHEWAN LTD.
2509 KILLDEER DRIVE
NORTH BATTLEFORD, SASKATCHEWAN
S9A 3Z2

ATTENTION: MR. GLENN HORNICK, PRESIDENT

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1.0 INTRODUCTION

The following report has been prepared on the results of a geotechnical investigation and slope stability study conducted for a proposed residential subdivision to be constructed within a portion of the property described as:

LLD: NW¼-19-47-16-W3M Ext. 1
LLD: (Parcel A) Plan # 101699040 Ext. 5
LLD: SW¼-30-47-16-W3M Ext. 65

The subject site is situated along the east shore of Jackfish Lake in the Resort Village of Cochin, Saskatchewan. The subject property is situated up-slope of existing residential development.

The Terms of Reference for this investigation were presented in PMEL Proposal No. 1015-4625, dated October 16, 2007. Authorization to perform this investigation was provided on October 17, 2007.

The field test drilling and soil sampling were performed between November 5 and 8, 2007.

2.0 FIELD INVESTIGATION

Seven test holes, located as shown on the Site Plan, Drawing No. S07-6301-1, were dry drilled during this investigation using our truck and track-mounted continuous flight auger drilling systems. The test holes were 150 mm in diameter and were extended to depths of 12 to 57 metres below existing ground surface. Drilling was terminated at the location of Test Hole No. 07-1 at a depth of 16.5 metres (lost augers down the hole).

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

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

Standpipe piezometers were installed in each test hole (with the exception of Test Hole No. 07-1) to monitor the static groundwater conditions. The details of piezometer construction have been presented on the respective field drill logs.

3.0 FIELD DRILL LOGS

The field drill logs recorded during test drilling have been shown plotted on Drawing Nos. S07-6301-2 through 8, inclusive.

The ground surface elevations and plan location of the test holes were provided by Tri City Surveys Ltd. (North Battleford, Saskatchewan).

3.1 Soil Profile

The soil profile varied considerably across the subject site. An examination of Stratigraphic Section A-A’ in the north portion of the site (Test Hole Nos. 07-4, 07-5 and 07-6 - refer to Drawing No. S07-6301-9) revealed that the general soil profile consisted of interbedded sand and glacial till deposits overlying an extensive silt deposit, followed by variable deposits of sand and silt then glacial till. Near the lower portion of the slope, the soil conditions consisted of sand and gravel deposits (beach deposits) overlying clay shale.

An examination of Stratigraphic Section B-B’ in the south portion of the site (Test Hole Nos. 07-1, 07-1A, 07-2 and 07-3 - refer to Drawing No. S07-6301-10) revealed that the general soil profile consisted of an extensive deposit of glacial till overlying clay shale. Clay and silt deposits were encountered within the mid-portion of the slope (inferred from the location of Test Hole No. 07-2). Sand deposits were encountered immediately overlying the clay shale near the mid to lower portion of the slope.

Along Stratigraphic Section A-A’ (north portion of the subject site), the clay shale deposit dips to the east, and was not encountered within the up-slope Test Holes (i.e., the clay shale was situated at an elevation of about 526 metres in Test Hole No. 07-6, and was situated below an elevation of 508 metres in Test Hole No. 07-4). Along Stratigraphic Section B-B’ (south portion of the slope), the clay shale was essentially flat-lying at an elevation of about 528 metres. On the basis of our test drilling, the clay shale deposit appears to generally dip from the south to the north.

3.2 Groundwater Conditions and Sloughing

Groundwater seepage and sloughing conditions were encountered during test drilling as shown on the Field Drill Logs, Drawing Nos. S07-6301-2 through 8, inclusive. A summary of the groundwater levels recorded in the standpipe piezometers installed during this investigation has been presented in Table I.

TABLE I. RECORDED GROUNDWATER LEVELS

Test Hole No.	Piezometer Rim Elevation (metres)	Ground Surface Elevation (metres)	*Recorded Groundwater Levels (metres)	
			November 8, 2007	November 21, 2007
07-1A	569.1	568.1	530.8	536.1
07-2	550.5	549.5	522.4	531.7
07-3	532.3	531.4	529.6	529.6
07-4	565.3	564.3	528.8	530.8
07-5	552.5	551.5	529.4	529.5
07-6	532.2	531.2	529.4	529.5

*Higher and potentially perched water levels should be expected during or following spring snowmelt and/or during or following periods of precipitation.

3.3 Cobblestones and Boulders

Cobblestones and/or boulders were encountered during test drilling. The depths at which cobblestones and/or boulders were encountered have been shown on Drawing Nos. S07-6301-2 through 8, inclusive.

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

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

4.0 LABORATORY ANALYSIS

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

The results of soil classification and index tests conducted on representative samples of soil recovered from this site have been plotted alongside the depth at which the samples were recovered as shown on Drawing Nos. S07-6301-2 through 8, inclusive.

The interpreted soil stratigraphy has been shown plotted on Stratigraphic Sections A-A' and B-B', Drawing Nos. S07-6301-9 and 10.

The results of the grain size distribution analyses have been shown graphically on Drawing Nos. S07-6301-11 through 24, inclusive.

5.0 SLOPE STABILITY

The theoretical slope stability analysis was performed using the SLOPE/W computer program available through Geo-Slope International Ltd.[1]

5.1 Input for Analysis

5.1.1 Surface Geometry

The surface geometry was interpreted from topographic information provided by TriCity Surveys Ltd. (North Battleford, Saskatchewan).

5.1.2 Soil Stratigraphy

The stratigraphic units as well as the lithologic boundaries were interpreted from the results of the subsurface soils investigation. The slope was analyzed for circular and composite failure.

5.1.3 Piezometric Conditions

The piezometric conditions used for the slope stability analysis were interpreted from seepage zones identified during field test drilling and from water levels recorded during this investigation. A hydrostatic pore pressure condition was used for the analysis.

A sensitivity analysis was performed to assess changes in the calculated Factor of Safety as a result of potential variations in the static water levels (i.e., during or following periods of precipitation or spring snowmelt).

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[1] Geo-Slope International Ltd., 2007. Slope/W User's Manual, A Comprehensive Program for Slope Stability Analysis, Geo-Slope International Ltd., Calgary, Alberta.

5.1.4 Soil Properties

The soil properties obtained during this investigation as well as the design strength parameters used for the theoretical slope stability analysis have been presented in Table II.

TABLE II. SLOPE STABILITY SOIL INPUT PARAMETERS

Material Type	Total Unit Weight (kN/m^3)	Effective Unit Cohesion (kPa)	Effective Internal Angle of Friction (Degrees)
Glacial Till	21.5	7	27
Silt	18.5	0	23
Sand	19.0	0	33
Silt and Sand	19.0	0	25
Clay and Silt	18.5	5	22
Clay Fill	20.0	0	20
Clay Shale	19.5	0	15
- Impenetrable Surface*	-1.00	0	0

*Input for slip composite slip surface analysis.

5.2 Results of Analysis

The results of the stability analysis for the existing slope have been presented in Table III.

TABLE III. SLOPE STABILITY ANALYSES RESULTS– EXISTING SLOPE

Model Parameters	Calculated Factor of Safety
Circular Failure - Recorded Water Levels	1.3 to 1.5
Circular Failure - Water Level +3 Metres	1.3 to 1.4
Composite Failure - Recorded Water Levels	1.3 to 1.5
Composite Failure - Water Levels +3 Metres	1.2 to 1.4

The Factor of Safety of a slope (FS) is defined as the ratio of the available shear strength of the soil, to the minimum shear strength required to maintain stability. A Factor of Safety of less than 1 would indicate the potential for slope failure.

An examination of Table III revealed that the calculated Factor of Safety of the existing slope was 1.3 to 1.5. The calculated Factor of Safety decreased slightly to 1.2 to 1.4 with a three (3) metre rise in the static water level. The stability analysis revealed that the calculated factor of safety is sensitive to a rise in the static water level. A factor of safety of at least 1.3 is recommended for development. To attain a minimum Factor of Safety of 1.3, a minimum setback distance of 12 metres from the crest of the slope is recommended.

5.3 Slope Stability Recommendations

The following considerations and recommendations have been presented for development of the subject property.

1. Site development must achieve and maintain a calculated Factor of Safety of at least 1.3 during and following construction.

2. Site development should be undertaken with no net increase in loading on the existing slope or increase in static water levels.

3. Natural drainage patterns should not be adversely altered by site development. Wherever possible, all existing vegetation should be retained. Where site grading is undertaken, vegetation should be re-established as soon as practical.

4. All roof runoff and surface drainage should be collected and conveyed offsite to minimize the potential for groundwater recharge.

5. Irrigation and lawn watering should be kept to a minimum to minimize saturation and/or hydraulic loading of the slope.

6. The final design drawings, site drainage and landscaping details should be reviewed by the Geotechnical Consultant.

6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

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

6.1 Design Considerations

The proposed residential subdivision area is situated on the upper plateau of the slope adjacent to the east shore of Jackfish Lake in the resort Village of Cochin, Saskatchewan. Extensive residential development currently exists down-slope of the proposed development area. It is anticipated that site development will consist of wood frame structures complete with walkout basements and decks. It is understood that sewage from the proposed development will be collected in Septic tanks and them pumped out and transported to the existing Cochin Lagoon.

The near-surface founding subgrade soils at the site of the proposed subdivision consisted predominantly of sand and glacial till. The groundwater table within the proposed development area was situated at a depth in excess of 30 metres below (plateau) ground surface. Higher and potentially perched temporary water levels should be expected, during or following spring snowmelt and/or during or following periods of precipitation.

The subgrade soil conditions at the average bearing depth for a shallow foundation system consisted of sand or glacial till. Footings and floor slabs based on the glacial till or sand soils should perform satisfactorily.

A deep foundation system consisting of drilled, cast-in-place concrete piles could perform satisfactorily for support of the residences, garages and decks. Temporary casing may be required to complete the installation of some drilled piles.

It is anticipated that site development could induce the development of perched groundwater conditions which will fluctuate on a seasonal basis with the amount of precipitation, surficial drainage, snow melt, irrigation, etc. As such, a perforated drainage pipe (weeping tile) drainage system should be constructed around the exterior of the foundation. Additionally, a continuous layer of clean, granular drainage aggregate should be placed beneath the floor slab and drained to a sump pit(s) for controlled discharge of water. Roof downspouts should extend well away from the perimeter of the proposed Residences.

Recommendations have been prepared for site preparation; excavations and dewatering; standard strip or spread footings; drilled, cast-in-place concrete piles; floor slabs; foundation walls; grade beams; foundation concrete and subdivision roads and parking structures.

6.2 Site Preparation

All organic topsoil and deleterious materials should be stripped from the building sites. All suitable soil should be stockpiled for final site grading. The surface of the subgrade should be levelled and compacted to the following minimum density requirements.

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

Fill, required to bring the subgrade soil to the design subgrade elevation in the building areas and roadways, should preferably consist of locally available glacial till or sand soils. The fill should be placed in thin lifts (maximum 150 mm loose) and compacted to a minimum of 96 percent of standard Proctor density at optimum moisture content.

All site grading (i.e. landscaping) of individual lots and roadways including soil fill and/or site excavations should be reviewed and approved by the Geotechnical Consultant prior to construction as per Section 5.3 of this report.

6.3 Excavations and Dewatering

It is considered unlikely that shallow localized excavation will affect the stability of the overall slope provided positive site drainage is maintained during construction.

Excavations at this site may be completed with unbraced, sloped excavation walls. The long-term stability of the excavation walls will be affected by wetting and drying of the exposed excavation walls, the length of time that the excavation remains open and the consistency and structure (degree of fracturing, slickensiding, etc.) of the subgrade soils.

The recommended minimum excavation sideslopes have been presented in Table IV.

TABLE IV. RECOMMENDED MINIMUM EXCAVATION SIDESLOPES

Soil Type	***Minimum Safe Sideslope**	
	Horizontal	**Vertical**
Sand	2	1
Glacial Till	1.5	1

* The slopes should be flattened if wet soil conditions are encountered.

Precipitation runoff should be collected in a drainage system at the base of the excavation (i.e., drainage ditches/interceptors, sump pits). The drainage system should drain positively to a collection sump(s) equipped with a sump pump(s).

6.4 Standard Strip or Spread Footings

The following minimum recommendations should be incorporated into the design of a footing foundation.

1. For a continually heated dwelling with basement, the footings should be founded on naturally deposited, undisturbed soil at a minimum depth of 1.2 metres below finished ground surface. Footings not protected with an interior heat source and 1.2 metres of soil cover should be based below the average depth of frost (i.e., 1.8 metres) or protected with strategically placed rigid polystyrene insulation. In this case, a continuous layer of rigid polystyrene insulation should be placed over the exterior face of the foundation wall, extending vertically a minimum of 300 mm above grade and laterally a minimum distance of 1.2 metres away from the foundation. The insulation should be a minimum of 50 mm in thickness and should be positively sloped away from the foundation to promote drainage. The insulation should be placed a minimum of 300 mm below finished grade.

2. Footings based on naturally deposited, undisturbed soil may be designed to exert an allowable bearing pressure of 100 kPa. The footing excavations should be hand-cleaned to remove all loose, disturbed soil.

3. Where sand subgrade soils are encountered, it is recommended that a mud slab be placed as soon as practical after cleaning to minimize the potential for disturbance of the sand subgrade soils. The mud slab should have a minimum thickness of 75 mm and a minimum compressive strength of 15 MPa.

4. A minimum strip footing width of 450 mm is recommended. A minimum dimension of 1,000 mm is recommended for square and rectangular footings.

5. If the subgrade soil is disturbed during excavation below the design depth, then the disturbed soil should be removed to an undisturbed, level surface. Fill, required to raise the subgrade elevation to the underside of the footings, should be concrete.

6. A representative of the Geotechnical Consultant should inspect the excavation prior to the installation of the footings.

7. Footings should not be constructed on desiccated, frozen or wet subgrade soil. Frost should not be allowed to penetrate beneath the footings prior to, during or after construction. In unheated areas, where potential damage due to frost penetration and upheaval could occur, adequate insulation should be installed to prevent frost penetration below the footings. In this case, the Geotechnical Consultant should review the proposed insulation details.

8. The finished grade should be landscaped to provide for positive site drainage away from the residence.

6.5 Drilled, Cast-In-Place Concrete Piles

Drilled, cast-in-place, reinforced concrete piles may be designed on the basis of skin friction only.

The allowable skin friction bearing pressures of the undisturbed soil are as follows:

TABLE V. SKIN FRICTION BEARING PRESSURES (DRILLED PILES)

Zone (metres)	Allowable Skin Friction Bearing Pressure (kPa)
0 to 2	0
Below 2	25

Notes:

1. To minimize frost heave potential, skin friction piles should be extended to and reinforced to a minimum depth of 6 metres below finished ground surface. The use of a sono-tube form for the uppermost 2 metres of the pile shaft is recommended, as it would significantly reduce the potential for frost-heaving of the straight shaft concrete piles. The sono-tube should be at least 50 mm in diameter smaller than the drilled hole.

2. Piles should be reinforced.

3. A minimum pile diameter of 300 mm is recommended for the primary structural loads. Larger pile diameters may be required to allow for the removal of cobbles and boulders in some pile holes, if encountered.

4. The pile holes should be filled with concrete as soon as practical after drilling.

5. Sloughing conditions were encountered within the near-surface sand deposits during test drilling. Temporary casing will be required where sloughing conditions are encountered to maintain the pile holes open for placing of the reinforcing steel and concrete. The annular space between the casing and drilled hole must be filled with concrete.

6. A minimum centre-to-centre pile spacing of not less than three pile diameters is recommended.

7. A representative of the Geotechnical Consultant should inspect and document the installation of the drilled, cast-in-place concrete piles.

6.6 Floor Slabs

The following minimum provisions should be incorporated into the design of a heated grade-supported, cast-in-place, reinforced concrete slab subject to light floor loading.

1. Prepare the site in accordance with Section 6.2, Site Preparation. Over-excavate the subgrade soil to allow for the placement of a minimum of 200 mm of clean, drainage aggregate below the floor slab. Shape the subgrade surface to allow for free drainage to a sump pit(s). The drainage aggregate should meet the following gradation requirements.

Sieve Designation	**Percent Passing**
25.0 mm	100
9.5 mm	60 - 100
4.75 mm	44 - 90
2.00 mm	20 - 80
0.850 mm	0 - 53
0.425 mm	0 - 32
0.150 mm	0 - 10
0.071 mm	0 - 3

2. Excavate soft subgrade areas and replace with suitable, non-expansive fill, placed and compacted to 96 percent of standard Proctor density.

3. Subgrade fill, if required, should preferably consist of imported granular soil or locally available glacial till or sand soils, placed in thin lifts (maximum 150 mm loose) and compacted to 96 percent of standard Proctor density at optimum moisture content.

4. All fill placed above the subgrade elevation should be compacted to a minimum of 98 percent of standard Proctor density at optimum moisture content.

5. A sump pit is recommended below basement floor slabs to collect any free water which may accumulate beneath the floor, and, to collect water from the perimeter drainage system. The surface of the subgrade should be positively graded towards the sump pit. The sump pit should be perforated to allow water to drain in from the sub-slab drainage layer.

6. Isolate the slab from foundation walls, columns, etc., by means of separation joints.

7. Reinforce the concrete slab and articulate the slab at regular intervals to provide for controlled cracking.

8. Separate the slab from the fill by means of a polyethylene vapour barrier.

9. Provide positive site drainage away from the Residence.

10. Floor slabs should not be constructed on desiccated, wet, or frozen subgrade soil, fill or base.

11. Frost should not be allowed to penetrate beneath the floor slab just prior to, during or after construction.

12. If insulation is to be utilized below the floor slab, a minimum of 1 metre of un-insulated space should be provided around the perimeter of the foundation walls to allow heat loss to the underside of the perimeter strip footing/grade beam.

The above recommended floor system should perform satisfactorily if some floor movements resulting in cracking is deemed tolerable.

Partition walls, staircases and any other structural elements resting on the basement floor slab should be designed to accommodate differential movements without imparting stresses on the upper levels of the Residence.

In unheated structures (i.e., garage), frost heaving is a common cause of differential slab movement and cracking. If some slab movements and cracking is not deemed tolerable, increasing the depth of granular fill, thickness of concrete slab and amount of reinforcing steel could be utilized to minimize floor slab distress. Heating the area to about +5 ^{o} C with adequate air circulation would minimize the depth of frost penetration below the slab. Alternately, strategically placed rigid polystyrene insulation could be utilized to limit frost penetration below floor slabs.

6.7 Foundation Walls

Subsurface foundation walls should be designed to resist lateral earth pressure exerted by the backfill as well as the horizontal pressure induced by any surcharge loading. The lateral earth pressure may be calculated on the basis of an equivalent fluid pressure distribution of 9 kN/m^3.

The lateral earth pressure loading of 9 kN/m^3 assumes that the backfill will be free-draining (imported material or locally available sand), uniformly placed around the structure and lightly compacted, and, a perforated drainage pipe will be installed alongside the foundation walls with the invert elevation at or below the base of the foundation. The perforated drainage pipe should be at least 100 mm in diameter and installed on non-woven geotextile capable of transmitting a flow of not less than 50 litres per second per square metre (ASTM D-4491). The geotextile should be placed on naturally deposited, undisturbed soil or free-draining sand as may be required for levelling. The geotextile should be used to encapsulate at least 300 mm of clean, granular drainage aggregate above the invert of the drainage pipe. The clean drainage aggregate should meet the gradation requirements presented in Section 6.6 – Floor Slabs.

In the zone 300 mm above the invert of the drainage pipe and extending to within 500 mm of ground surface, clean, free-draining granular material with less than 5 percent material finer than the 0.071 mm sieve size should be used (imported material or locally available sand soils). The uppermost 500 mm should consist of clay or other low permeability material.

The lateral earth pressure loading assumes that the backfill will be placed in thin lifts (maximum 300 mm loose), will be lightly compacted and a peripheral (weeping tile) drainage system will be installed alongside the foundation walls with the invert elevation set at the base of the footing elevation.

6.8 Grade Beams

Grade beams should be reinforced both top and bottom throughout their length.

6.9 Foundation Concrete

Water soluble sulphate salts exist in the geologic deposits in this region. Sulphate resistant (CSA Symbol HS) cement should be used for all foundation concrete in contact with the soil. All concrete should be manufactured in accordance with current CSA standards. It should be recognized that water soluble sulphate salts, combined with moist soils or low pH soils, could render the soil highly corrosive to some metals in contact with the soil.

6.10 Subdivision Roads and Parking Structures

Suitable borrow soils (i.e., glacial till or sand) exist at the subject site for construction of subdivision roads and parking areas. Mixing with glacial till may be required to stabilize the sand subgrade soils. It is anticipated that the subdivision roads and parking areas will be subject to predominantly passenger car and light truck traffic and infrequent heavy truck traffic. As a subgrade support, the California Bearing Ratio (CBR) rating of the compacted subgrade soil should be in the order of 5. Based on the CBR rating, the following pavement and granular surfacing structures have been presented.

TABLE VI. THICKNESS DESIGN FOR ACCESS ROADS/PARKING STRUCTURES

Pavement/Granular Structure	**Heavy Truck Traffic Wheel Loading (5,400 kg) (mm)**		**Light Truck/Passenger Vehicle Traffic Wheel Loading (1,830 kg) (mm)**	
Surfacing Gravel	-	50	-	50
Asphalt Concrete	100	-	65	-
Granular Base (Min CBR = 65)	150	150	100	150
Granular Sub-Base (Min. CBR = 20)	200	350	135	175
Prepared Subgrade	(150)	(150)	(150)	(150)
Geotextile	*	*	*	*
Total Thickness	**450**	**550**	**300**	**375**

*Geotextile will be required where soft subgrade soils are encountered. High-strength, permeable, woven geotextile is recommended.

All granular fill placed above the subgrade elevation should be placed in thin lifts (150 mm loose, maximum) and compacted to 98 percent of standard Proctor density. The granular base, sub-base course and surfacing material should meet the following aggregate gradation requirements.

TABLE VII. AGGREGATE GRADATION REQUIREMENTS

Grain Size (mm)	Percent Passing		
	Surfacing Gravel	Base Course	Sub-Base Course
50.0	--	--	100
25.0	100	100	85 – 100
18.0	--	87 – 100	80 – 100
12.5	--	72 – 93	70 – 100
5.0	45 – 80	45 – 77	50 – 85
2.0	25 – 60	26 – 56	35 – 75
0.900	--	18 – 39	25 – 50
0.400	0 – 30	13 – 26	15 – 35
0.160	--	7 – 16	8 – 22
0.071	--	6 – 11	0 – 13
Plasticity Index (%)	0 – 6	0 – 6	0 – 6
CBR (min.)	--	65	20
% Fracture (min.)	40	50	--

The following minimum general recommendations should be incorporated into the design of the proposed subdivision roads and parking structures.

1. Prepare the site in accordance with Section 6.2, Site Preparation.

2. Excavate soft subgrade areas and replace with suitable soil compacted to a minimum of 96 percent of standard Proctor density at optimum moisture content. Geotextile may be required to reinforce and stabilize the subgrade soils.

3. All borrow material for the subject roadways and parking areas should be placed in thin lifts (maximum 150 mm loose) and compacted to at least 96 percent of standard Proctor density at optimum moisture content.

4. In cut areas, the subgrade should be scarified (to 150 in light traffic areas and 300 mm in heavy traffic areas) and re-compacted to 96 percent of standard Proctor density.

5. All common borrow used for embankment construction should consist of imported granular material or select, locally available glacial till or sand soils. Mixing with glacial till may be required to stabilize the sand subgrade soils.

6. All granular fill should be placed in thin lifts (maximum 150 mm loose) and compacted to at least 98 percent of standard Proctor density.

7. Positive surface drainage is recommended to minimize the potential for moisture infiltration into the subgrade soil. Ditches and culverts should be provided where necessary to provide adequate site drainage. Surface water should be prevented from seeping back under the outer edges of the pavement structure.

8. For glacial till or sand borrow materials, roadway embankment slopes should be no steeper than 3.0 Horizontal to 1.0 Vertical (3H:1V). Similarly, ditch sideslopes should be no steeper than 3H:1V.

9. Erosion protection is recommended for all embankment sideslopes. The slopes should be covered with topsoil and seeded to encourage vegetation growth. Alternately, erosion control blankets (North American Green S150 or equivalent) or hydromulch could be installed.

10. Periodic maintenance of the granular/pavement surface will be required (i.e., grading of the gravel surface or crack sealing of the pavement surface). The final road grade should be elevated a minimum of 600 mm above the average terrain to minimize snow accumulation on the road.

7.0 LIMITATIONS

The presentation of the summary of the field drill logs and foundation design recommendations has been completed as authorized. Seven, 150 mm diameter test holes were completed at this site. A field drill log was compiled for each Test Hole during test drilling which, we believe, was representative of the subsurface conditions at the Test Hole locations at the time of test drilling. Variations in the subsurface conditions from that shown on the drill logs at locations other than the exact Test Hole locations should be anticipated. If conditions should differ from those reported here, then we should be notified immediately in order that we may examine the conditions in the field and reassess our recommendations in the light of any new findings.

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

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

This report has been prepared for the exclusive use of 101105144 Saskatchewan Ltd. and their agents for specific application to the proposed residential development to be constructed within a portion of the property described as LLD: NW¼-19-47-16-W3M Ext. 1; LLD: (Parcel A) Plan # 101699040 Ext. 5; and, LLD: SW¼-30-47-16-W3M Ext. 65, within the Resort Village of Cochin, Saskatchewan. It has been prepared in accordance with generally accepted geotechnical engineering practices and no other warranty, express or implied, is made.

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

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

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

P. MACHIBRODA ENGINEERING LTD.

C.C. ZUBROWSKI
MEMBER 12138
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YR. MO. DAY

Cory Zubrowski, P. Eng.

Frank Hynes, P. Eng., M. Eng.

K. Pardoski

Kelly Pardoski, P. Eng.
CZ/FH/KP/clb

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

Discipline	SK. Reg. No.	Signature
Geotechnical	10461	K. Pardoski
Slope Stability		07-12-20

APPENDIX A

EXPLANATION OF TERMS ON
TEST HOLE LOGS

CLASSIFICATION OF SOILS

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

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

Organic Soils: Soils containing a high natural organic content.

Soil Classification By Particle Size

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

TERMS DESCRIBING CONSISTENCY OR CONDITION

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

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

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

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

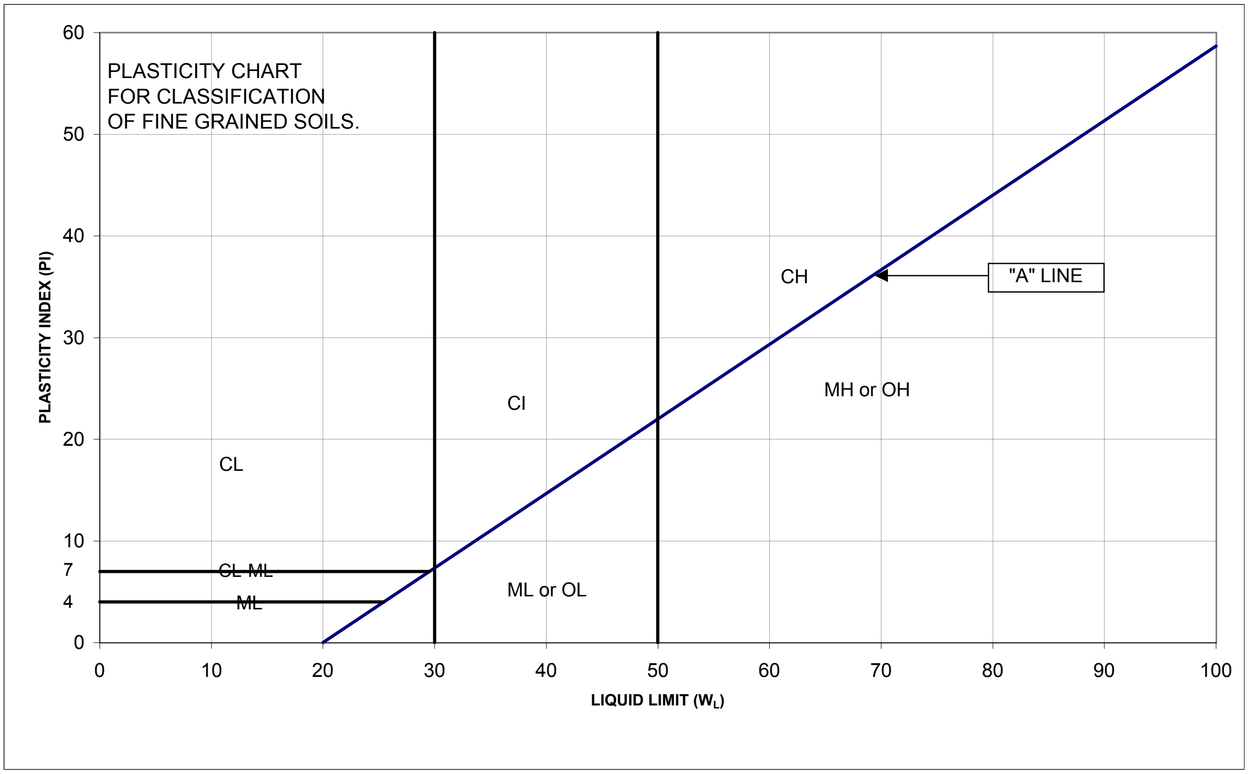
Organic Soils: Readily identified by colour, odour, spongy feel and frequently by fibrous texture.

DESCRIPTIVE TERMS COMMONLY USED TO CHARACTERIZE SOILS

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

SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR AND OFTEN FIBROUS TEXTURE
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE)	GRAVELS More than half coarse fraction larger than No. 4 sieve size	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 4 \quad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1$ to 3
			GP	POORLY-GRADED GRAVELS AND GRAVEL-SAND MIXTURES <5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS FOR GW
		DIRTY GRAVELS	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR PI < 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE WITH PI > 7
	SANDS More than half coarse fraction smaller than No. 4 sieve size	CLEAN SANDS	SW	WELL-GRADED SANDS, GRAVELLY SANDS MIXTURES <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 6 \quad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1$ to 3
			SP	POORLY-GRADED SANDS OR GRAVELLY SANDS <5% FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW
		DIRTY SANDS	SM	SILTY SANDS, SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR PI < 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE WITH PI >7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSING NO. 200 SIEVE SIZE)	SILTS Below "A" line on plasticity chart; negligible organic content		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	$W_L < 50$
			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	$W_L > 50$
	CLAYS Above 'A" line on plasticity chart; negligible organic content		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	$W_L < 30$
			CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	$W_L > 30 < 50$
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	$W_L > 50$
	ORGANIC SILTS & ORGANIC CLAYS Below "A" line on plasticity chart		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	$W_L < 50$
			OH	ORGANIC CLAYS OF HIGH PLASTICITY	$W_L > 50$



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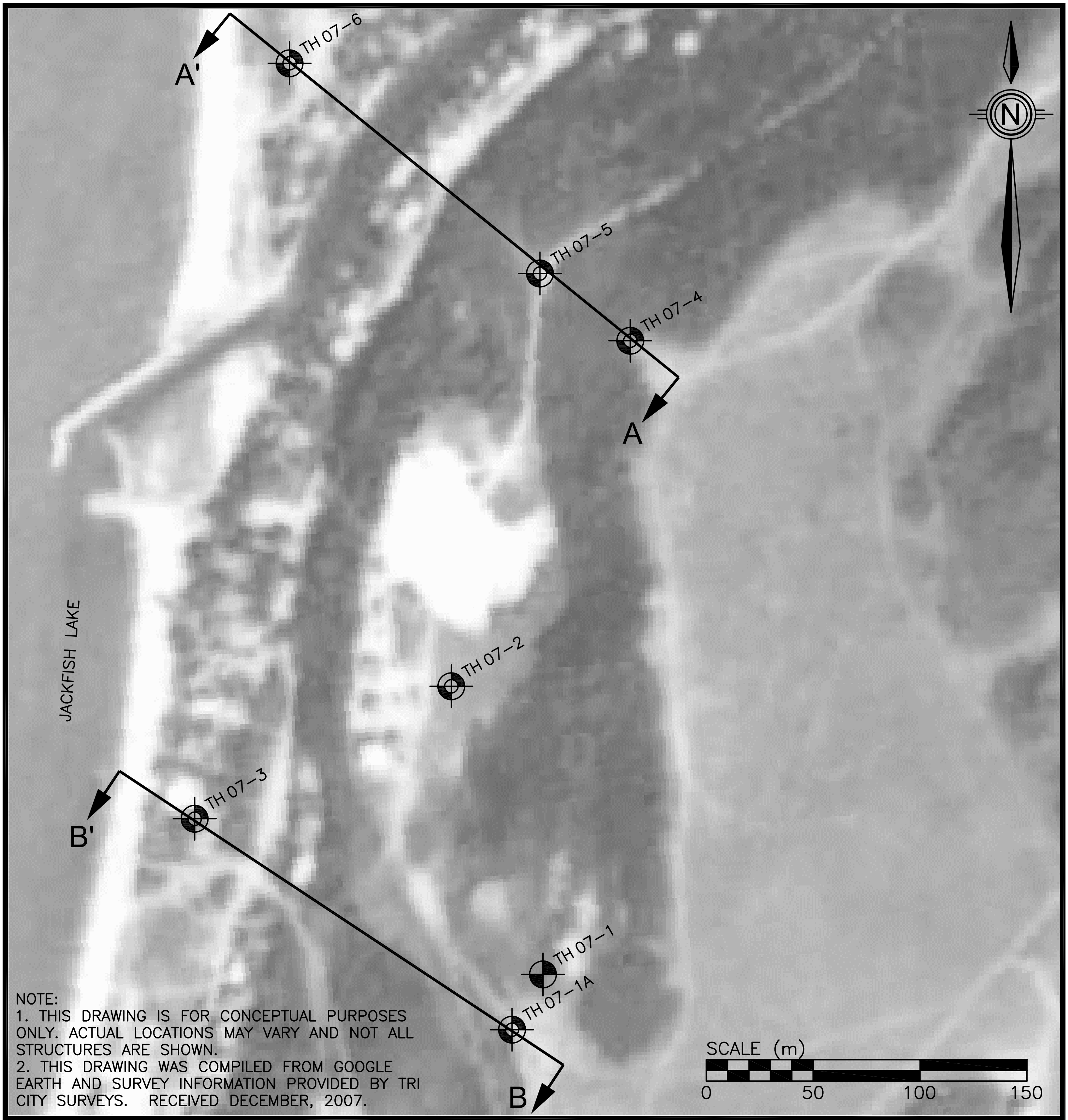
GEOTECHNICAL/GEOENVIRONMENTAL
ENGINEERS

DRAWINGS



NOTE:
1. THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.
2. THIS DRAWING WAS COMPILED FROM GOOGLE EARTH AND SURVEY INFORMATION PROVIDED BY TRI CITY SURVEYS. RECEIVED DECEMBER, 2007.

LEGEND	⊕ –PMEL TEST HOLE	◉ –PMEL TEST HOLE (PIEZOMETER INSTALLED)

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

P. MACHIBRODA ENGINEERING LTD.

2623 B FAITHFULL AVENUE
SASKATOON, SK
S7K 5W2

DRAWING TITLE:
SITE PLAN - TEST HOLE LOCATIONS

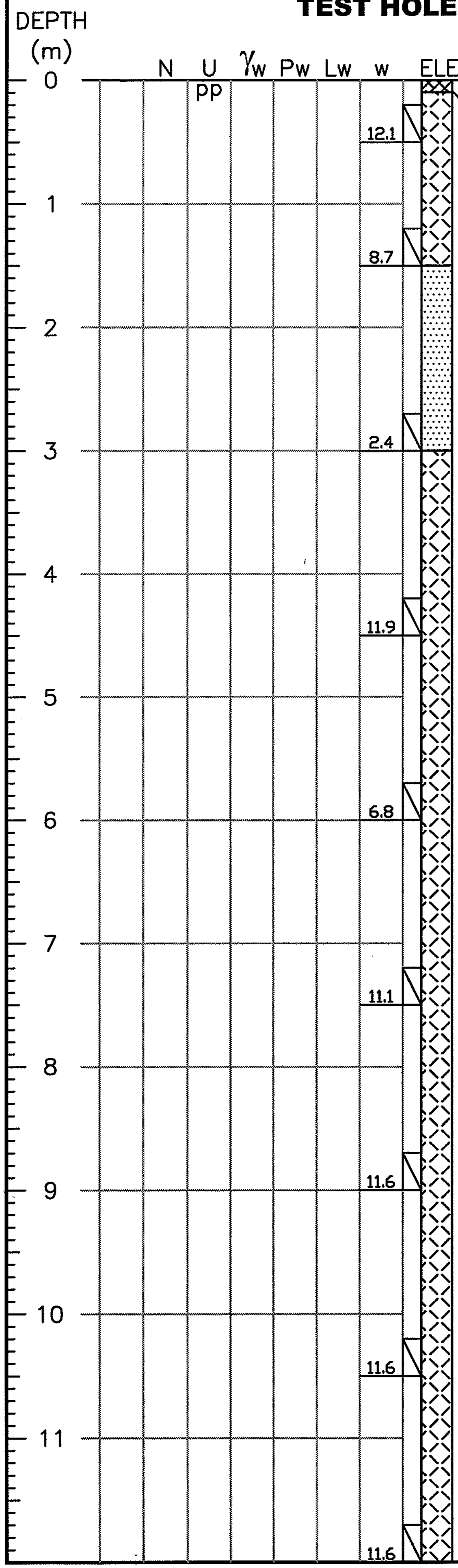
PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK

APPROVED BY: CZ
DRAWN BY: JH
DRAWING NUMBER: S07-6301-1
DATE: DECEMBER, 2007
SCALE: 1:2500

PAGE 1 OF 2

TEST HOLE 07-1

ELEV: 568.1 m



TOPSOIL, organic, brown, rootlets.

GLACIAL TILL, clay, silty, some sand, trace gravel, very stiff, low plastic, damp, brown.
-cobbles/boulders at 500 mm.

SAND, some gravel, compact, poorly graded, fine grained, damp, brown, sloughing.

GLACIAL TILL, clay, silty, sandy, trace gravel, very stiff to hard, low plastic, moist, brown, oxide stained.

CONTINUED ON NEXT PAGE

LEGEND:

- ▩ TOPSOIL
- ▤ FILL
- ▦ GRAVEL
- ░ SAND
- ▥ SILT
- ▧ CLAY
- ☒ GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

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

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

N.....STANDARD PENETRATION TEST (ROPE-CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ◺ CUTTINGS

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

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FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

LOCATION:
COCHIN, SK

NORTHING:

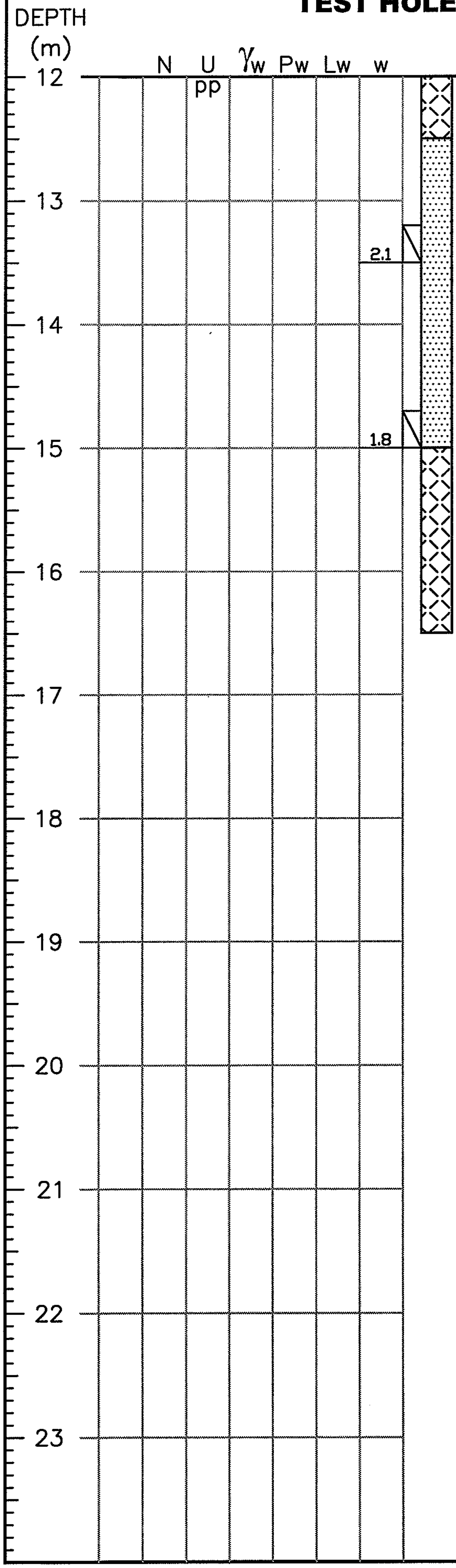
EASTING:

DATE DRILLED: NOV 7/07

DRAWING NUMBER: S07-6301-2

PAGE 2 OF 2

TEST HOLE 07-1



GLACIAL TILL, clay, silty, sandy, trace gravel, very stiff to hard, low plastic, moist, brown, oxide stained.

SAND, some gravel, dense, well graded, fine to coarse grained, damp, brown.

GLACIAL TILL, clay, silty, sandy, trace gravel, very stiff to hard, low plastic, moist, brown, oxide stained.

–Augers broke at 16.5 m, unable to recover. Abandoned Test Hole.

NOTE:
1. Test Hole open to 16.5 m and dry I.A.D.

LEGEND:

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

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ◪ CUTTINGS

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FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

LOCATION:
COCHIN, SK

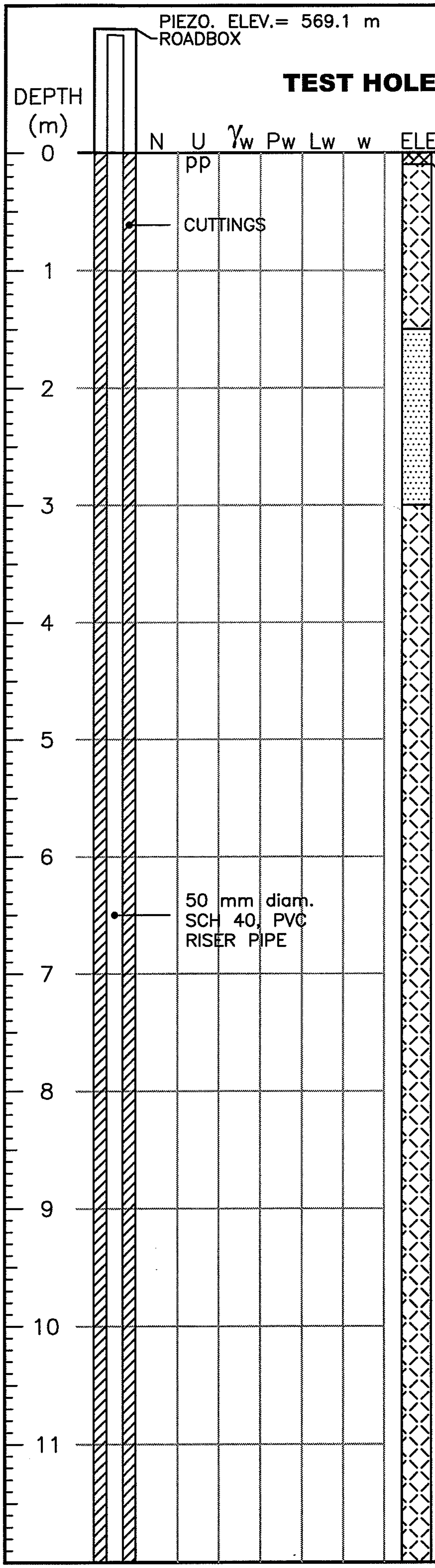
NORTHING:
EASTING:

DATE DRILLED: NOV 7/07

DRAWING NUMBER: S07-6301-2A

PAGE 1 OF 4

TEST HOLE 07-1A



TOPSOIL, organic, brown, rootlets.

GLACIAL TILL, clay, silty, some sand, trace gravel, very stiff, low plastic, damp, brown.
–cobbles/boulders at 500 mm.

SAND, some gravel, compact, poorly graded, fine grained, damp, brown, sloughing.

GLACIAL TILL, clay, silty, sandy, trace gravel, very stiff to hard, low plastic, moist, brown, oxide stained.

CONTINUED ON NEXT PAGE

LEGEND:

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

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m^3)

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

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

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ⧅ CUTTINGS

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P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

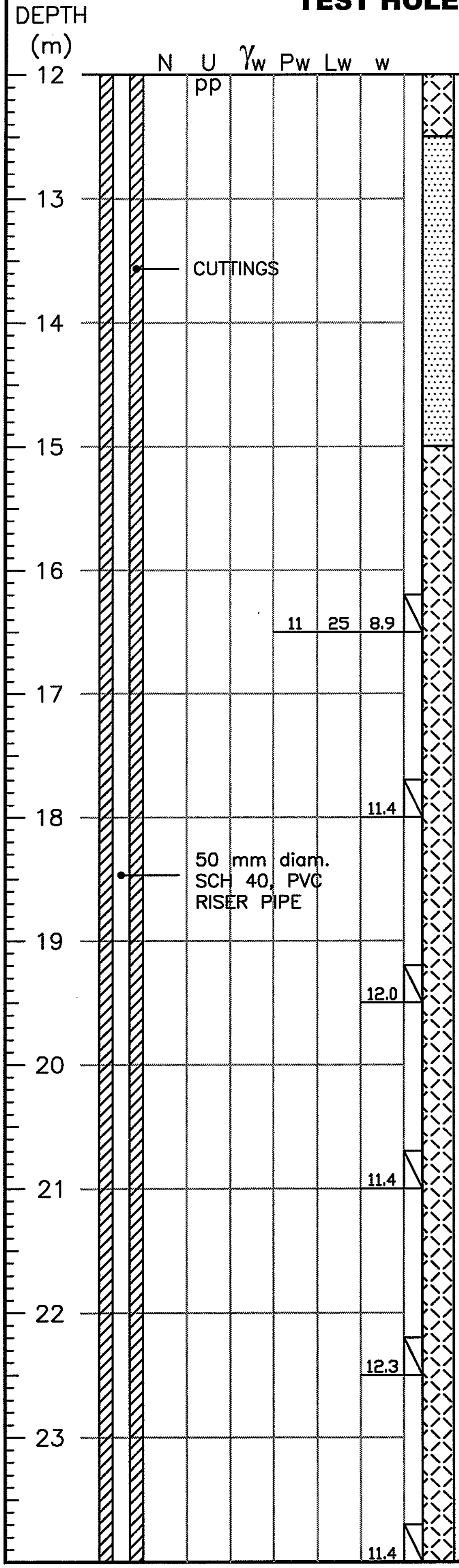
LOCATION:
COCHIN, SK

NORTHING: 5883744 **EASTING:** 678030

DATE DRILLED: NOV 7/07

DRAWING NUMBER: S07-6301-3

TEST HOLE 07-1A



GLACIAL TILL, clay, silty, sandy, trace gravel, very stiff to hard, low plastic, moist, brown, oxide stained.

SAND, some gravel, dense, well graded, fine to coarse grained, damp, brown.

GLACIAL TILL, silt, sandy, trace clay, trace gravel, very stiff to hard, low plastic, moist, grey.

–clay, silty, sandy, medium plastic below 17.5 m.

CONTINUED ON NEXT PAGE

LEGEND:

TOPSOIL ▨ FILL ▤ GRAVEL SAND SILT ▥ CLAY ▧ GLACIAL TILL ☒

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ⧄ CUTTINGS

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P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

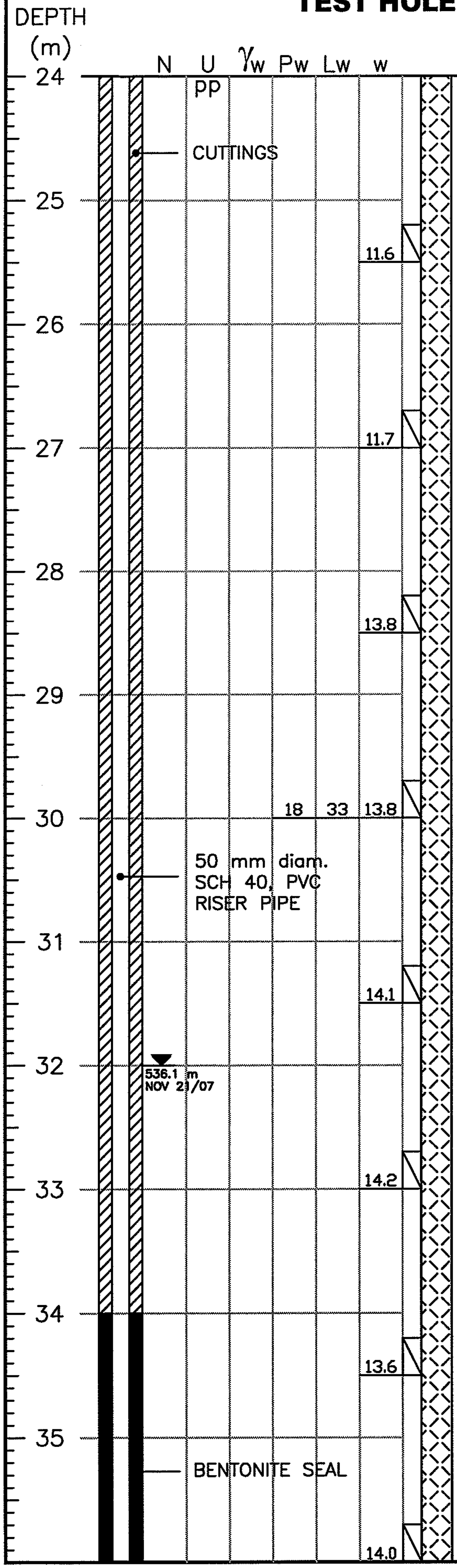
LOCATION:
COCHIN, SK

NORTHING: **EASTING:**

DATE DRILLED: NOV 7/07

DRAWING NUMBER: S07-6301-3A

TEST HOLE 07-1A



GLACIAL TILL, clay, silty, sandy, trace gravel, very stiff to hard, medium plastic, moist, grey.

CONTINUED ON NEXT PAGE

LEGEND:

TOPSOIL ▩ FILL ☰ GRAVEL ▦ SAND ░ SILT ▥ CLAY ▧ GLACIAL TILL ▨

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO₄.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ◺ CUTTINGS

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FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

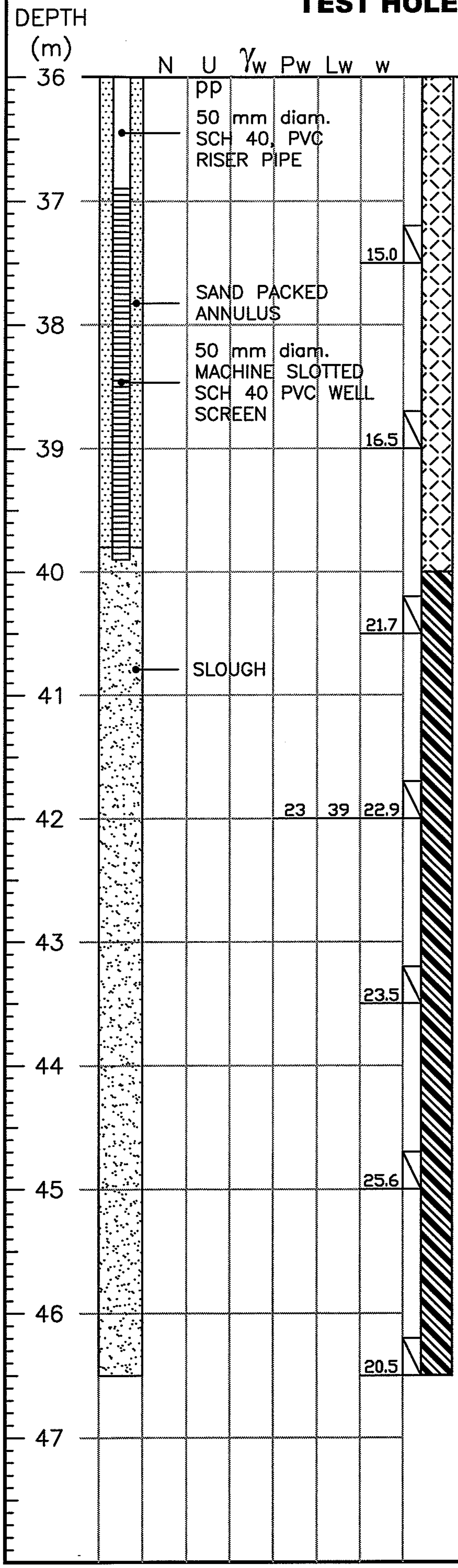
LOCATION:
COCHIN, SK

NORTHING:

EASTING:

DATE DRILLED:	**DRAWING NUMBER:**
NOV 7/07	S07-6301-3B

TEST HOLE 07-1A



GLACIAL TILL, clay, silty, sandy, trace gravel, very stiff to hard, medium plastic, moist, grey.

–sand seam, wet, seepage, sloughing at 37.8 m.

CLAY SHALE, silty, hard, medium plastic, moist, mottled blue/grey.

NOTE:
1. Test Hole sloughed to 39.8 m I.A.D.

LEGEND:

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

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m^3)

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

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

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ⧄ CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

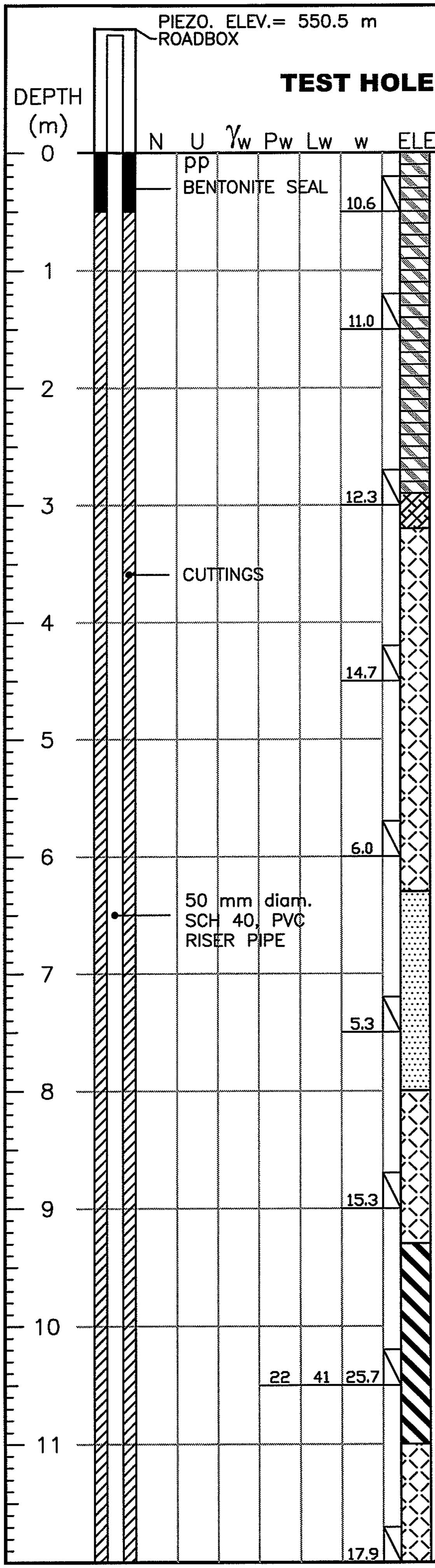
LOCATION:
COCHIN, SK

NORTHING:
EASTING:

DATE DRILLED: NOV 7/07

DRAWING NUMBER: S07-6301-3C

TEST HOLE 07-2



FILL, clay, silty, some sand, trace gravel, stiff, low plastic, moist, brown, trace organic debris.

TOPSOIL, organic, brown.

GLACIAL TILL, clay, silty, sandy, trace gravel, stiff, medium plastic, moist, brown.

SAND, some silt, compact, poorly graded, fine grained, moist, brown.
—cobbles/boulders at 6.5 m.

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

—cobbles/boulders at 9.2 m.

CLAY, some silt, trace sand, very stiff, medium plastic, moist, grey, oxide stained.

GLACIAL TILL, clay, silty, sandy, trace gravel, hard, medium plastic, moist, brown.

CONTINUED ON NEXT PAGE.

LEGEND:

TOPSOIL ▨ FILL ☰ GRAVEL SAND ░ SILT ▥ CLAY ▧ GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ⧄ CUTTINGS

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

P. MACHIBRODA
ENGINEERING
LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED
RESIDENTIAL SUBDIVISION

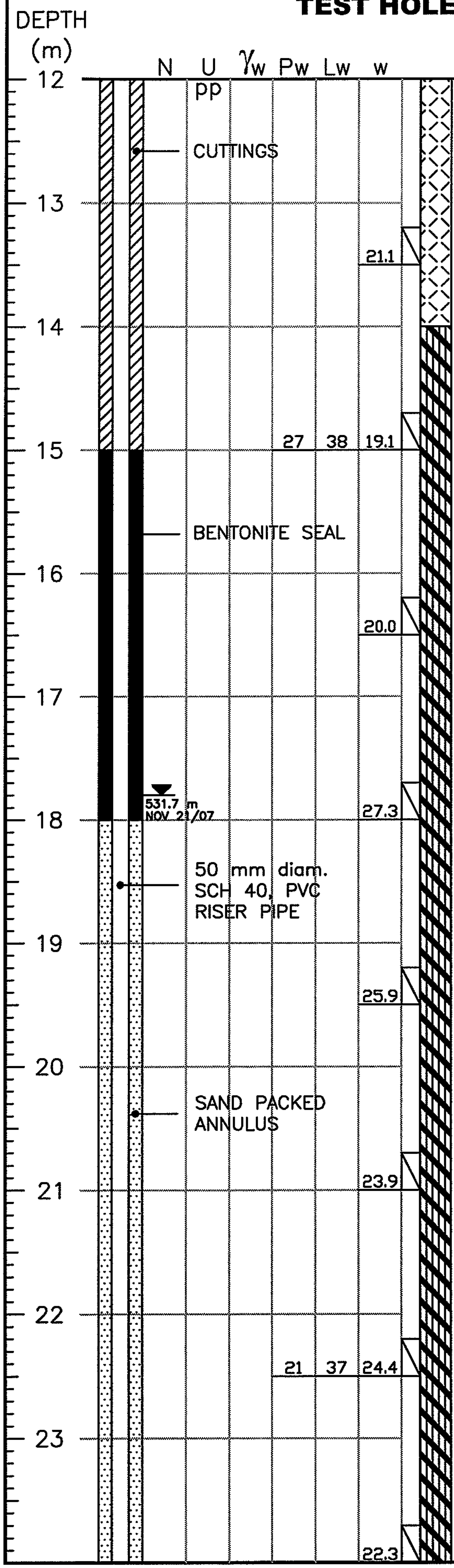
LOCATION:
COCHIN, SK

NORTHING: 5883904 **EASTING:** 677994

DATE DRILLED: NOV 8/07

DRAWING NUMBER: S07-6301-4

TEST HOLE 07-2



GLACIAL TILL, clay, silty, sandy, trace gravel, hard, medium plastic, moist, brown.

–gravel layer 13.2 to 13.5 m.

CLAY AND SILT, trace sand, stiff to very stiff, medium plastic, moist, brown.

–grey, trace organic odours below 14.8 m.

–brown, heavily oxide stained below 17.0 m.

–sandy below 20.0 m.

CONTINUED ON NEXT PAGE

LEGEND:

▨ TOPSOIL ▤ FILL ▨ GRAVEL ▨ SAND ▥ SILT ▨ CLAY ▨ GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ◺ CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED
RESIDENTIAL SUBDIVISION

LOCATION:
COCHIN, SK

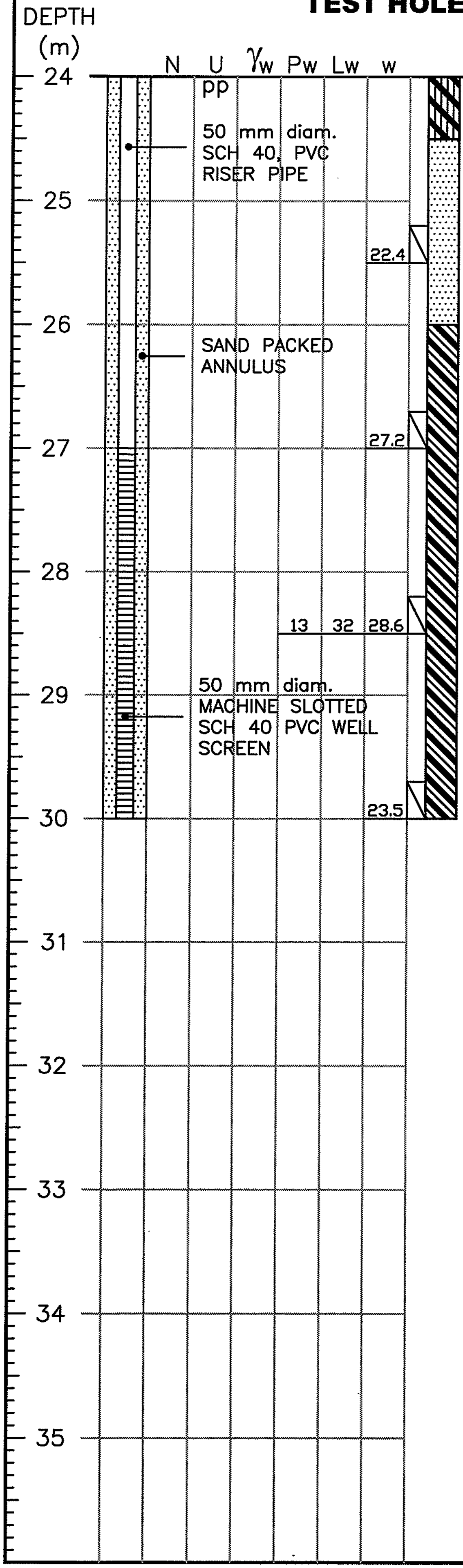
NORTHING: **EASTING:**

DATE DRILLED: NOV 8/07

DRAWING NUMBER: S07-6301-4A

PAGE 3 OF 3

TEST HOLE 07-2



CLAY AND SILT, sandy, stiff to very stiff, medium plastic, moist, brown, oxide stained.

SAND, silty, trace clay, very dense, poorly graded, fine grained, moist, grey.

CLAY SHALE, silty, stiff, medium plastic, moist, grey.

NOTE:
1. Test Hole open to 30.0 m and dry I.A.D.

LEGEND:

▤ FILL ▨ GRAVEL ▒ SAND ▥ SILT ▧ CLAY ▧ CLAY SHALE ☒ GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ⧅ CUTTINGS

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

P. MACHIBRODA
ENGINEERING
LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED
RESIDENTIAL SUBDIVISION

LOCATION:
COCHIN, SK

NORTHING: **EASTING:**

DATE DRILLED: NOV 8/07

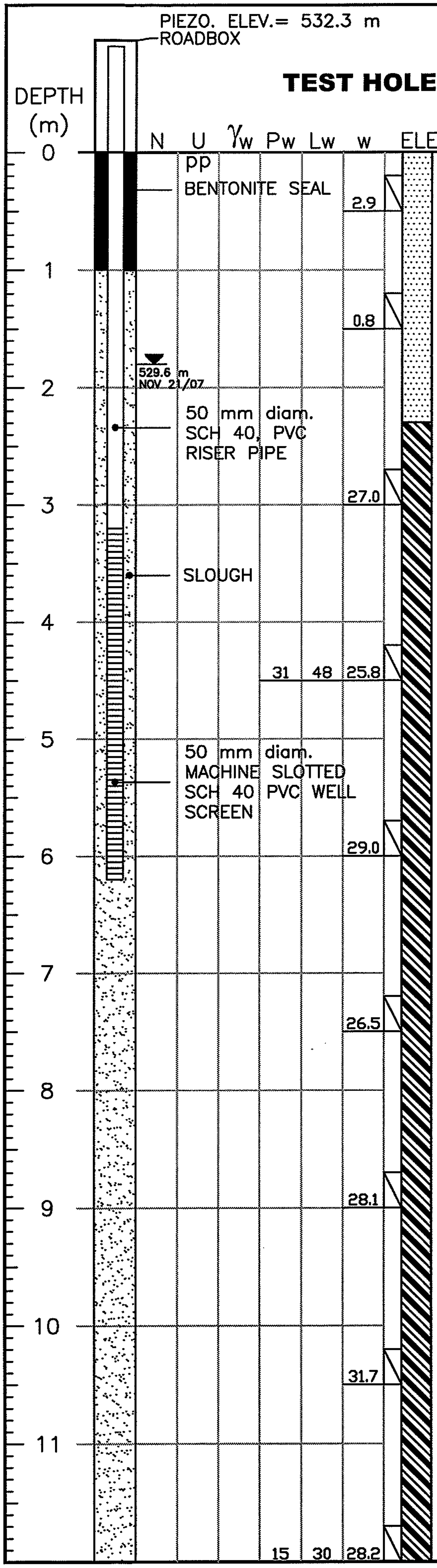
DRAWING NUMBER: S07-6301-4B

PAGE 1 OF 2

TEST HOLE 07-3

PIEZO. ELEV.= 532.3 m

ELEV: 531.4 m



SAND, some gravel, trace silt, loose, poorly graded, fine to medium grained, damp, brown.

—wet, seepage, sloughing below 1.7 m.

CLAY SHALE, silty, very stiff to hard, medium to highly plastic, moist, grey.

—sand seam, seepage at 8.8 m.

CONTINUED ON NEXT PAGE

LEGEND:

▩	▤	▦	⬚	▥	▧	⊠
TOPSOIL	FILL	GRAVEL	SAND	SILT	CLAY SHALE	GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■	⊠	◺
SHELBY TUBE	SPLIT SPOON	CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION

LOCATION: COCHIN, SK

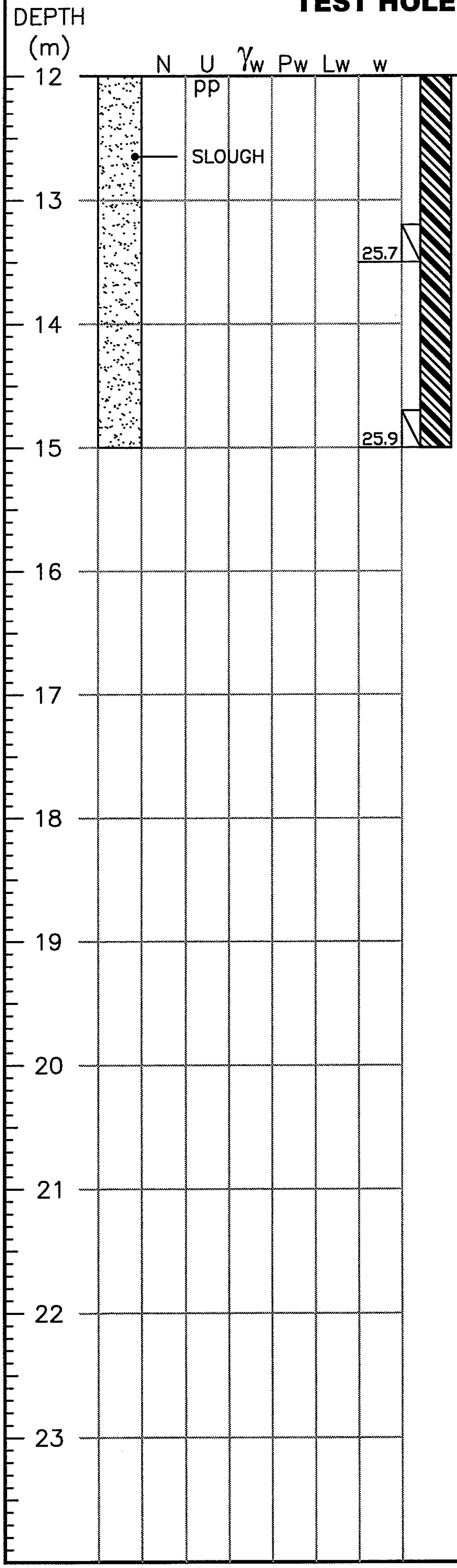
NORTHING: 5883841 **EASTING:** 677884

DATE DRILLED: NOV 5/07

DRAWING NUMBER: S07-6301-5

PAGE 2 OF 2

TEST HOLE 07-3



CLAY SHALE, silty, very stiff to hard, medium to highly plastic, moist, grey.

NOTE:
1. Test Hole sloughed to 1.0 m I.A.D.

LEGEND:

TOPSOIL ▩ FILL ☰ GRAVEL SAND ▒ SILT ▥ CLAY SHALE ▧ GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

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

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

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ◸ CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

LOCATION:
COCHIN, SK

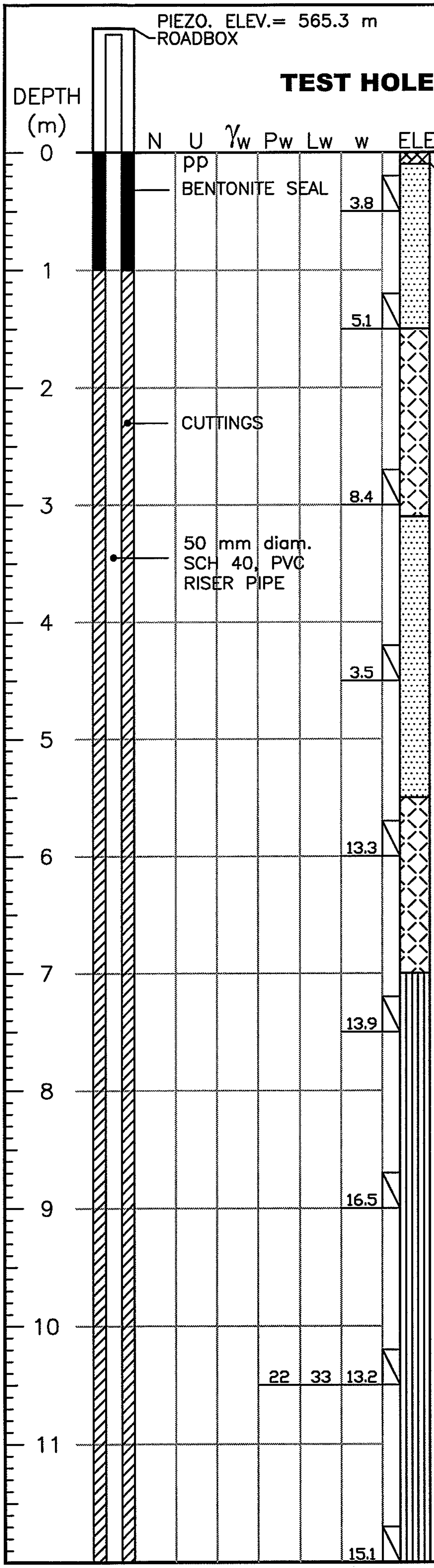
NORTHING: **EASTING:**

DATE DRILLED: NOV 5/07

DRAWING NUMBER: S07-6301-5A

PAGE 1 OF 5

TEST HOLE 07-4



TOPSOIL, organic, brown, rootlets.

SAND, some gravel, trace silt, loose, well graded, fine to coarse grained, damp, brown.

GLACIAL TILL, clay, silty, sandy, trace gravel, very stiff, low plastic, moist, brown, oxide stained.

SAND, some gravel, trace silt, compact, well graded, fine to coarse grained, damp, brown.

GLACIAL TILL, clay, silty, sandy, trace gravel, very stiff, low plastic, moist, brown, oxide stained.

SILT, sandy, trace clay, hard, low plastic, moist, brown.

—some clay, some sand, medium plastic, oxide stained 8.0 to 13.9 m.

CONTINUED ON NEXT PAGE

LEGEND:

TOPSOIL ▩ FILL ▤ GRAVEL SAND SILT ▥ CLAY ▧ GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ⧅ CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

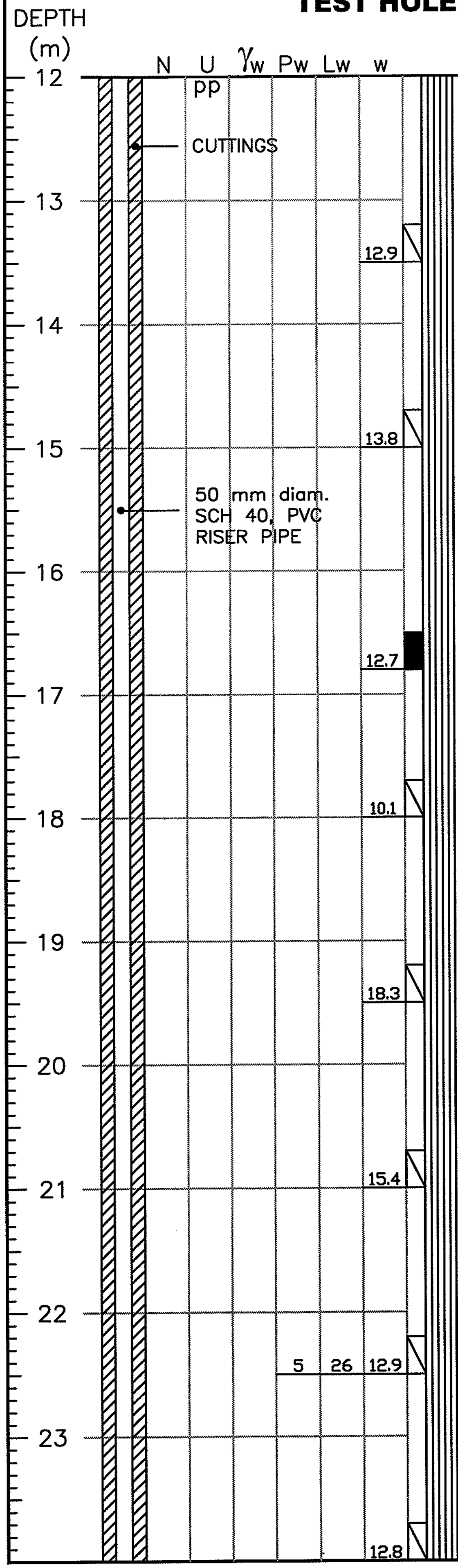
LOCATION:
COCHIN, SK

NORTHING: 5884070 **EASTING:** 678078

DATE DRILLED: NOV 6/07

DRAWING NUMBER: S07-6301-6

TEST HOLE 07-4



SILT, some clay, some sand, hard, medium plastic, moist, brown, oxide stained.

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LEGEND:

▨ TOPSOIL
▤ FILL
▨ GRAVEL
▒ SAND
▥ SILT
▧ CLAY
☒ GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m^3)

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

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

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO$_4$.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE
☒ SPLIT SPOON
◺ CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

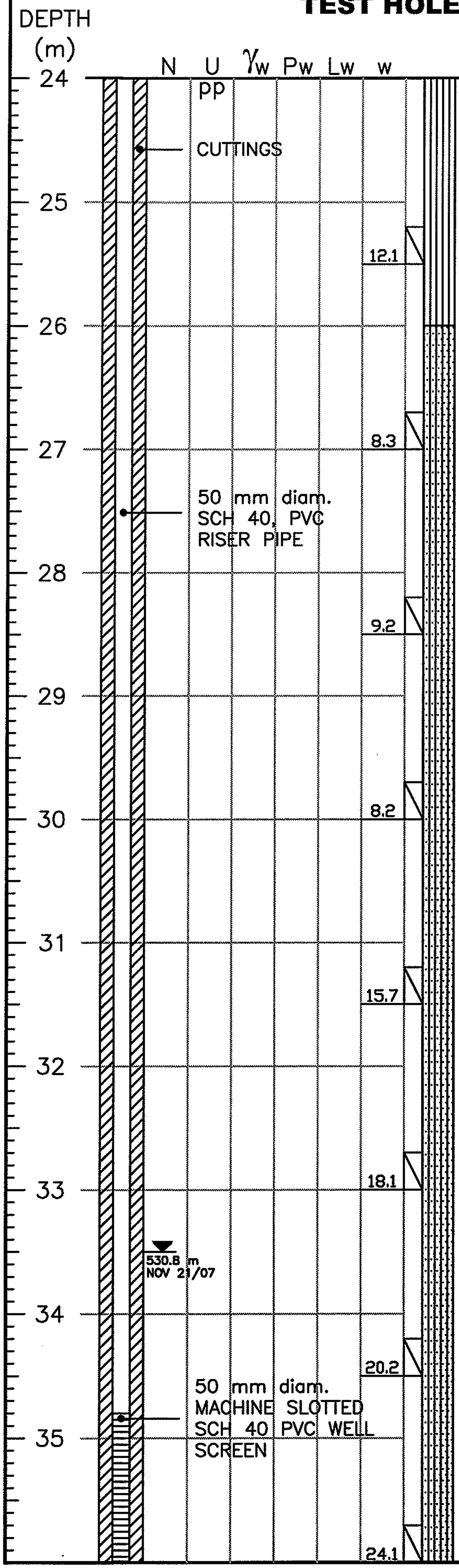
LOCATION:
COCHIN, SK

NORTHING:
EASTING:

DATE DRILLED: NOV 6/07

DRAWING NUMBER: S07-6301-6A

TEST HOLE 07-4



SILT, some clay, some sand, hard, low plastic, moist, brown, oxide stained.

SILT AND SAND, very stiff to hard, non to low plastic, damp to moist, brown.

—silt layer 28.0 to 29.0 m.

—silt layer 31.0 to 31.8 m.

—wet, seepage, sloughing below 33.9 m.

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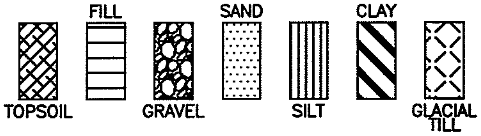
LEGEND:



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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m^3)

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

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

N.....STANDARD PENETRATION TEST
(ROPE—CATHEAD & DONUT HAMMER)
(50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ⧄ CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED
RESIDENTIAL SUBDIVISION

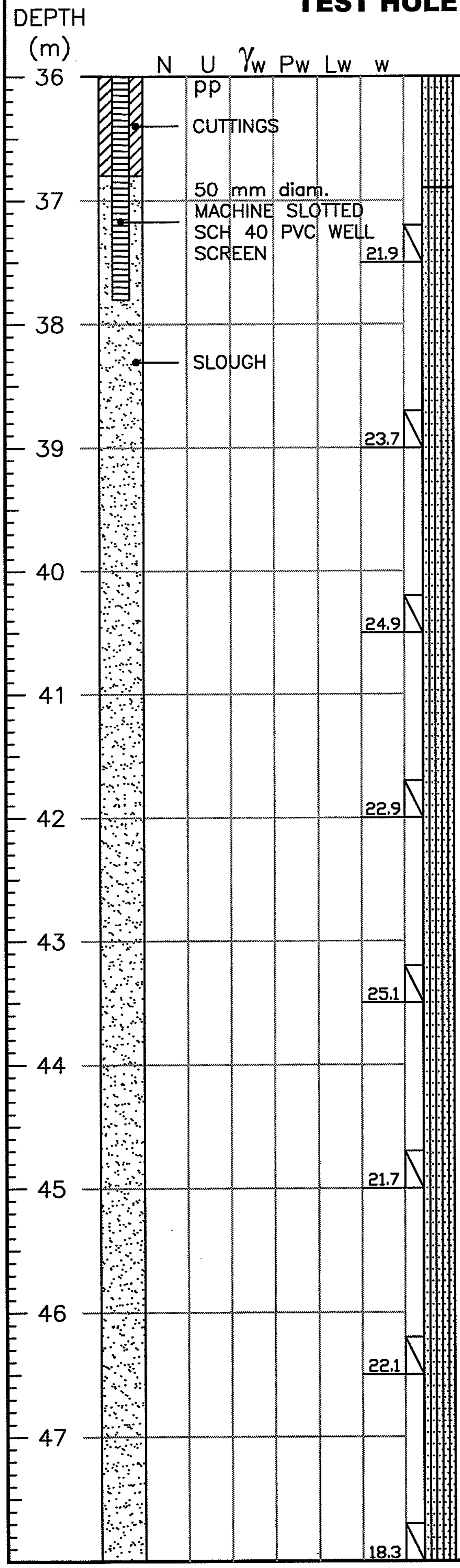
LOCATION:
COCHIN, SK

NORTHING: **EASTING:**

DATE DRILLED: NOV 6/07

DRAWING NUMBER: S07-6301-6B

TEST HOLE 07-4



SILT AND SAND, very stiff to hard, non to low plastic, wet, brown, seepage, sloughing.

SAND AND SILT, dense, poorly graded, fine grained, wet, brown, seepage, sloughing.

CONTINUED ON NEXT PAGE

LEGEND:

TOPSOIL FILL GRAVEL SAND SILT CLAY GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ⧄ CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED
RESIDENTIAL SUBDIVISION

LOCATION:
COCHIN, SK

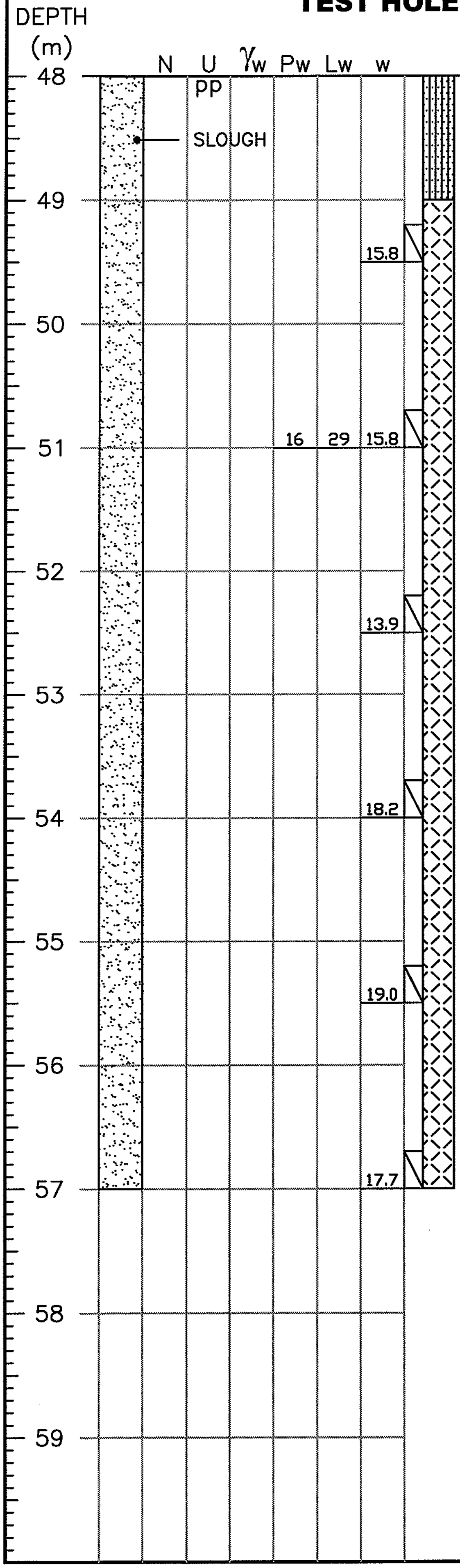
NORTHING: **EASTING:**

DATE DRILLED: NOV 6/07

DRAWING NUMBER: S07-6301-6C

PAGE 5 OF 5

TEST HOLE 07-4



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

GLACIAL TILL, clay, silty, sandy, trace gravel, very stiff to hard, medium plastic, moist, grey.

NOTE:
1. Test Hole sloughed to 36.8 m I.A.D.

LEGEND:

TOPSOIL FILL GRAVEL SAND SILT CLAY GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO$_4$ .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ⧅ CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED
RESIDENTIAL SUBDIVISION

LOCATION:
COCHIN, SK

NORTHING: **EASTING:**

DATE DRILLED: NOV 6/07

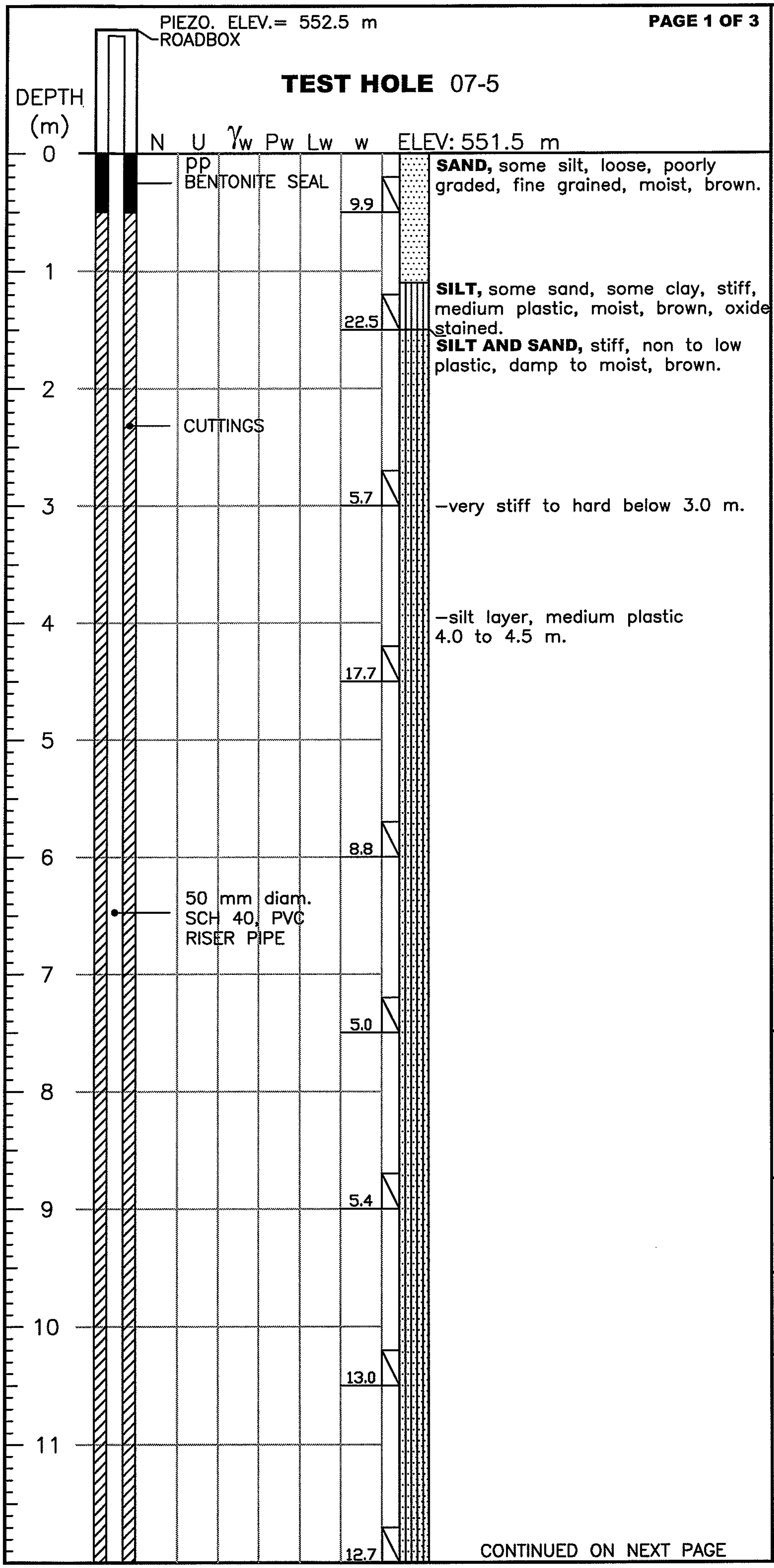
DRAWING NUMBER: S07-6301-6D

PIEZO. ELEV.= 552.5 m

PAGE 1 OF 3

TEST HOLE 07-5

ELEV: 551.5 m



SAND, some silt, loose, poorly graded, fine grained, moist, brown.

SILT, some sand, some clay, stiff, medium plastic, moist, brown, oxide stained.

SILT AND SAND, stiff, non to low plastic, damp to moist, brown.

–very stiff to hard below 3.0 m.

–silt layer, medium plastic 4.0 to 4.5 m.

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LEGEND:

▨ TOPSOIL
▤ FILL
● GRAVEL
░ SAND
▥ SILT
▧ CLAY
☒ GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

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

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE
☒ SPLIT SPOON
◺ CUTTINGS

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P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

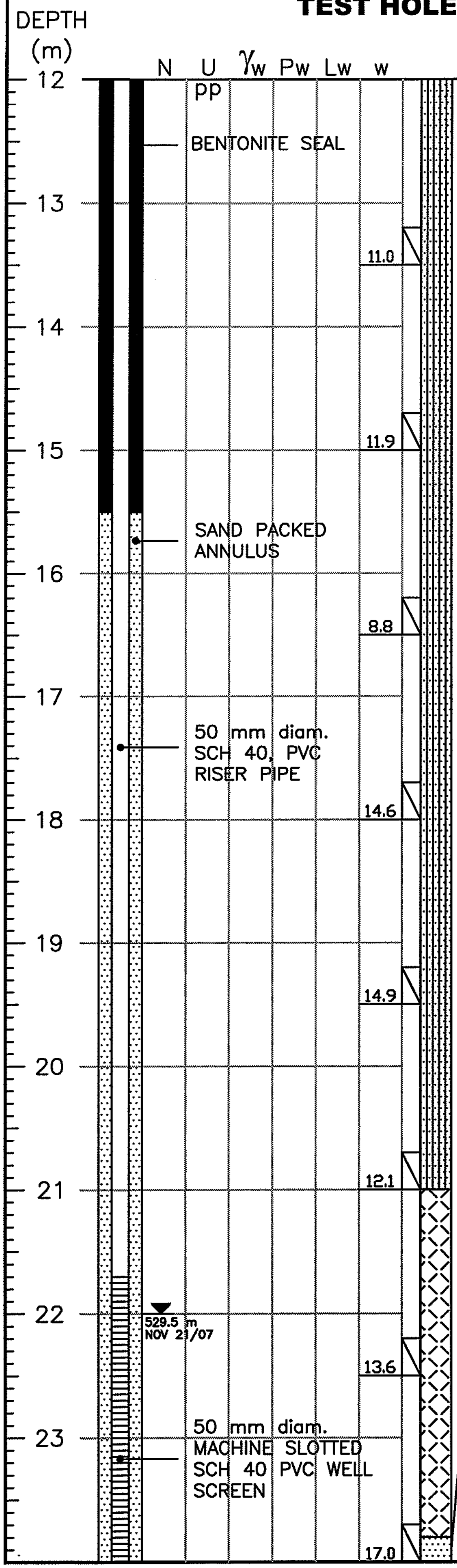
PROJECT:
PROPOSED
RESIDENTIAL SUBDIVISION

LOCATION:
COCHIN, SK

NORTHING: 5884107 **EASTING:** 678029

DATE DRILLED:	**DRAWING NUMBER:**
NOV 8/07	S07-6301-7

TEST HOLE 07-5



SILT AND SAND, very stiff to hard, non to low plastic, damp to moist, brown.

—oxide stained below 15.5 m.

—some clay, stiff, low plastic, moist, oxide stained below 18.3 m.

GLACIAL TILL, clay, silty, sandy, trace gravel, hard, low to medium plastic, moist, grey.
—trace seepage at 21.5 m.

CONTINUED ON NEXT PAGE

SAND, silty, some gravel, trace clay, very dense, well graded, fine to coarse grained, wet, grey, seepage, sloughing.

LEGEND:

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

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)
Lw...LIQUID LIMIT
Pw...PLASTIC LIMIT
γw...WET UNIT WEIGHT (kN/m³)
U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)
pp...POCKET PENETROMETER (kg/cm²)
N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])
SO_4.....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)
P200...% PASSING No. 200 SIEVE
I.A.D.....IMMEDIATELY AFTER DRILLING
▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)
▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ⧄ CUTTINGS

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P. MACHIBRODA
ENGINEERING
LTD.

FIELD DRILL LOG
AND
SOIL TEST RESULTS

PROJECT:
PROPOSED
RESIDENTIAL SUBDIVISION

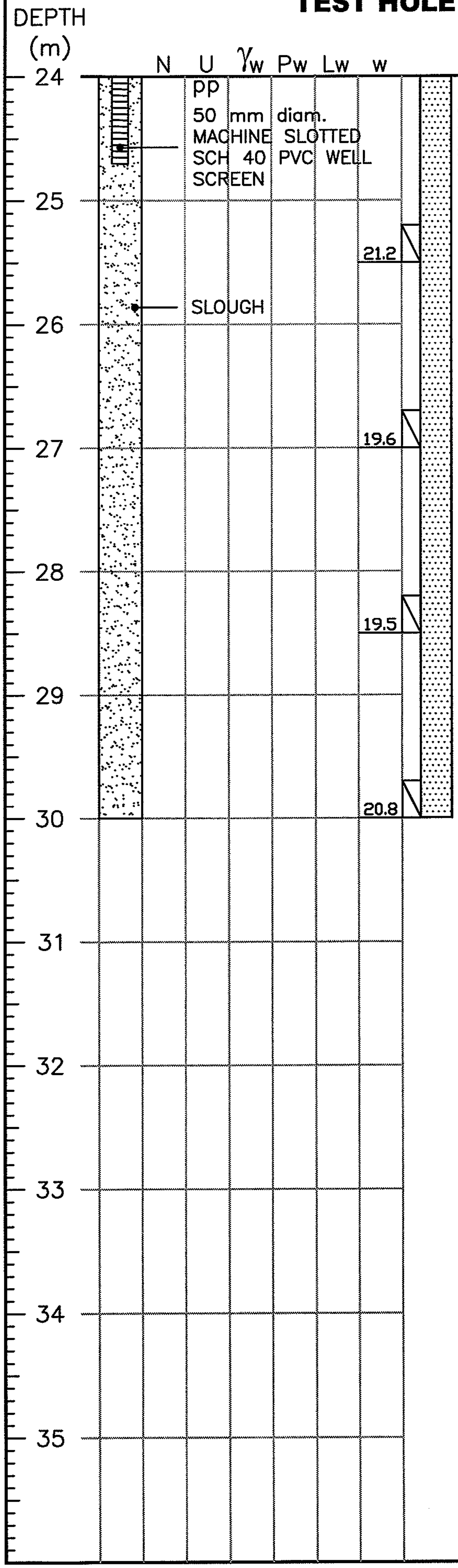
LOCATION:
COCHIN, SK

NORTHING:
EASTING:

DATE DRILLED:	**DRAWING NUMBER:**
NOV 8/07	S07-6301-7A

PAGE 3 OF 3

TEST HOLE 07-5



SAND, silty, some gravel, trace clay, very dense, well graded, fine to coarse grained, wet, grey, seepage, sloughing.

NOTE:
1. Test Hole sloughed to 24.0 m I.A.D.

LEGEND:

▨ TOPSOIL ▤ FILL ▩ GRAVEL ░ SAND ▥ SILT ▧ CLAY ☒ GLACIAL TILL

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m^3)

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

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

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE ☒ SPLIT SPOON ◺ CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT: PROPOSED RESIDENTIAL SUBDIVISION

LOCATION: COCHIN, SK

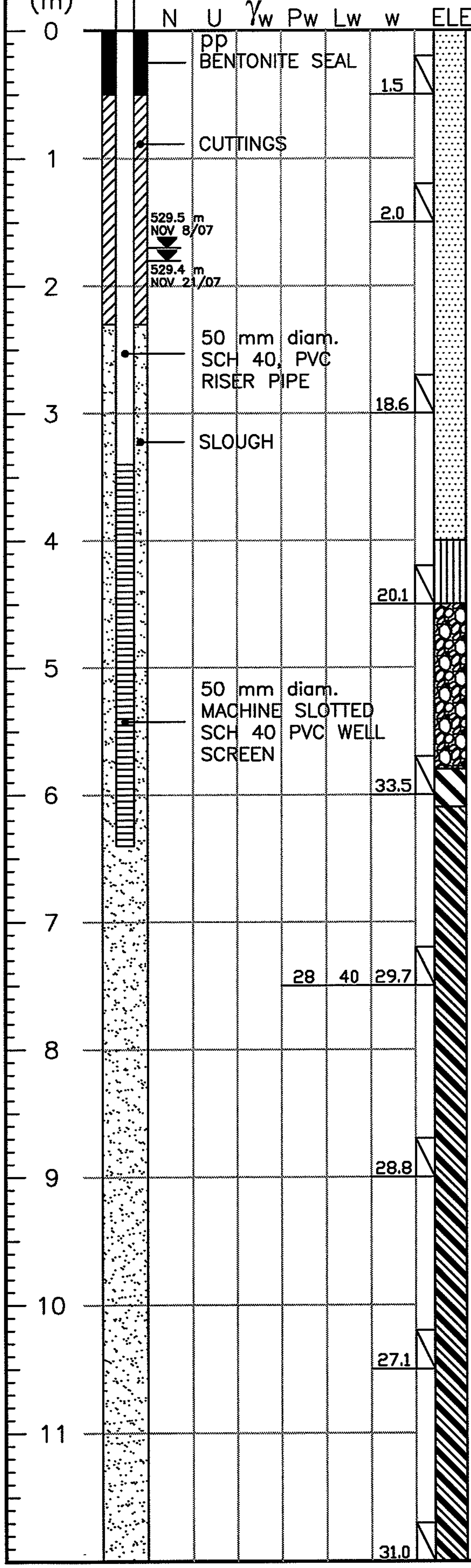
NORTHING:

EASTING:

DATE DRILLED:	**DRAWING NUMBER:**
NOV 8/07	S07-6301-7B

PIEZO. ELEV.= 532.2 m

TEST HOLE 07-6



SAND, some gravel, trace silt, loose, poorly graded, fine to medium grained, damp, brown.

–wet, seepage, sloughing below 1.5 m.
–grey below 1.8 m.

–silty, poorly graded, fine grained below 2.3 m.

SILT, sandy, stiff, non plastic, wet, grey, seepage, sloughing.

GRAVEL, sandy, some silt, loose, well graded, fine to coarse grained, wet, grey, seepage, sloughing.

CLAY, silty, firm, highly plastic, very moist, grey.

CLAY SHALE, silty, stiff, medium to highly plastic, moist, mottled blue/grey.

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

LEGEND:

▨ TOPSOIL
▤ FILL
▨ GRAVEL
▨ SAND
▥ SILT
▨ CLAY
▨ CLAY SHALE

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

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γw...WET UNIT WEIGHT (kN/m³)

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

pp...POCKET PENETROMETER (kg/cm²)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

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

P200...% PASSING No. 200 SIEVE

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

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

▼...RECORDED WATER LEVEL (PIEZO)

■ SHELBY TUBE
☒ SPLIT SPOON
◹ CUTTINGS

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

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

LOCATION:
COCHIN, SK

NORTHING: 5884197 **EASTING:** 677918

DATE DRILLED: NOV 7/07

DRAWING NUMBER: S07-6301-8

STRATIGRAPHIC SECTION A–A'

LEGEND

FILL
GRAVEL
SAND
SILT
CLAY
CLAY SHALE
GLACIAL TILL
W.L. ▼ NOV 21/07 RECORDED WATER LEVEL

LIMITATIONS

THIS STRATIGRAPHIC SECTION IS A SUMMARY OF SUBSURFACE FIELD CONDITIONS INFERRED FROM DATA ENCOUNTERED AT SPECIFIC TEST HOLE LOCATIONS AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS AND, IN TIME, MAY CHANGE AT THE SPECIFIC LOCATION OF ANY TEST HOLE.

P. MACHIBRODA ENGINEERING LTD.
CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS
2623 B FAITHFULL AVENUE
SASKATOON, SK
S7K 5W2

DRAWING TITLE:
STRATIGRAPHIC SECTION
A - A'

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK

APPROVED BY: CZ
DRAWN BY: JH
DATE: DECEMBER, 2007
SCALE: AS SHOWN
DRAWING NUMBER: S07-6301-9

STRATIGRAPHIC SECTION B–B'

LEGEND

- ☰ FILL
- ▩ GRAVEL
- ░ SAND
- ▥ SILT
- ▧ CLAY
- ▨ CLAY SHALE
- ⊠ GLACIAL TILL
- W.L. ▼ NOV 21/07 RECORDED WATER LEVEL

LIMITATIONS

THIS STRATIGRAPHIC SECTION IS A SUMMARY OF SUBSURFACE FIELD CONDITIONS INFERRED FROM DATA ENCOUNTERED AT SPECIFIC TEST HOLE LOCATIONS AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS AND, IN TIME, MAY CHANGE AT THE SPECIFIC LOCATION OF ANY TEST HOLE.

P. MACHIBRODA ENGINEERING LTD.

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

2623 B FAITHFULL AVENUE
SASKATOON, SK
S7K 5W2

DRAWING TITLE:
STRATIGRAPHIC SECTION
B - B'

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK

APPROVED BY: CZ	DRAWN BY: JH
DATE: DECEMBER, 2007	DRAWING NUMBER: S07-6301-10
SCALE: AS SHOWN	

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK

Project No.: S07-6301

Date Tested: NOVEMBER 14, 2007

Test Hole No.: 07-1A

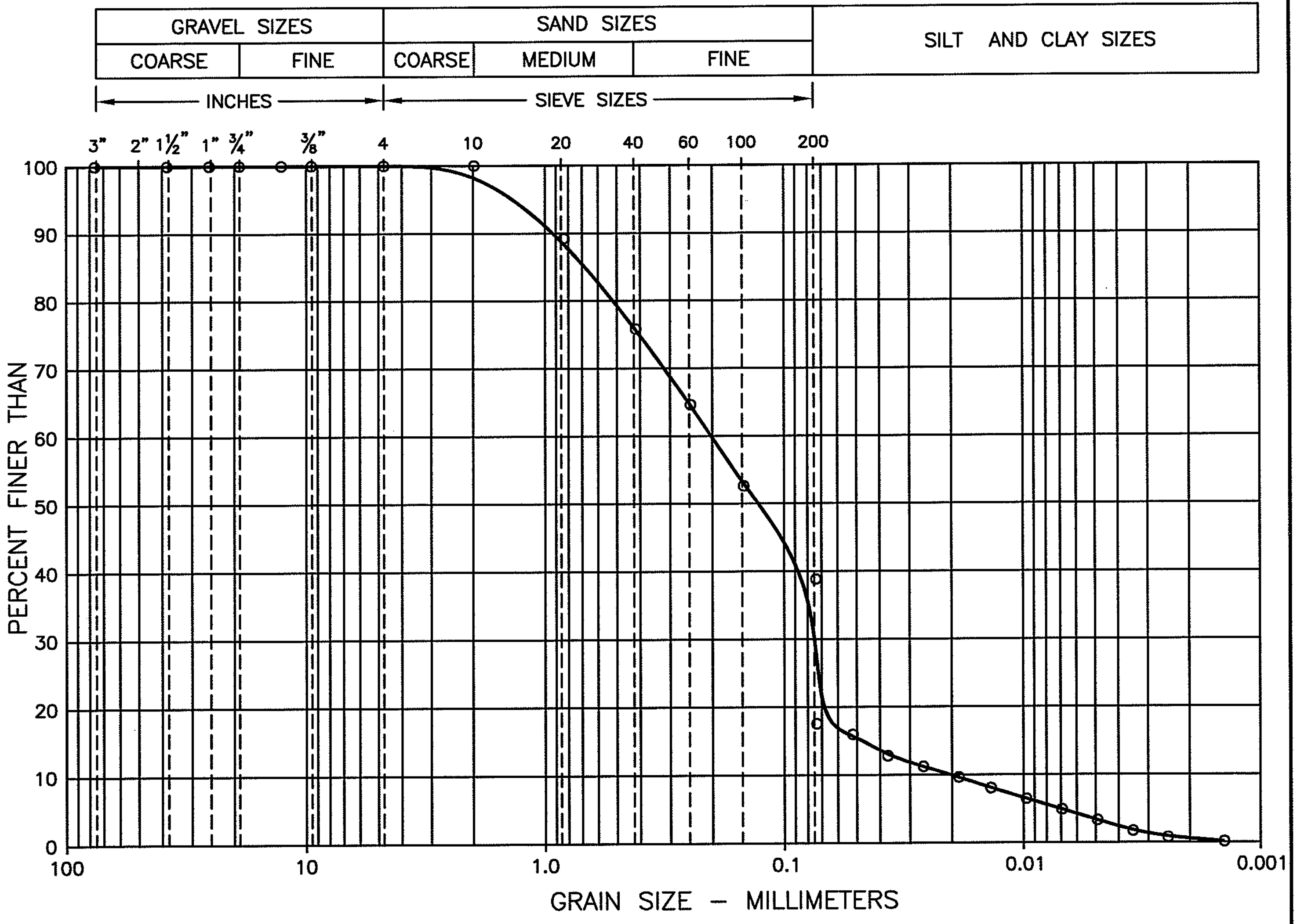
Sample No.: 62

Depth (m): 16.5

Remarks:

Material Description

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



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

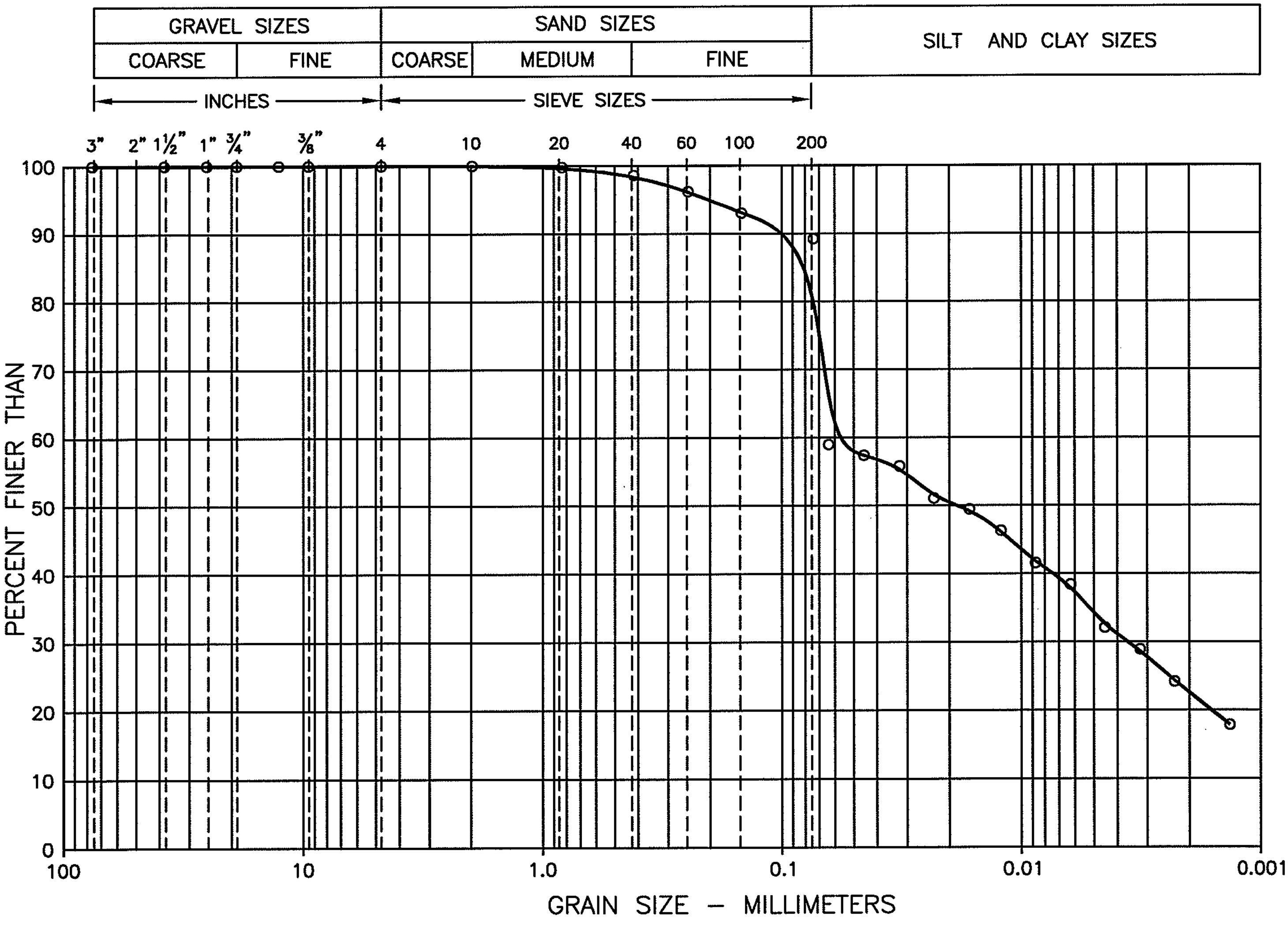
S07-6301-11

GRAIN SIZE DISTRIBUTION TEST REPORT

Project:	PROPOSED RESIDENTIAL SUBDIVISION COCHIN, SK
Project No.:	S07-6301
Date Tested:	NOVEMBER 14, 2007
Test Hole No.:	07-1A
Sample No.:	71
Depth (m):	30.0
Remarks:	

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	11	67	22



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

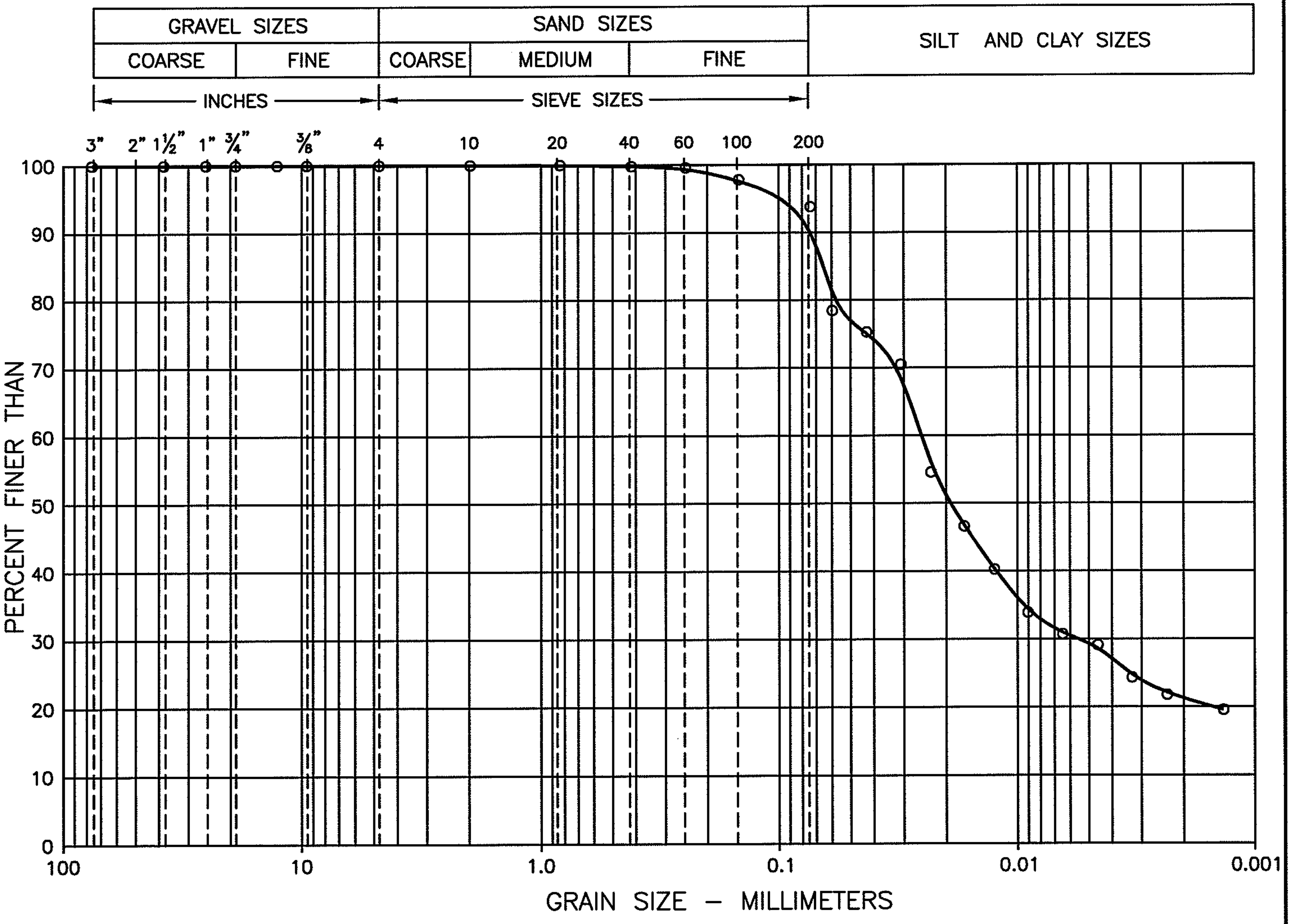
S07-6301-12

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK
Project No.: S07–6301
Date Tested: NOVEMBER 15, 2007
Test Hole No.: 07–2
Sample No.: 102
Depth (m): 15.0
Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	6	73	21



P. MACHIBRODA ENGINEERING LTD.

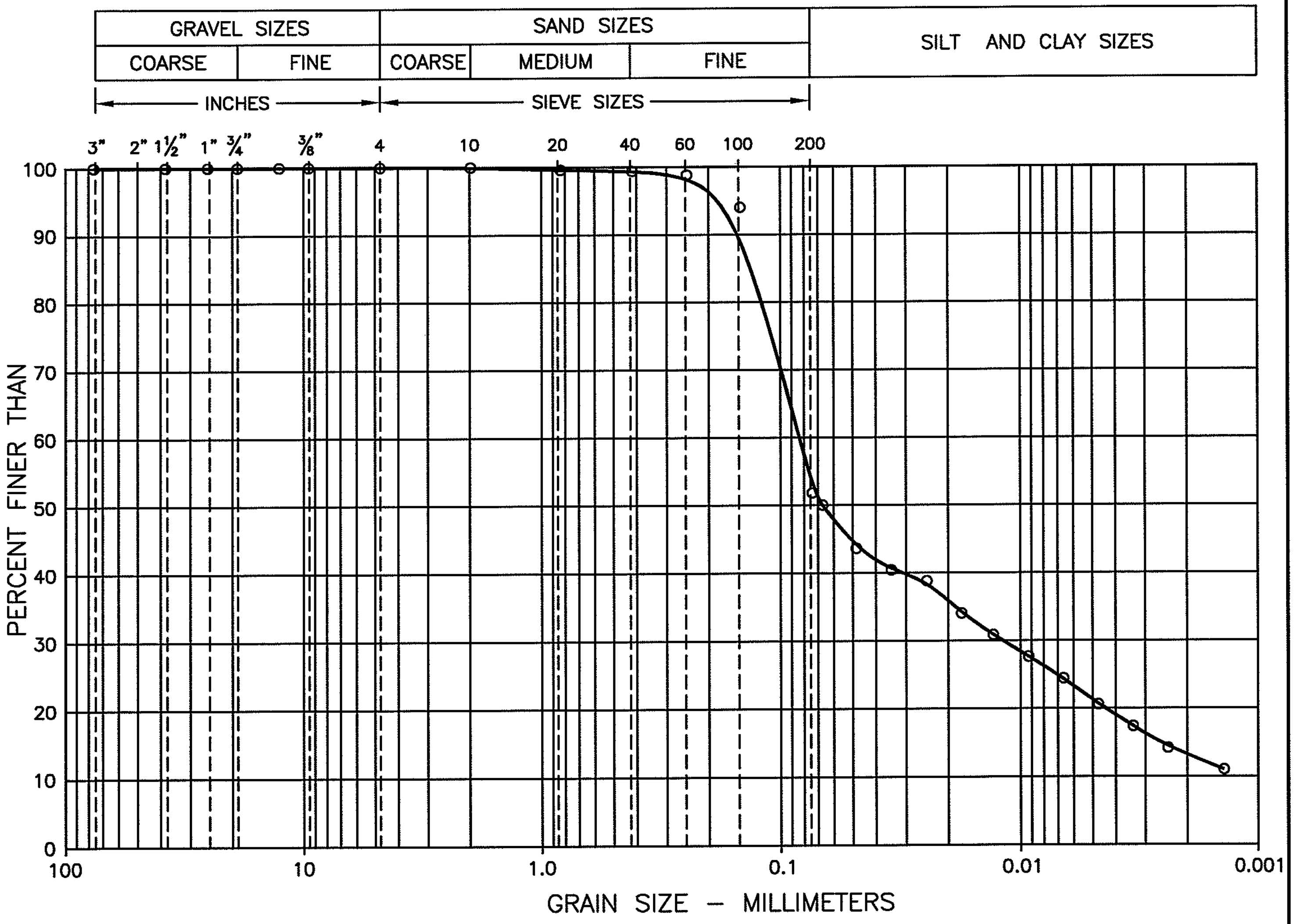
DRAWING NO.
S07-6301-13

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK
Project No.: S07–6301
Date Tested: NOVEMBER 15, 2007
Test Hole No.: 07–2
Sample No.: 107
Depth (m): 22.5
Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	48	39	13



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.
S07-6301-14

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK

Project No.: S07−6301

Date Tested: NOVEMBER 14, 2007

Test Hole No.: 07−4

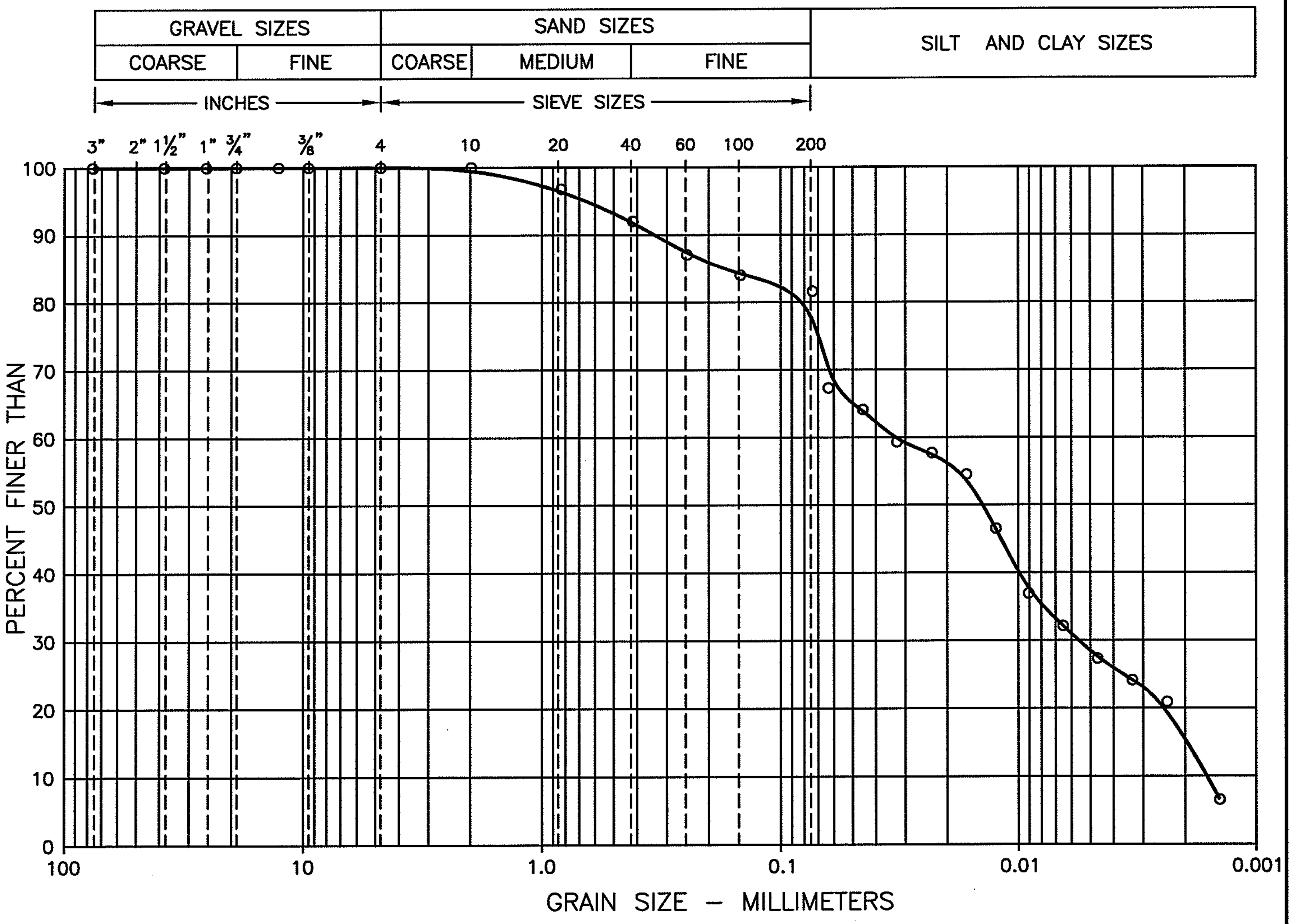
Sample No.: 30

Depth (m): 10.5

Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	18	67	15



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S07-6301-15

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK

Project No.: S07-6301

Date Tested: NOVEMBER 14, 2007

Test Hole No.: 07-4

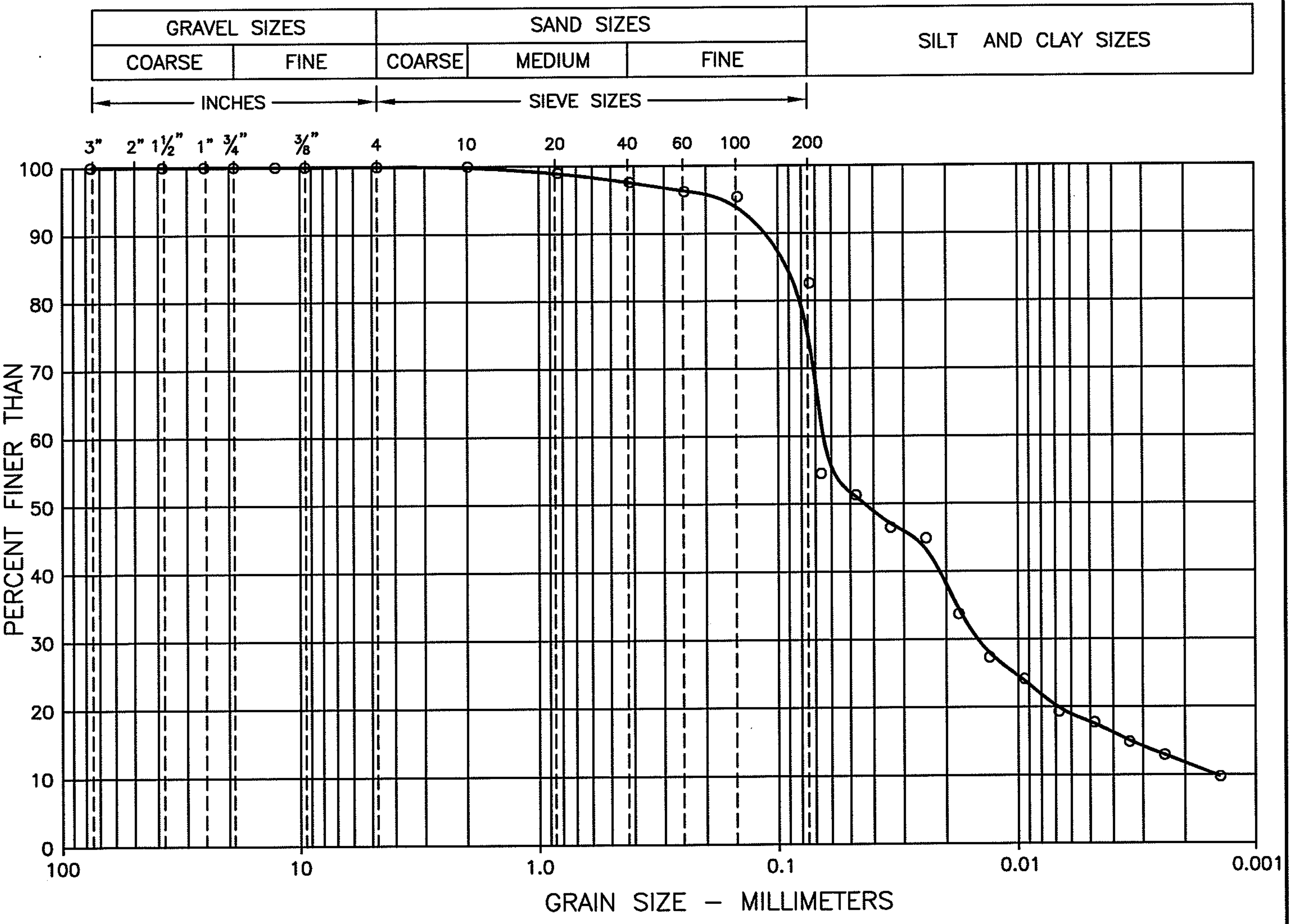
Sample No.: 38

Depth (m): 22.5

Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	17	71	12



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S07-6301-16

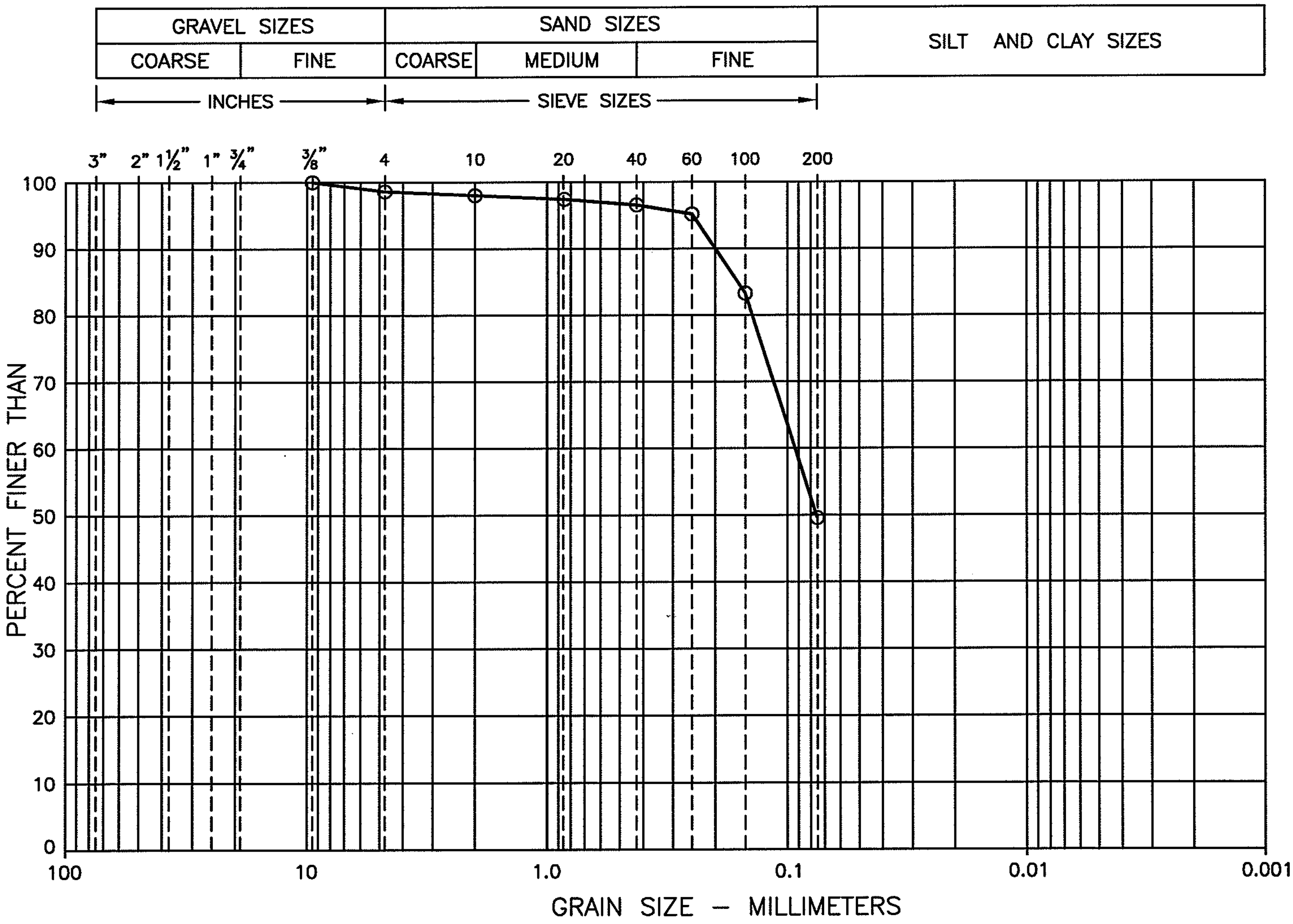
GRAIN SIZE DISTRIBUTION TEST REPORT

Project:	PROPOSED RESIDENTIAL SUBDIVISION COCHIN, SK
Project No.:	S07-6301
Date Tested:	NOVEMBER 14, 2007
Test Hole No.:	07-4
Sample No.:	43
Depth (m):	30.0
Remarks:	

SIEVE SIZE	PERCENT PASSING
3/8 inch	100.0
No. 4	98.6
No. 10	98.0
No. 20	97.4
No. 40	96.6
No. 60	95.2
No. 100	83.3
No. 200	49.5

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
1	49	50



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S07-6301-17

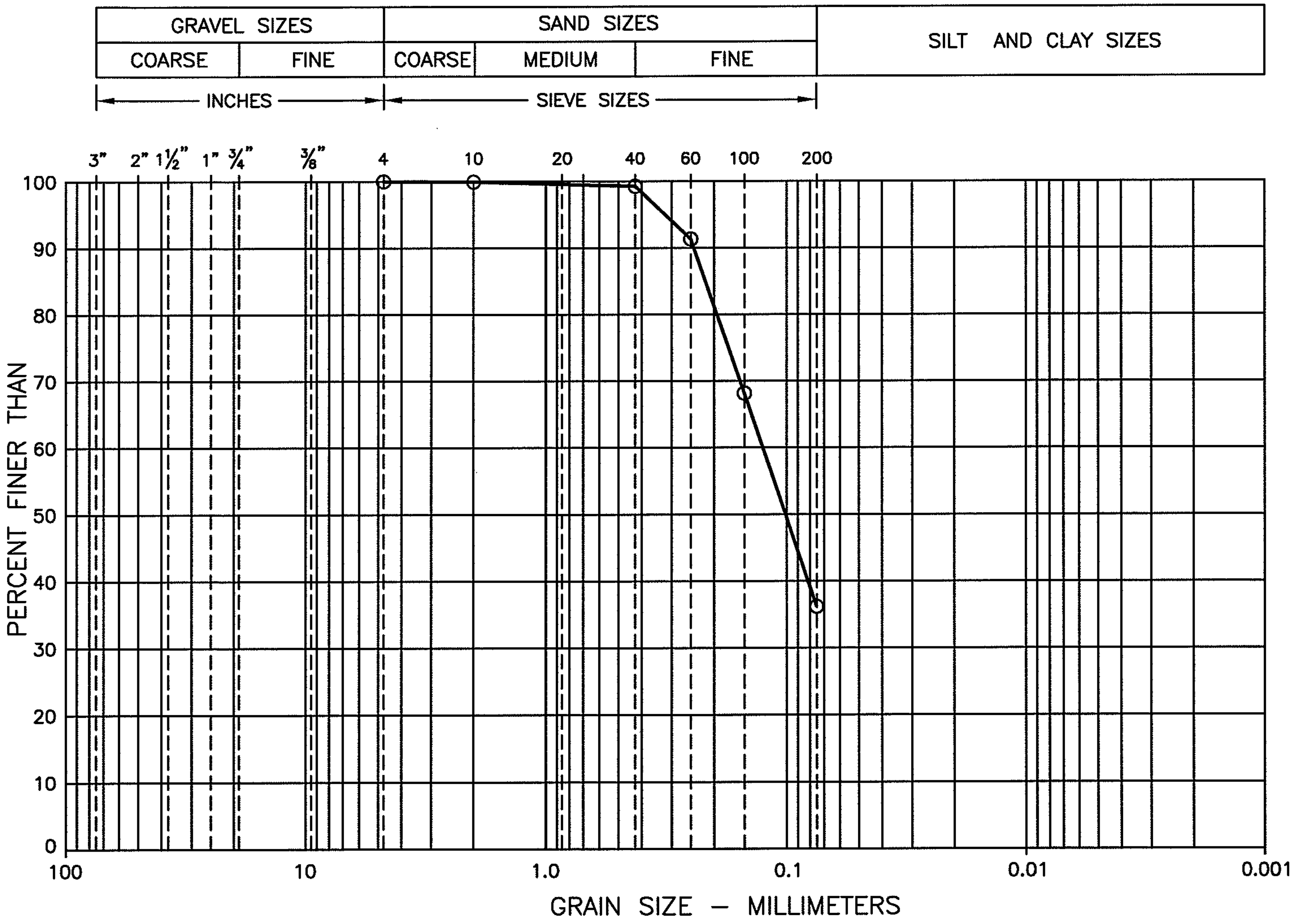
GRAIN SIZE DISTRIBUTION TEST REPORT

Project:	PROPOSED RESIDENTIAL SUBDIVISION COCHIN, SK
Project No.:	S07–6301
Date Tested:	NOVEMBER 14, 2007
Test Hole No.:	07–4
Sample No.:	53
Depth (m):	45.0
Remarks:	

SIEVE SIZE	PERCENT PASSING
No. 4	100.0
No. 10	99.9
No. 40	99.3
No. 60	91.3
No. 100	68.1
No. 200	36.2

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	64	36



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

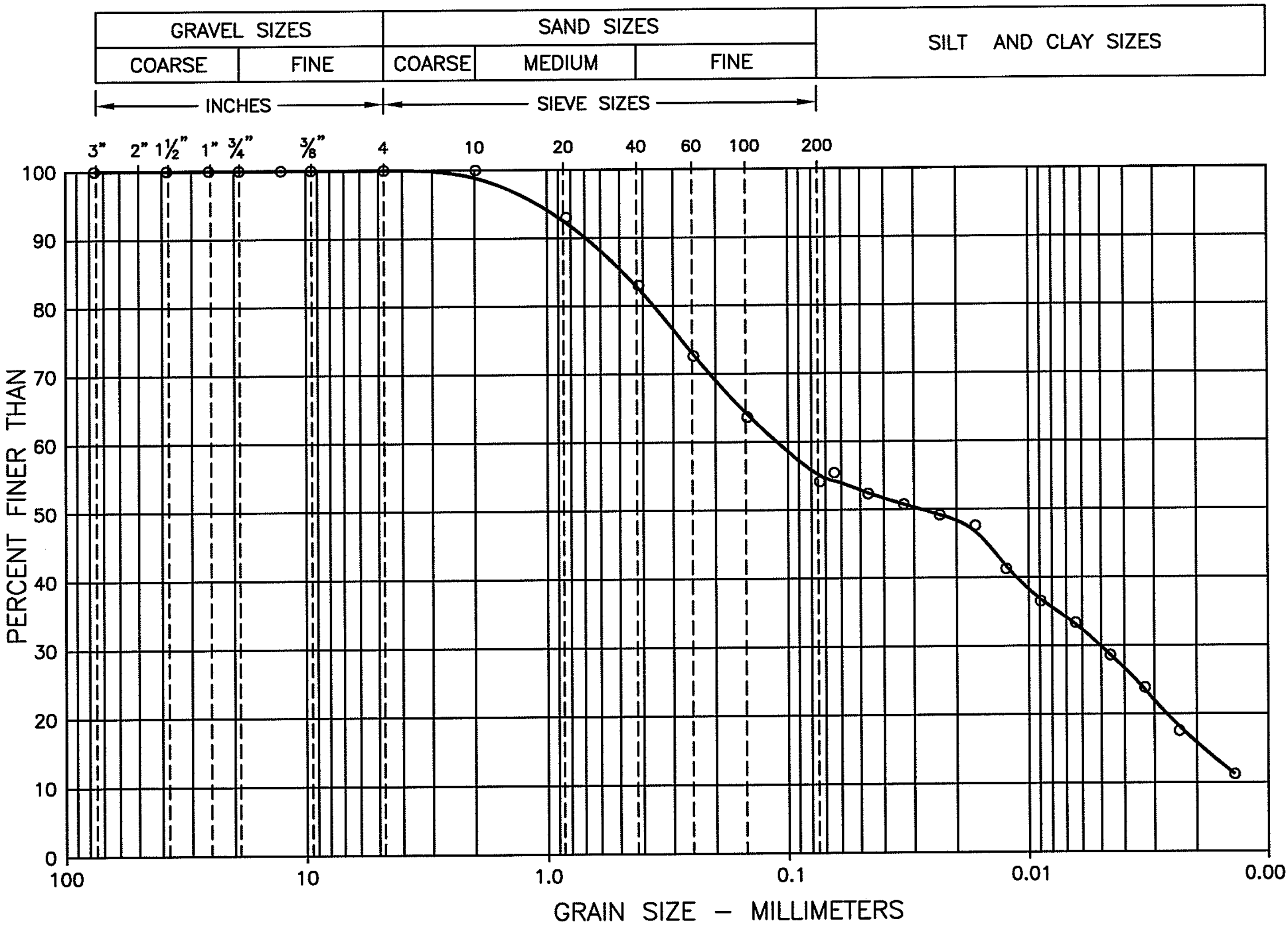
S07-6301-18

GRAIN SIZE DISTRIBUTION TEST REPORT

Project:	PROPOSED RESIDENTIAL SUBDIVISION COCHIN, SK
Project No.:	S07-6301
Date Tested:	NOVEMBER 14, 2007
Test Hole No.:	07-4
Sample No.:	57
Depth (m):	51.0
Remarks:	

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	48	37	15



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S07-6301-19

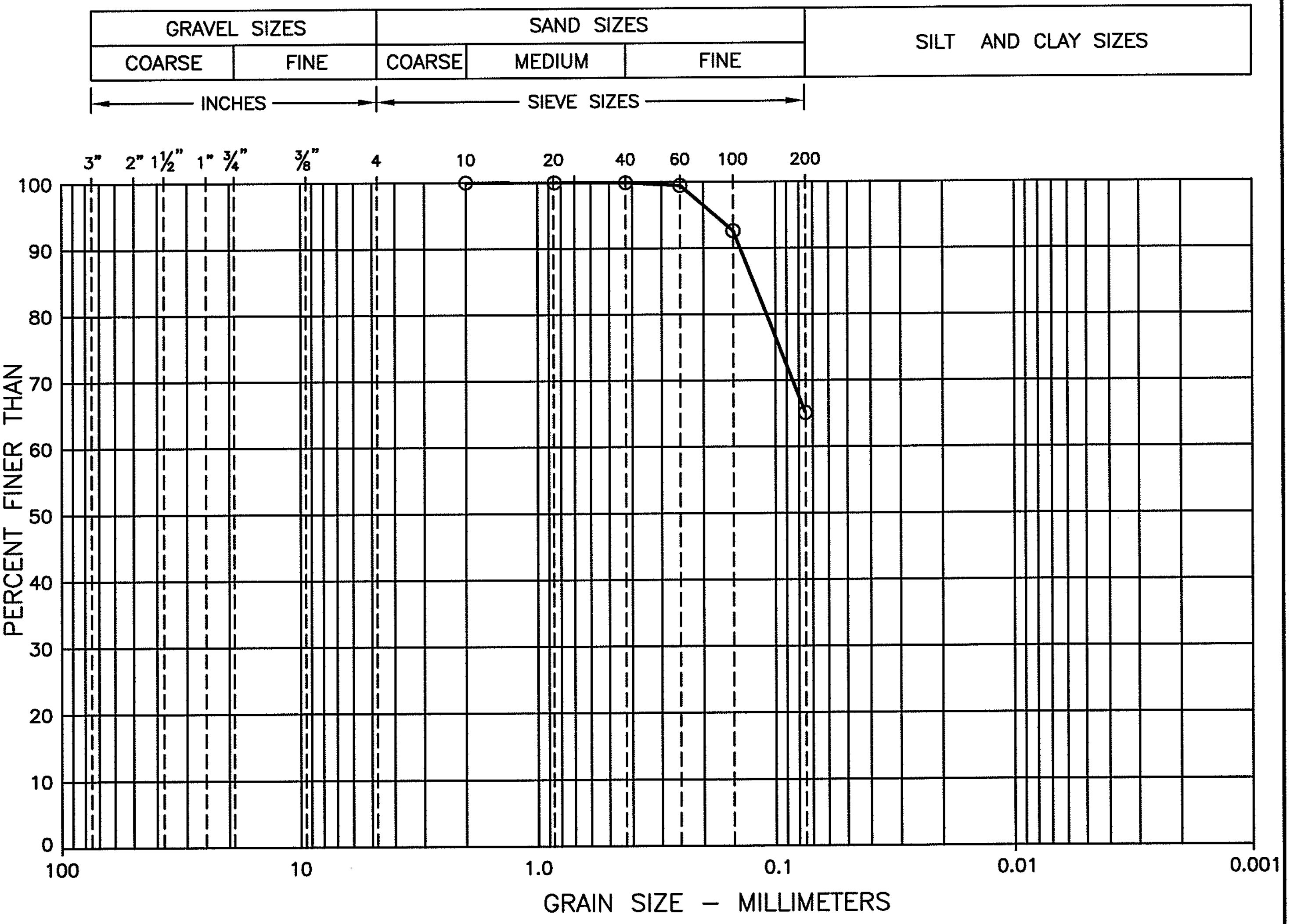
GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK
Project No.: S07-6301
Date Tested: NOVEMBER 14, 2007
Test Hole No.: 07-5
Sample No.: 117
Depth (m): 6.0
Remarks:

SIEVE SIZE	PERCENT PASSING
No. 10	100.0
No. 20	100.0
No. 40	99.9
No. 60	99.5
No. 100	92.6
No. 200	65.1

Material Description

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



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S07-6301-20

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK

Project No.: S07–6301

Date Tested: NOVEMBER 14, 2007

Test Hole No.: 07–5

Sample No.: 123

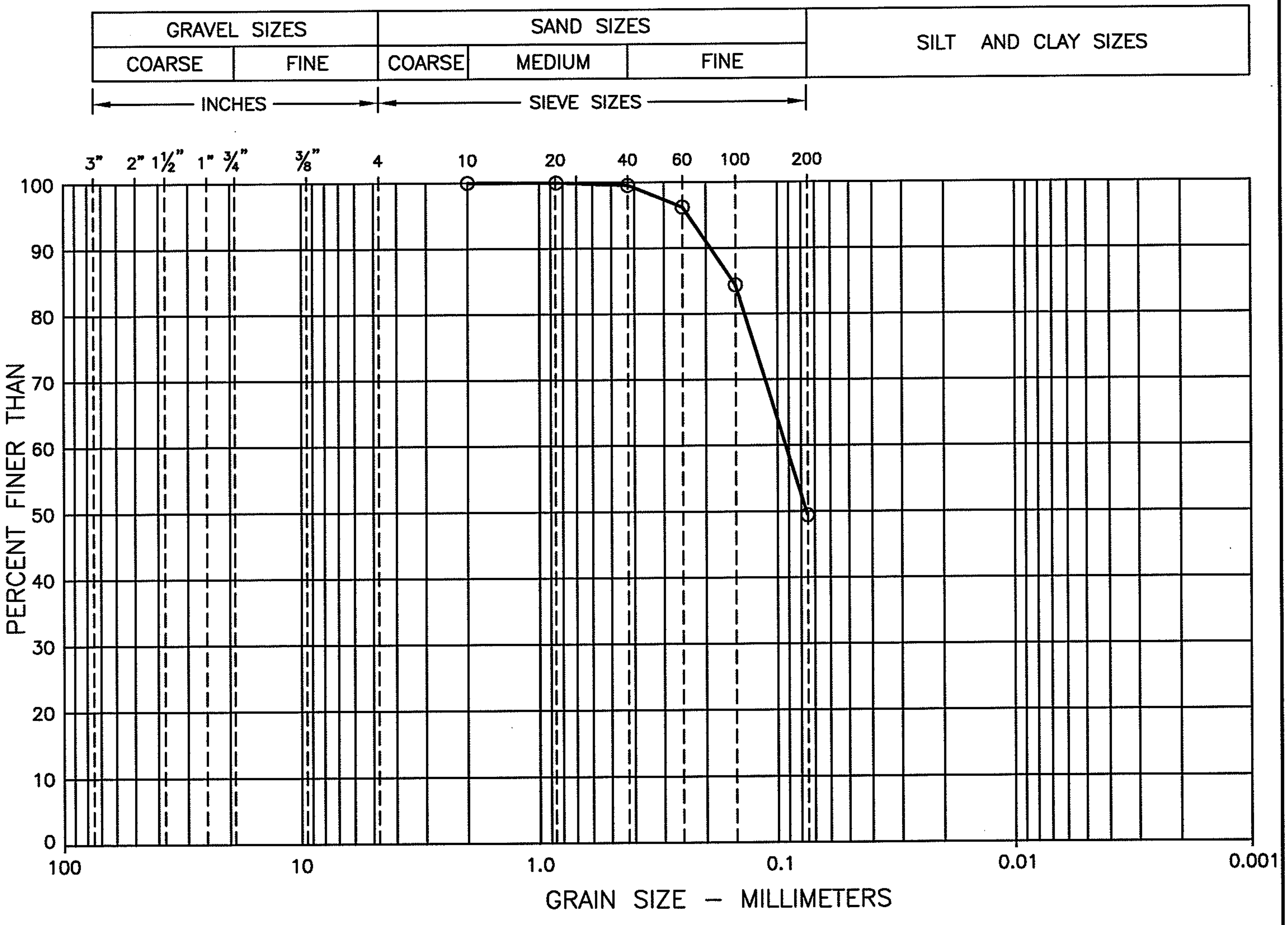
Depth (m): 15.0

Remarks:

SIEVE SIZE	PERCENT PASSING
No. 10	100.0
No. 20	100.0
No. 40	99.5
No. 60	96.2
No. 100	84.4
No. 200	49.4

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	51	49



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

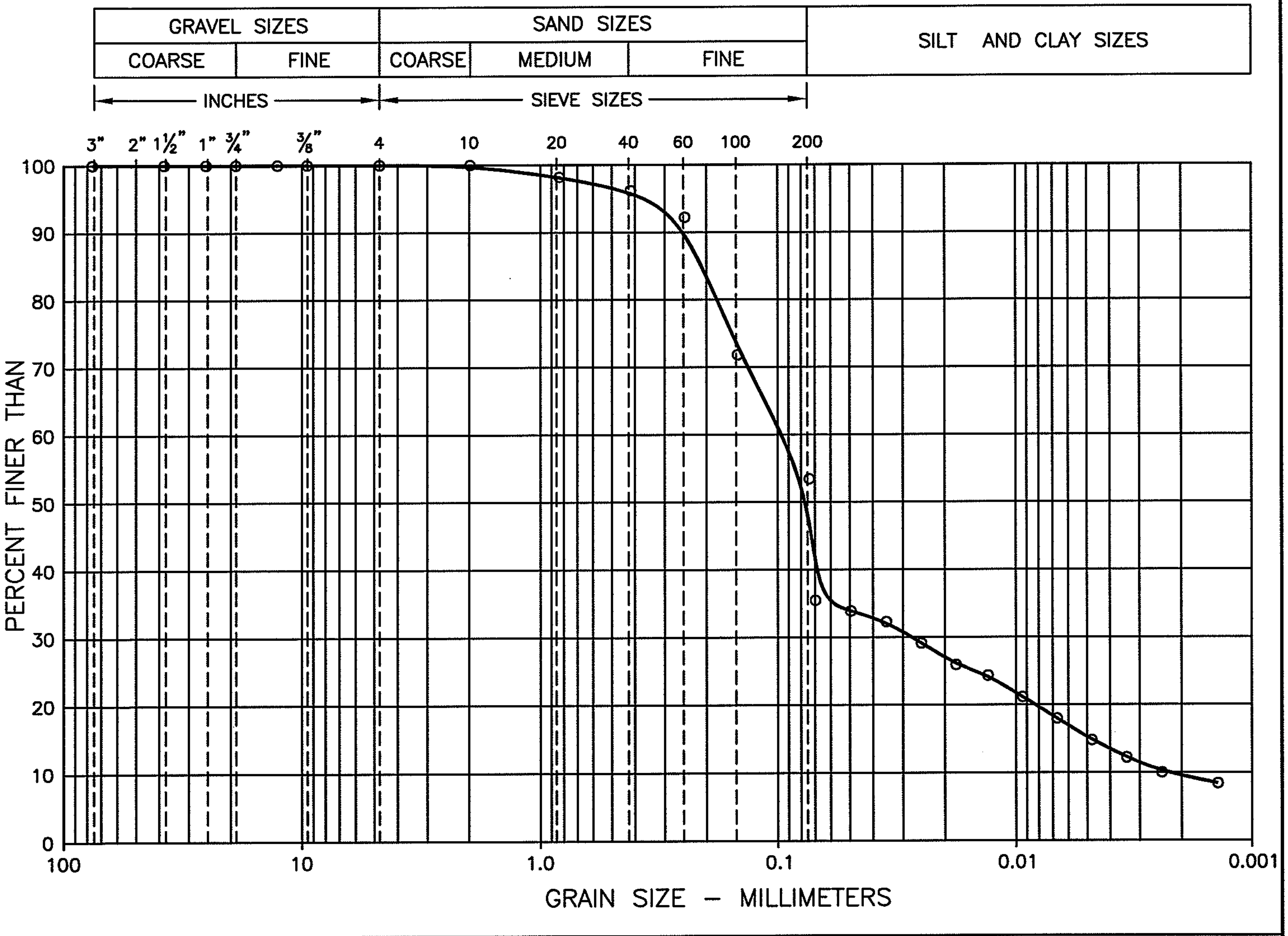
S07-6301-21

GRAIN SIZE DISTRIBUTION TEST REPORT

Project:	PROPOSED RESIDENTIAL SUBDIVISION COCHIN, SK
Project No.:	S07–6301
Date Tested:	NOVEMBER 15, 2007
Test Hole No.:	07–5
Sample No.:	126
Depth (m):	19.5
Remarks:	

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	47	44	9



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

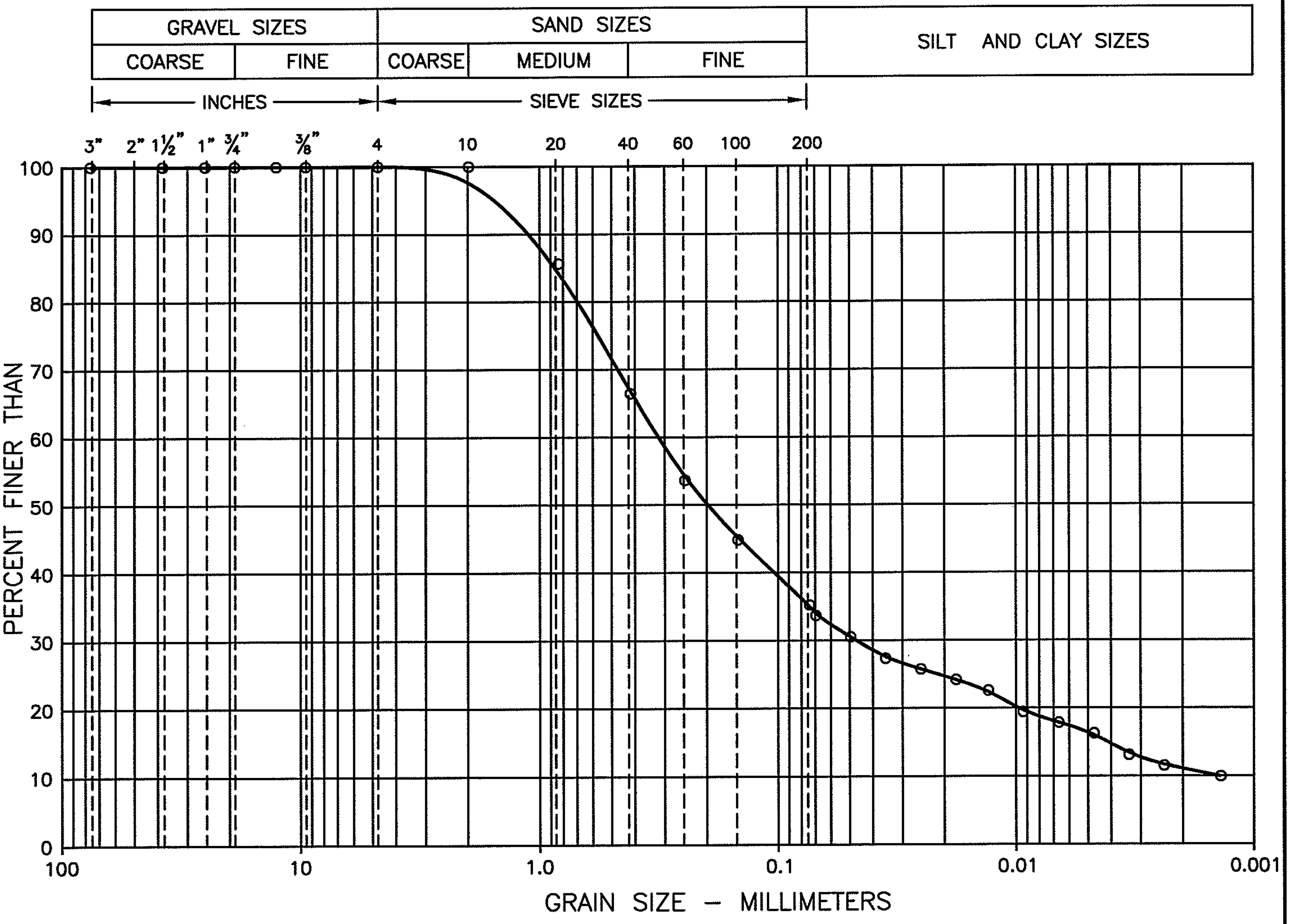
S07-6301-22

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK
Project No.: S07–6301
Date Tested: NOVEMBER 15, 2007
Test Hole No.: 07–5
Sample No.: 128
Depth (m): 22.5
Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	65	24	11



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.
S07-6301-23

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: PROPOSED RESIDENTIAL SUBDIVISION
COCHIN, SK

Project No.: S07-6301

Date Tested: NOVEMBER 15, 2007

Test Hole No.: 07-5

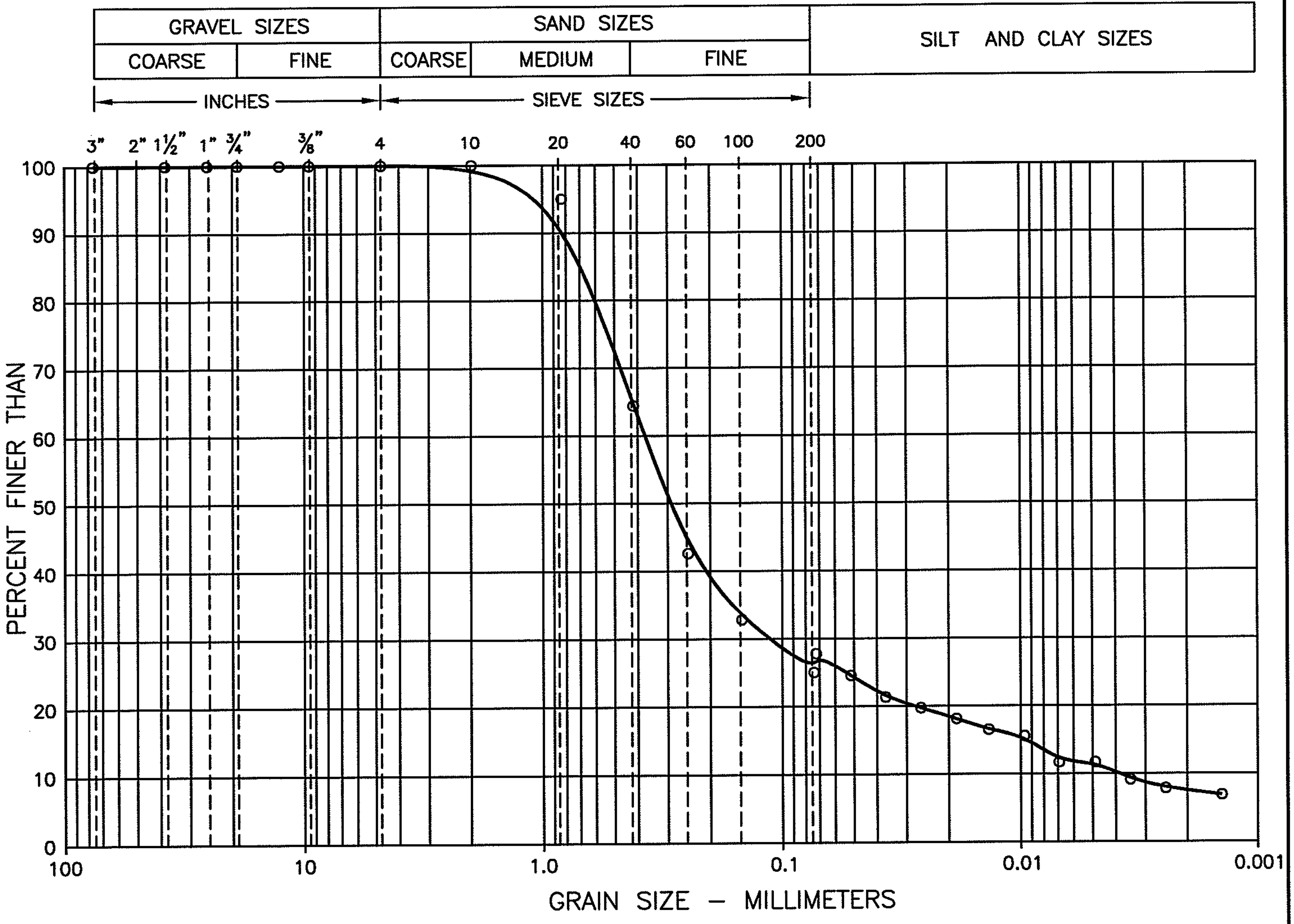
Sample No.: 131

Depth (m): 27.0

Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	75	18	7



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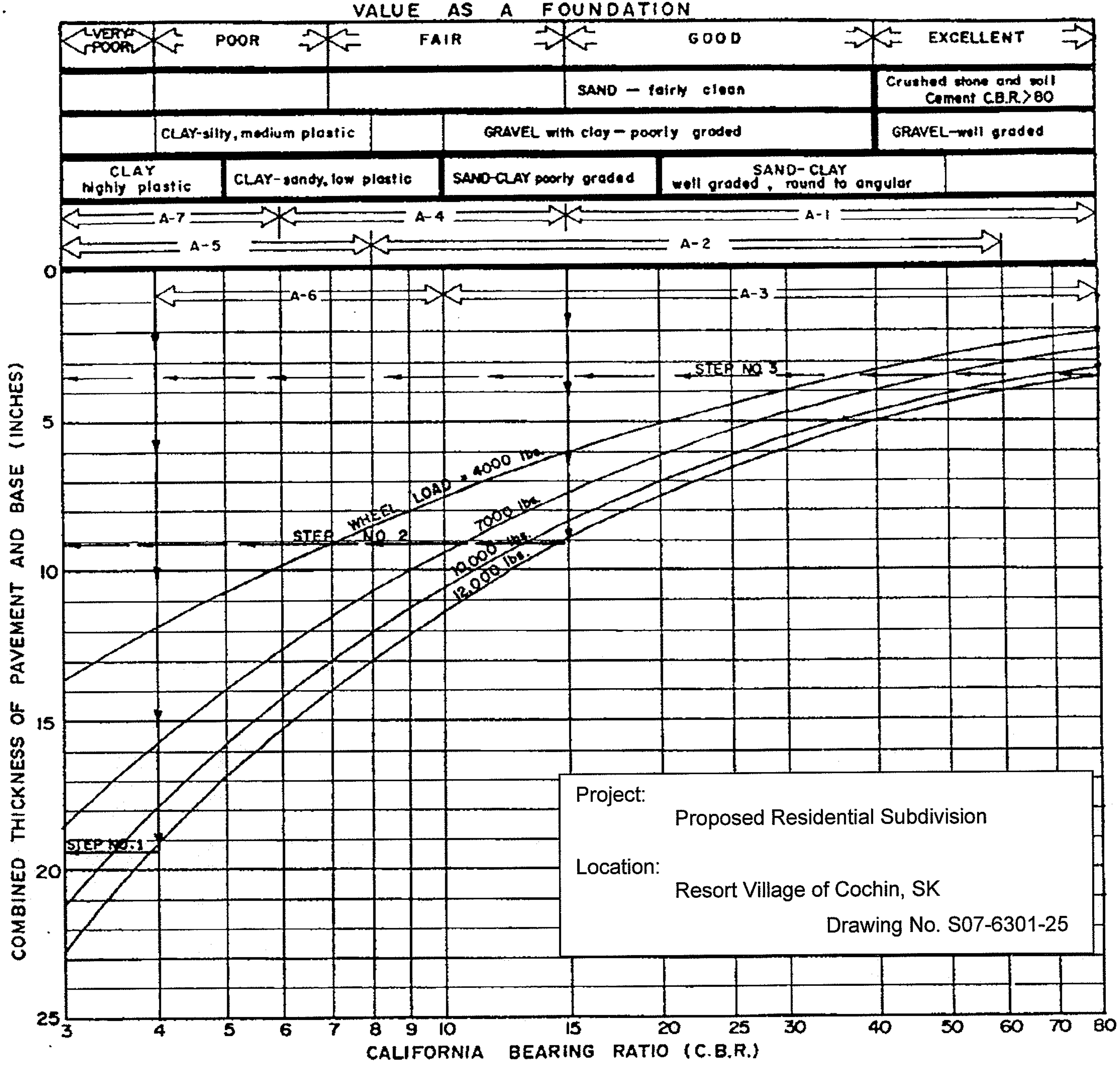
DRAWING NO.

S07-6301-24

DESIGN OF PAVEMENT & BASE BY CALIFORNIA METHOD



Project:
Proposed Residential Subdivision

Location:
Resort Village of Cochin, SK

Drawing No. S07-6301-25

DESIGN CURVES:

The curves give the total base and pavement thickness over any subgrade or sub-base of known C.B.R. The C.B.R. of a material is its bearing value expressed as a percentage of that of crushed stone at 100%. The curves are empirical, and were developed by California's Highway Dept. for a tire pressure of 60 p.s.i. The ranges for soil types are approximate only. The soil types are used only when actual laboratory tests are not available.

NOTE:

Using base material with a high C.B.R. for lower layers in place of materials with a lower C.B.R. does not decrease the total thickness which is governed by the C.B.R. of the subgrade. In any case the combined thickness of pavement and non-frost action base material such as clean sand or gravel should be from 1/2 to full depth of frost penetration. The minimum C.B.R. of the upper base material for a depth of 5" to 8" beneath the pavement should be 80 for 10,000 lbs. and 12,000 lbs. wheel loads and 40 to 65 for 4,000 lbs. and 7,000 lbs. wheel loads.