

**PAVEMENT DESIGN REPORT  
HIGHWAY 6  
FROM 1.1 KM SOUTH OF GREY COUNTY ROAD 9  
(NORTH JUNCTION) NORTHERLY 10.5 KM  
TO DURHAM SOUTH LIMIT  
G.W.P. 338-97-00  
Consultant Agreement No. 3004- E- 0042**

**Report Submitted to:**

**UMA ENGINEERING LIMITED**

**for**

**Ministry of Transportation, Ontario  
Southwestern Region Geotechnical Section**

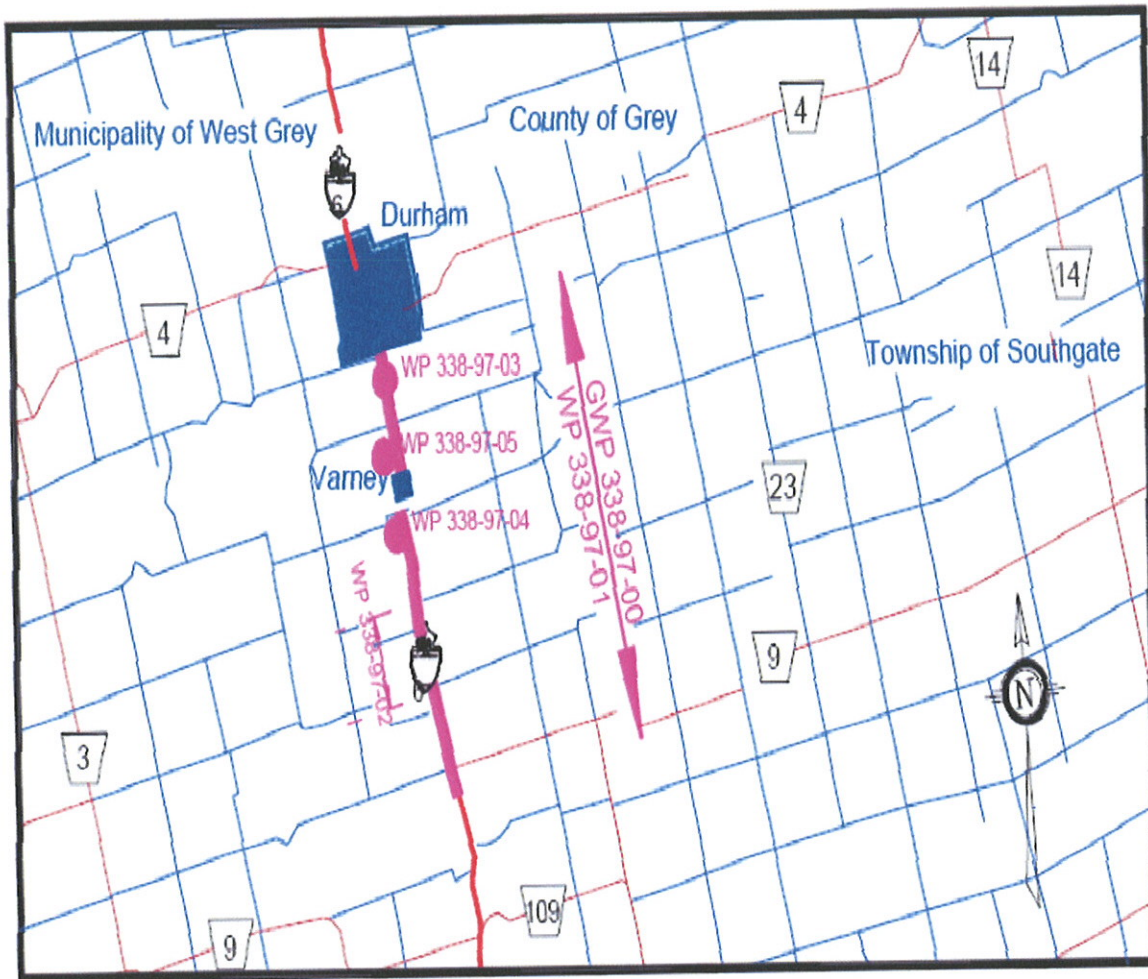
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**Project: SPT1174  
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## KEY PLAN

**G.W.P. 338- 97- 00  
HIGHWAY 6  
FROM 1.1 KM SOUTH OF GREY ROAD 9(NORTH JUNCTION) NORTHERLY  
TO DURHAM SOUTH LIMITS**

**TOWN OF DURHAM, ONTARIO**



## EXECUTIVE SUMMARY

This project (W.P. 338-97-00) is intended to rehabilitate Highway 6, from 1.1 km south of Grey County Road 9 northerly to Durham south limit, for a total of 10.5 km, in the County of Grey, Ontario.

This report covers the pavement rehabilitation, construction of northbound passing lane, intersection improvements at 9 intersections, vertical alignment improvements and reconstruction /rehabilitation of private and commercial entrances.

The field investigation consisted of borehole drilling at the existing edge of pavement, on the pavement, and granular shoulders along Highway 6 and private /commercial entrances; coring of the main lane pavement and side roads; and visual pavement condition survey.

The investigation shows that the predominant subgrade along Highway 6, within project limits, varies from sandy silt to silt with some sand. Clayey silt was also encountered occasionally throughout the project. This report identifies these and other geotechnical features of importance to this project.

Life cycle cost analysis (LCCA) was performed based on 1 km of the existing two-lane highway including granular shoulders. The options considered were (1) Pulverization and Pave, (2) Full Depth Asphalt Removal and Pave, (3) Cold In- Place Recycling and Pave, and (4) Mill and Pave.

The LCCA shows that Option 3 (Cold In- Place Recycling and Pave) has the lowest initial and life cycle cost. Therefore, the following pavement rehabilitation recommendations are , as follows:

Mill existing pavement at select locations where applicable, cold in-place recycle the existing asphalt to a depth of 120 mm, and pave with 90 mm hot mix asphalt (40 mm SP 12.5 FC1 surface course over 50 mm SP19.0 binder course).

The Cold In- Place Recycling and Pave option can practically eliminates pavement distress and reflective cracking, re-use of pavement materials (environmental benefit), reduced material off-site hauling, and help the public not to travel on granular road during construction.

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**PAVEMENT DESIGN REPORT  
HIGHWAY 6  
FROM 1.1 KM SOUTH OF GREY COUNTY ROAD 9 (NORTH JUNCTION)  
NORTHERLY 10.5 KM TO DURHAM SOUTH LIMIT  
G.W.P. 338-97-00 AGREEMENT NO. 3004-E-0042**

**1. GENERAL**

**1.1 TERMS OF REFERENCE**

UMA Engineering Limited, under original Consultant Assignment No. 3004-E-0042 with the Ministry of Transportation of Ontario (MTO), Southwestern Region, retained the services of Shaheen & Peaker Ltd. (S&P) in 2006 to conduct a geotechnical (pavement) investigation for rehabilitation and widening of Highway 6, from 1.1 km south of Grey County Road 9 northerly to Durham south limit, for a total length of 10.5 km, in the County of Grey, Ontario. The purposes of the project are as follows:

- Rehabilitation of the existing Highway 6 within the project limits for 10.5 km
- Rehabilitation of the existing SB Passing Lane (from Station 29+100 to 11+705)
- Construction of new NB Passing Lane (widening from Station 24+200 to 26+460)
- Intersection improvements at 9 intersections
- Vertical alignment improvements (Vertical Cut)
- Reconstruction/rehabilitation of private and commercial entrances
- Determination of buried concrete under the pavement, if applicable

**1.2 PROJECT LIMITS**

The project is located within the Municipality of West Grey, in the Townships of Southgate and Normanby, County of Grey, Ontario. The south limit of the project is Station 21+100 (1.1 km south of Grey County Road 9, while the north limit of the project is at Station 11+887, south limit of Town of Durham. The Highway 6 chainage, within the project limits, increases from south to north. There is a chainage equation as described below.

**1.3 CHAINAGE EQUATION**

There is a chainage equation at the centerline of Egremont-Glenelg Townline / Normanby-Bentinck Townline:

$$\text{Station } 29+691.722 = \text{Station } 10+000$$

## 1.4 BACKGROUND HISTORY

Project history as outlined in the Preliminary Design Report (Planning and Design Section, Southwestern Region, MTO), as well as in Regional geotechnical Pavement Condition Report (MTO) indicates that Highway 6, within the project limits, was originally constructed under Contract 61-010 and 62-46 and reconstructed under Contract 84-08 (Resurfacing) and 99-123 (Mill and Pave). Resurfacing under Contract 84-08 involved 35 mm binder and 40 mm HL4 surface course. The 0.5 m partially paved shoulders are part of the surface course. The granular subbase is full width. Contract 99-123 consisted of milling the existing asphalt 50 mm and resurfacing with 50 mm HL4. Passing lanes and widening consisted of 50 mm HL4 surface, 40 mm HL4 upper binder and 50 mm HL4 lower binder over 150 mm Granular "A" and 650 mm Granular "B".

It also shows that a 1990 Preservation Management contract routed and sealed all transverse, mid lane, pavement edge, and centerline cracks. Cold mix patching was also performed at partially paved shoulder (PPS) break-up areas and to the inside of curves to hold pavement edge alligatored sections. In addition, a 600 mm strip along the west edge of pavement was repaired in 2000. Lastly, a 2004 Minor Capital Contract 2004-3250 routed and sealed the passing lanes that were constructed under Contract 99-123, 2.5km south of Durham to south limit of Durham.

Within the project limits, Highway 6 is classified, based on functional classification, as Rural Arterial Undivided 100 (RAU -100) with one lane in each direction (except the sections of passing lanes, two lanes in one direction) and pavement width of 7.5 m. The shoulders, 2.5m wide, are partially paved, in most part, with of a width of 0.5m.

Due to deficiencies in pavement performance, low lane capacity (from Station 24+200 to 26+460), and lack of turning lanes at various intersections, Highway 6 is experiencing operational and safety problems. For this reason, the MTO has identified remedial measures in the form of a new passing lane in the immediate time frame.

There are 9 major intersections along Highway 6 within the project limits of which none is signalized.

## 2. DESIGN CRITERIA

### 2.1 EXISTING GEOMETRIC DESIGN

Table 2.1.1 summarizes the geometric parameters, taken from the Southwestern Region, MTO. See Appendix 1 for complete Design Criteria.

**Table 2.1.1 Present and proposed geometric conditions – Highway 6**

Design Parameters	Present Conditions	Design standards	Proposed Design
Highway Classification	RAU 100	RAU 100	RAU 100
Minimum Stopping Sight Distance (m)	123	185	123(*)
Equivalent Min. 'K' Factor	K=30 crest K=20 sag	K=70 crest K=45 sag	K=30 crest K=20 sag(*)
Grades Maximum (%)	5.0	6 - 8	5.0
Minimum Radius (m)	249.482	420	249.482(**)
Pavement Width (m)	7.5 – 11.25	7.5 – 11	7.5 – 11.25
Shoulder Width (m)	2.5	3.0	3.0(***)
Shoulder rounding (m)	0.5 – 1.0	0.5 – 1.0	0.5 – 1.0(***)
R.O.W. Width (m)	Varies from 18 minimum	N/A	Varies from 18 minimum
Posted Speed (km/h)	80	N/A	80(****)

\* Ten (10) sag curves and nine (9) crest curves within the project limits do not meet the requirements of a 100km/h design speed.

\*\* One (10) horizontal curve within the project limits does not meet the requirements of a 100km/h design speed.

\*\*\* Within the resurfacing limits it is proposed to retain the existing lane widths of 3.75m. (See Appendix 1 for details)

\*\*\*\* The posted speed is generally 80km/h throughout the project except two reduced speed (70km/h) zones at Varney and immediately south of Durham respectively.

Appendix 1 also shows the existing pavement and shoulder widths at 500 m interval, as provided by the TPM.

## 2.2 TRAFFIC DATA

Traffic volumes for Highway 6, as given in Table 2.2.1, were taken from the Preliminary Design Report (Planning and Design Section, Southwestern Region, MTO).

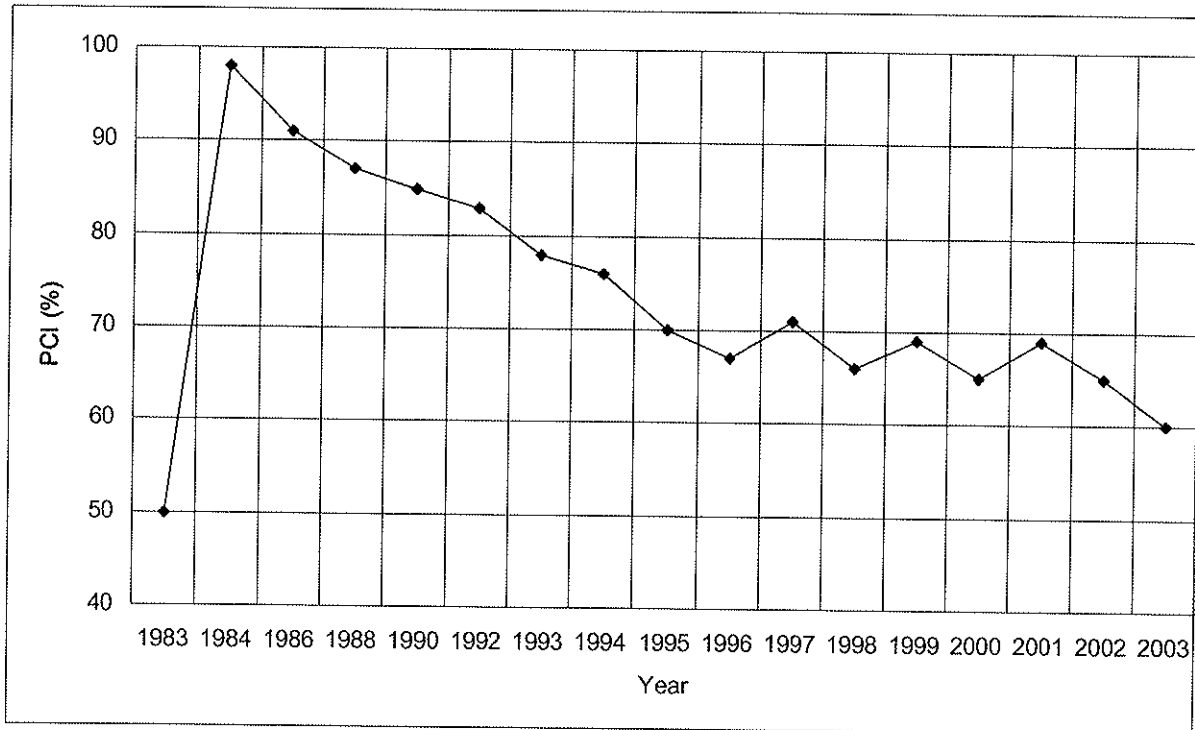
**Table 2..2.11 Traffic Volumes on Highway 6**

Highway 6	Distance (km)	AADT		% CommercialH CV
		2002	2012	
1.1 km South of Grey Country Road 9 to Durham South Limit	10.5	5850	6845	10.8

### 3. PAVEMENT CONDITION

#### 3.1 PAVEMENT PERFORMANCE HISTORY

Pavement performance of the Highway 6 was recorded by MTO in 2005. Pavement Performance Records (PPR) shows that this section of Highway 6 has a 2005 Pavement Condition Rating (PCR) of 49 with a Ride Condition Rating (RCR) of 5.0. The AADT for Year 2003 reaches 5950 from County Road 9 to Durham South Limit at Douglas Street. Based on these, the condition of the pavement is considered poor except for the recently rehabilitated southbound passing lane area (between Station 29+100 to 11+705).



**Figure 3.1.2.1 Variations of PCI on Highway 6, Durham**

Figure 3.1.1 presents the rate of deterioration for Highway 6 as indicated in the PPR. It can be seen from the curve that the Pavement Condition Index (PCI) was deteriorating from a high of 98 in 1984, when resurfacing under Contract 84-08 was performed, to a low of 60 in 2003. No significant increase in PCI was observed due to no major rehabilitation work implemented within this time frame. Figure 3.1.1 indicated that rate of deterioration for Highway 6 is about 2.0 % per year. Based on this, with initial PCI of 95 and terminal PCI of 65 the life expectancy for rehabilitation job for Highway 6 would be in the in order of 16 to 18 years. The PPR at Year 2003 along with highway Design Criteria are presented in Appendix 1. The pavement condition photographs are illustrated in Appendix 2.



### 3.2 PRESENT PAVEMENT CONDITION

A visual pavement condition survey was carried out within the limits of the project on Highway 6 in August 2006. The main distress features observed at the site are as follows:

- Slight, throughout coarse aggregate loss
- Slight, extensive wheel track rutting
- Moderate, throughout distortion due mostly to cupped transverse cracking
- Slight, few longitudinal wheel track cracking
- Moderate, frequent centerline cracking with slight and few alligators
- Slight, throughout pavement edge cracking
- Slight to severe, throughout transverse cracking with cupping and few very severe transverse cracking
- Slight, intermittent alligator cracking
- Moderate, intermittent longitudinal meander and mid lane cracks
- Severe, extensive cracks in the PPS with break-up and edge breaking

### 4. PHYSIOGRAPHY AND DRAINAGE

The study area consists of 10.5 km stretch of Highway 6, from Durham South Limits at Station 11+870 through Village of Varney southerly to 1.1 km south of Grey County Road 9 (North Junction) at Station 21+100. The site is located just south of Saugeen River (in the Town of Durham) which wanders westwards into Lake Huron and the overburden primarily consists of sand and gravel.

According to the Physiography of Southern Ontario (by Putnam & Chapman) and the Ontario Geological Survey Map P.2715, the study area lies in the area known as the Horseshoe Moraines. The Horseshoe Moraines has two main distinguishing features; i.e., irregular sand and gravel knobs and ridges (sand plain and kame moraine), and gravel or swamp-covered valleys. These granular deposits constitute aquifers associated primarily with kame deposits at or near the ground surface within a larger more extensive regional till plain. The existing gravel pit in Durham is part of the moraine spillway.

According to Ontario Department of Mines Map 2039, entitled distribution of Limestone, Dolomite and Precambrian Pebbles in Gravels of Southern Ontario, the overburden (glacial drift), in this general area, is underlain by bedrock of predominately Guelph-Lockport-Amabel Formations with occasional Ancaster Chert beds. However, some shale and occasional gypsum and salt inclusions may also be found in the surrounding area.

## 5. FIELD INVESTIGATION AND LABORATORY TESTING

### 5.1 SURVEYING

Staking was carried out by TPM Consultant surveyors every 50 m on the east side of Highway 6.

### 5.2 FIELDWORK

As per the requirements described in the "Geotechnical Investigation and Pavement Design Report Guidelines for the Ministry of Transportation, Southwestern Region, June 2005" as well as the RFP, the field work for the assignment was conducted from July 2006 to November 2006 in conformity with Ministry requirements for workplace safety and the requirements of the Ontario Traffic Manual (Book 7), after clearing all underground services. Short term temporary closure procedures were adopted. A safety check was conducted prior to start of the field work each day to ensure all personnel were properly equipped and all vehicles and signal lights, including 360 degree rotating amber lights, were in working order. The scope of the field investigation included:

- Visual pavement condition survey of Highway 6. Appendix 2 includes photographs of more evident distress types within the project limits.
- Pavement coring (a minimum of 100 mm in diameter; and 150 mm diameter used for coring the pavement with cracks) to determine the thickness, different components of the asphalt concrete, as well as the type and nature of the transverse cracks.

Asphalt cores were taken from the main lanes (2 every lane kilometer), in the cracks (minimum 1 every 2 lane kilometer), tapers only (one per taper), on side roads (one per side road). A total of 55 cores were taken in this study. All the cores were transferred to the laboratory for further visual analysis and photography. Core logs along with the selected photographs are given in Appendix 3.

- Power auger drilling for pavement rehabilitation (150 mm diameter truck mounted solid stem continuous flight auger), one at the edge of existing pavement and one at mid-shoulder (every 250 m alternating sides).
- Power auger drilling for new alignments, roadbed widening, slopes and ditches (150 mm diameter truck mounted solid stem continuous flight auger) at 25 m intervals in cut areas and 50 m intervals in fills.
- Power auger drilling (150 mm diameter truck mounted solid stem continuous flight auger) at commercial entrances and at proposed intersection radius improvements. Two (2) boreholes were drilled for new radii construction for minor intersections and 4 boreholes for major intersections such as Southgate Road 22/Normanby Road 21, Southgate Road 24/Maplewood Road, and Egremont-Glenelg Townline/Normanby-Bentinck Townline. In addition, the pavements of side roads to 15 m beyond end of

radii are to be rehabilitated. Four (4) boreholes were drilled for side road pavement rehabilitation for minor intersections and 8 drilled for major intersections. One core and bore borehole for each intersection was also advanced.

- Hand auger drilling (50 mm diameter portable hand auger and/or 100 mm diameter power hand auger) at locations where inaccessible by power auger (such as ditches, steep slopes and swamps) including soil sampling.
- Borehole drilling was conducted under the direction and supervision of Shaheen and Peaker Ltd. personnel during which existing pavement structure depth was measured and soil samples were retrieved. Samples from the granular material and subgrade soil were taken and returned to Shaheen and Peaker Ltd. for detailed visual examination and laboratory testing. Borehole logs along with pavement thickness spreadsheet are given in Appendix 4.

Table 5.2.1 presents the field borehole counts.

**Table 5.2.1 Field Borehole and Cores Counts**

Item	Location	Offset	Auger Type	# Boreholes/Cores/Core and Bore
Pavement Structure Rehabilitation	Highway 6 from Sta. 21+100 (Normanby Township) to Sta.11+870 (Bentinck Township)	EP and Mid- shoulder	Machine	72/34/12
Vertical Curve Improvements	See Table 5.2.2 for details	Top/Bottom of Slope	Machine/Hand	59
Northbound Passing Lane	Sta.24+200 to 26+460	EP, Mid- shoulder, Bottom of Slope	Machine/Hand	86
Private/Commercial Entrances	See Table 5.2.3 for details	EP, Shoulder with varying offset near entrances	Machine	12
Intersection Improvements	See Table 5.2.4 for details	Varying offsets of Main Lane/Side road at intersection, Ditch	Machine/Hand	80/0/9
<b>TOTAL BOREHOLES</b>				<b>309</b>
<b>TOTAL CORES</b>				<b>34</b>
<b>TOTAL CORE AND BORE</b>				<b>21</b>

All fieldwork has been carried out in full compliance with RFP requirements, OHSA Act and regulations, MOL requirements and the Interim Guidelines (Book 7), with safety of the public

being paramount. After clearing all underground services, the field work was conducted. Traffic protection services were provided by K.J. Beamish Construction Co. Limited and S&P personnel, and consisted of Traffic Control Persons (TCP's) and appropriate signs and TC cones.

**Table 5.2.2 Field Borehole Counts for Vertical Curve Improvements Sections**

No.	Location	Length (m)	No. of Boreholes	Average Depth of Boreholes (m)
1	22+800 (Normanby Twp)	300	23	2.0
2	24+150 (Normanby Twp)	250	17	2.0
3	29+600 (Normanby Twp)	Covered in foundations investigations.		
4	11+300 (Bentinck Twp)	250	19	2.0
<b>TOTAL</b>			<b>59</b>	

**Table 5.2.3 Field Borehole Counts for Private/Commercial Entrances**

Location	Name	Action	No. of Boreholes
25+550 Rt	West Grey Premium Beef Inc.	Reconstruct/Rehabilitate and pave to ROW	1
25+850 Lt	Maplewood Cemetery	Reconstruct/Rehabilitate main entrance and pave to ROW	1
		Removal and relocation of secondary entrance	2
26+900 Rt	IMPAX Mfg.	Reconstruct/Rehabilitate and pave to ROW	1
27+025 Rt	Varney Motor Speedway	Reconstruct/Rehabilitate and pave to ROW	1
27+150 Lt	Kelly Joe's Roadhouse	Reconstruct north entrance and pave to ROW	1
		Remove south entrance	1
23+275 Rt	Private Entrance	Remove	1
27+750 Rt	Comm. Entrance	Remove	1
28+280 Rt	Private Entrance	Remove	1
11+260 Rt	Private Entrance	Remove	1
<b>TOTAL</b>			<b>12</b>

**Table 5.2.4 Field Borehole and Core and Bore Counts for Intersection Improvements**

Name	Type of Work	No. of Boreholes	No. of Core and Bores
Grey County Road 9	Construct new truck-turning radii on both quadrants	2	1
	Rehabilitate right-turn lane and taper (85 m + 80 m)	4	



Name	Type of Work	No. of Boreholes	No. of Core and Bores
	Construct 30 m recovery taper	4	
	Rehabilitate sideroad pavement to 15 m beyond end of radii	4	
Normanby Con-12	Construct new 15 m radii on both quadrants	2	1
	Rehabilitate sideroad pavement to 15 m beyond end of radii	4	
Southgate Road-22 / Normanby Road-21	Construct new 15 m radii on all quadrants	4	1
	Rehabilitate sideroad pavement to 15 m beyond end of radii	8	
Southgate Road-24 / Maplewood Road	Construct new 15 m radii on all quadrants	4	1
	Rehabilitate sideroad pavement to 15 m beyond end of radii	8	
Wilder Lake Road	Construct new 15 m radii on both quadrants	2	1
	Rehabilitate sideroad pavement to 15 m beyond end of radii	4	
Field Street	Construct new 8 m radii on both quadrants	2	1
	Rehabilitate sideroad pavement to 15 m beyond end of radii	4	
Varney Road	Construct new 15 m radii on both quadrants	2	1
	Rehabilitate sideroad pavement to 15 m beyond end of radii	4	
Egremont-Glenelg Townline / Normanby-Bentinck Townline	Construct new 15 m radii on all quadrants	4	1
	Rehabilitate sideroad pavement to 15 m beyond end of radii	8	
Douglas Street	Construct new 10 m radii on both quadrants	2	1
	Rehabilitate sideroad pavement to 15 m beyond end of radii	4	
<b>TOTAL</b>		<b>80</b>	<b>9</b>

### 5.3 LABORATORY TESTING

Laboratory testing/examinations were carried out on the core/granular/soil samples. All tests were in accordance with materials testing requirements and procedures outlined in the Laboratory Testing Manual of the Ministry of Transportation, or ASTM/AASHTO, as applicable. All laboratory testing was carried out at the laboratory of Shaheen and Peaker Limited. All requirements for material testing under MTO's Engineering Materials Testing and Evaluation were met.

The following laboratory tests/examinations were completed:

- Visual examination of soil samples to verify soil classification carried out in the field.
- Visual examination of asphalt core samples to determine the various types and thickness of asphaltic concrete layers.
- Moisture Content (LS-701) of in situ subsoil and aggregate materials encountered during the field investigation.
- Particle Size Analysis (LS-702 & 602) of each of the differing subsoil and aggregate materials encountered during the field investigation.

- Atterberg Limits (LS-703 / LS-704) of clayey soils.

Laboratory test results are given in Appendix 5 of this report.

Samples will be retained for a minimum of one year. However, their condition may not be the same as when first put into storage.

## 6. EXISTING PAVEMENT STRUCTURE AND SOIL TYPES

We recommend that once the details of the culverts and retaining walls are finalized, our recommendations be reviewed for their specific applicability. The Limitations of Report, as quoted at the end of this report, are an integral part of this report. No buried concrete was encountered in the boreholes during the field investigations.

### 6.1 EXISTING PAVEMENT STRUCTURE OF MAIN LANES (STATION 21+100 TO 29+691.722 AND STATION 10+000 TO 11+887) ALONG HIGHWAY 6

Table 6.1.1 presents the existing pavement structure data obtained from core/borehole logs along Highway 6 main lanes and the shoulders.

Data presented in Table 6.1.1 indicate that hot mix asphalt thickness along Highway 6 ranges from 90 to 235 mm, with an average of 150 mm. Total granular thickness (base + subbase) varies from 270 to 1400 mm, with an average of 800 mm.

Table 6.1.1 also reveals that the granular material has been placed full width across the highway. Granular thickness along the shoulders is generally greater than that of the main lanes of highway.

**Table 6.1.1 Summary of Existing Pavement Structure Data along the Main Lanes**

Road	Pavement Component	No. of Observations	Thickness (mm)	
			Range	Design Mean
Highway 6	Total HMA <sup>1</sup>	94	90 - 235	150
	Granular Base Material	62	120 - 740	200
	Granular Subbase Material	62	150 - 1150	600
	Total Granular Material	62	270 - 1400	800
	Total HMA <sup>1</sup> (Paved Shoulders)	12	60 - 200	-
	Granular Base Material in Shoulders	92	0 - 800	250
	Granular Subbase in Shoulders	92	450 - 1300	800
	Total Granular Material in Shoulders	92	500 - 1500	1050

<sup>1</sup> HMA = Hot Mix Asphalt

Sieve analysis test was performed on ten (10) base and ten (10) subbase granular material samples. Test results indicate that the seven out of ten granular base materials satisfy the gradation specifications for Granular 'A' and the other three samples did not meet the

specification due to excessive fines (up to 14% passing sieve 75  $\mu$ m was observed). For granular subbase materials, results show that six samples meet the specification for Granular 'B' Type I and the other four fail to conform to the gradation requirement due to excessive fines (up to 15% passing sieve 75  $\mu$ m was observed).

## 6.2 EXISTING PAVEMENT STRUCTURE OF VARNEY SECTION (STATION 28+040 TO STATION 28+380)

Existing pavement structure for Varney section, based on findings of three boreholes and one core data shown in Pavement Structure Spreadsheet, is summarized as follows.

**Table 6.2.1 Summary of Existing Pavement in Varney Area**

Section	Pavement Component	No. of Observations	Thickness (mm)	
			Range	Design Mean
Varney, Hwy 6 (Sta. 28+040 -28+380)	Total HMA	4	140 - 260	185
	Granular Base Material	3	220 - 270	250
	Granular Subbase Material	3	250 - 500	350
	Total Granular Material	3	480 - 720	600

## 6.3 EXISTING PAVEMENT STRUCTURE OF EXISTING SOUTHBOUND PASSING LANE (STATION 29+100 TO STATION 11+705) ALONG HWY 6

This existing southbound passing lane of Highway 6, a truck-climbing lane, was originally constructed in 1999 under Contract 99-123. It consists of 50mm HL-4 Surface over 40mm HL-4 Upper Binder and 50 mm HL-4 Lower Binder, along with 150 mm Granular "A" over 650 mm Granular "B" Type I. Under the same contract the existing main lanes within the section were milled 50mm and paved with 50mm HL-4.

Existing pavement structure for this section, based on study of Pavement Structure Spreadsheet, is summarized as follows.

**Table 6.3.1 Summary of Existing Pavement Structure in Truck Climbing Lane Area**

Section	Pavement Component	No. of Observations	Thickness (mm)	
			Range	Design Mean
Highway 6 (Sta. 29+100-11+705)	Total HMA	10*	125 - 200	150(160**)
	Granular Base Material	12	145 - 250	150(160)
	Granular Subbase Material	12	450 - 850	650(670)
	Total Granular Material	12	595 - 1100	800(830)

\* Only core samples are used.

\*\* Values in brackets are average values.

The above table presents the existing pavement structure data obtained from core/borehole logs along Highway 6. Data presented in Table 6.3.1 indicate that hot mix asphalt thickness

in this section ranges from 125 to 200 mm, with an average of 160 mm. Total granular thickness (base + subbase) in this section varies from 595 to 1100 mm, with an average of 830 mm.

#### 6.4 EXISTING PAVEMENT STRUCTURE ALONG SIDE ROADS

As per RFP, new radii on all quadrants for intersecting sideroads will be constructed, 10 m for Douglas Street, 8 m for Field Street, and 15 m for the rest of side roads.

Table 6.4.1 provides a summary of the existing pavement structure for the side roads.

**Table 6.4.1 Summary of existing pavement structure at side roads**

Side Road	Asphalt Thickness (mm)		Granular Thickness (mm)		GBE <sup>1</sup> (mm) Average
	Range	Average	Range	Average	
TOWNSHIP OF NORMANBY					
Grey County Road 9	40-55	50	430-1460	830	480
Normanby Con Rd 12	60	60	790-1140	950	550
Southgate Road-22	25-100	85	750-1175	1018	615
Normanby Road-21	-	-	850	850	425
Southgate Road-24	-	-	400	400	200
Maplewood Road	-	-	850	850	425
Wilder Lake Road	60-100	80	890-1100	995	598
Field Street	-	-	750-1500	940	470
Varney Road	60	60	280-1500	890	520
TOWNSHIP OF BENTINCK					
Southgate-Glenelg Townline	100	100	700	700	475
Normanby-Bentinck Townline	70	70	880	880	528
Douglas Street	100	100	250-300	275	263

1. The existing GBE was calculated using the following equivalency factors:  
Existing asphalt = 1.25; Existing granular = 0.5

#### 6.5 EXISTING PAVEMENT STRUCTURE AT COMMERCIAL ENTRANCES

Commercial and private entrances were identified in Preliminary Design Report (Operational Services, Owen Sound). One borehole was drilled at each commercial entrance. Table 6.5.1 contains pavement structure encountered at commercial and/or private entrances.



**Table 6.5.1 Summary of existing pavement structure at commercial/private entrances**

Station	Offset (m)	Asphalt Thickness (mm)	Granular Thickness (mm)
<b>TOWNSHIP OF NORMANBY</b>			
25+550	6 Lt C/L	60	1140
25+860	5.5 Lt C/L	-	1200
25+950	6 Lt C/L	-	1500
26+900	6.2 Rt C/L	80	600
27+028	6 Rt C/L	80	720
27+150	5.5 Lt C/L	80	1220
27+190	5.5 Lt C/L	90	1110
23+270	5.5 Rt C/L	-	1200
27+750	5.5 Rt C/L	70	1430
28+270	5.5 Lt C/L	60	490
<b>TOWNSHIP OF BENTINCK</b>			
11+260	5.5 Rt C/L	200	1100

Note: The existing GBE was calculated using the following equivalency factors:  
Existing asphalt = 1.25; Existing granular = 0.5

## 6.6 SOIL TYPES

The predominant subgrade soil along Highway 6, within the project limits, varies from sandy silt to silt with some sand. Clayey silt was also encountered occasionally throughout the project. The 5-75  $\mu\text{m}$  fractions indicates moderate to high frost susceptibility potential for the observed subgrade soil types. Generally, the natural moisture content of the subgrade soil at the time of investigation was between 6 and 16 percent. Higher moisture contents were noted when soil contained organic material.

Topsoil thickness, within the widening width, varies from 50 to 700 mm with an average of 220 mm.

## 6.7 GROUNDWATER

Free water was not encountered at the time of investigation in this study. However, wet soil was noted in few boreholes (i.e. Sta. 22+700, 22+950, 22+900, 24+248, 28+270, 28+275, 29+600, etc.) drilled in this study (as indicated in the appended log sheets) when deep

boreholes were drilled to a depth greater than 2 m. It should be noted that groundwater conditions vary seasonally and, at certain times of the year (such as in early spring), the groundwater level could very well be near the ground surface.

## 7.0 PAVEMENT STRUCTURE DESIGN (MAIN LANES, HIGHWAY 6)

### 7.1 EXISTING PAVEMENT STRUCTURES

The average Granular Base Equivalency (GBE) along Highway 6 (main lanes) was determined using the equivalent factors (Existing asphalt = 1.25; existing base = 0.75 and existing subbase = 0.5). The GBE for the existing pavement structure was found to be 638.

The average Granular Base Equivalency (GBE) for the existing southbound passing lane of Highway 6 is 625.

The average Granular Base Equivalency (GBE) for Varney section is 554.

### 7.2 EQUIVALENT SINGLE AXLE LOADS (ESAL'S)

The equivalent single axle loads (ESAL) for main lanes of Highway 6 were calculated using traffic data presented in Table 2.2.1. The input parameters for the design lane ESAL calculation were derived from MTO publication MI-183 'Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions' and 'Procedures for Estimating Traffic Loads for Pavement Design, 1995'. Table 7.2.1 shows the input parameters used to calculate ESAL's in the design lane.

**Table 7.2.1 Input parameters for ESAL calculation – Highway 6**

Section	Base year AADT <sup>1</sup>	% Com. Vehicles	Avg. Truck Factor	Direc. Dist.	Annual Traffic Growth <sup>2</sup> (%)	Lane Dist.	No. of Days per Year	Design Period (Years)	Cumulative ESAL
Highway 6 (including Varney, Existing Southbound Passing Lane)	6233	10.8	1.725	0.5	1.6	1	365	18	4,381,000

1. Base Year = 2006
2. Annual traffic growth rates were derived from traffic data provided.

Figure 7.2.1 illustrates ESAL accumulation along Highway 6 for different sections over a 20-year period.

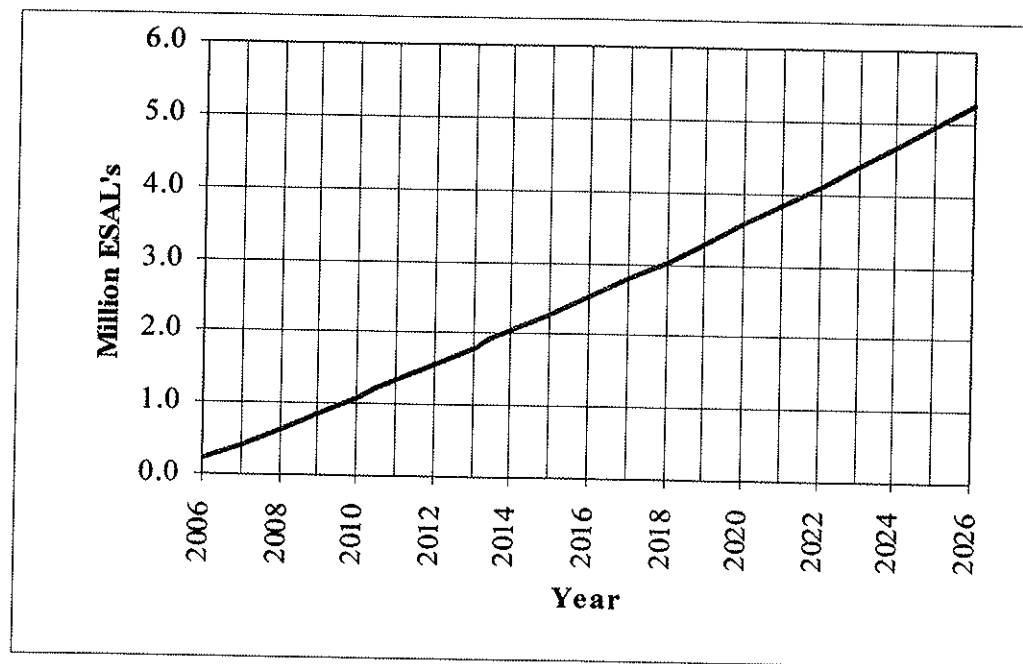


Figure 7.2.1 ESAL accumulation for Highway 6

### 7.3 THICKNESS DESIGN

Pavement structure thickness design for the design lane was determined using the AASHTO design method and the Ministry's Pavement Design Manual. Input parameters are shown in Table 7.3.1. The analysis sheets are given in Appendix 7.

Table 7.3.1 Input parameters for design lane pavement structure – Highway 6

Input Parameter	Selected Values
Initial/Terminal Serviceability	$p_i = 4.5$ ; $p_t = 2.5$
Design Period	18 years
Traffic	See Table 7.2.1
Cumulative ESAL's <sup>1</sup>	See Table 7.2.1
Subgrade Resilient Modulus ( $M_R$ )	25 MPa
Structural Coefficients ('a' values)	New Asphalt = 0.42; Existing Asphalt = 0.28 New Granular A = 0.14; New Granular B Type I = 0.09; Existing Base = 0.12 Existing Subbase = 0.07
Drainage Coefficient	$m = 1.0$ (for new granular base and sub-base) $m = 0.9$ (for existing granular)
Reliability and Std. Deviation	$R = 90\%$ ; $SD = 0.44$

1. Equivalent Single Axle Loads

The required pavement structure, based on the MTO routine and AASHTO design methods, for the input parameters noted in Table 7.3.1 and considering a high frost susceptible subgrade is shown in Table 7.3.2. Design output sheets are given in Appendix 7.

**Table 7.3.2 Pavement Design summary – Highway 6 (New Construction)**

Methodology	Materials Thickness (mm)	SN *	GBE(mm)*
MTO Routine	130 mm hot mix, 150 mm Granular A, 700 mm Granular B Type I	139	880
AASHTO	140 mm hot mix, 150 mm Granular A, 650 mm Granular B Type I	138	870

\* The Structural Number (SN) obtained was calculated using the following layer coefficients: Sub-base = 0.09; Base = 0.14; HMA = 0.42; the Granular Base Equivalency (GBE) was calculated using the following equivalency factors: Sub-base = 0.67; Base = 1.0; HMA = 2.0.

Table 7.3.2 shows that pavement structure recommended by MTO routine method is very similar to that by AASHTO method for a high frost susceptible subgrade (required SN=138). It should be noted that the above pavement design is for new construction; for pavement widening a thicker subbase layer will be needed in consideration of positive lateral drainage. As a result, minimum structural numbers shall be:

- SN = 135 (Based on the structural requirements, AASHTO method) for rehabilitation of existing Highway 6

#### 7.4 LIFE CYCLE COST ANALYSIS

Life cycle cost analysis was performed to select the most economic rehabilitation option. The analysis was based on the assumption that the existing two lanes will be rehabilitated. All options considered satisfy the minimum SN requirement, as specified above, for the life of the options examined (30 years analysis period). The four options considered were:

1. Pulverization and Pave. Mill existing pavement at selective locations where applicable, pulverize the asphalt and upper portion of base course to a depth of 300 mm, and pave with 140 mm hot mix asphalt (40 mm SP 12.5 FC1 surface course over two lifts of 50 mm SP 19.0 binder courses). The expected initial life of Option 1 is about 16 years.
2. Full Depth Asphalt Removal and Pave. Excavate existing asphalt full depth and pave 190 mm hot mix asphalt (40 mm SP12.5 FC1 surface course over three (3) lifts of 50 mm SP 19.0 binder course). The expected initial life of Option 2 is about 15 years.
3. Cold in-place recycling (CIR). Mill existing pavement at select locations where applicable, cold in-place recycle the existing asphalt to a depth of 120 mm, and pave with 90 mm hot mix asphalt (40 mm SP 12.5 FC1 surface course over 50 mm SP19.0 binder course). The expected initial life of Option 3 is about 15 years.

4. Mill and Pave. Mill existing asphalt to an average depth of 100 mm, and pave with 160 mm of HMA (40 mm SP 12.5 FC1 surface course over two lifts of 60 mm SP19.0 binder courses). The expected initial life of Option 4 is 12 years.

One kilometer of the highway with a two-lane pavement width of 7.5 m was considered. The LCCA was performed based on the present worth method over a 30-year period using a discount rate of 5%. Unit costs were provided by UMA, which were obtained from average values for similar projects in the Ministry's HICO cost data base. User delay costs were not considered in this study since a satisfactory model does not exist for this purpose. The LCC analysis includes periodic maintenance costs, such as crack sealing and maintenance repairs to the existing pavement. The pavement selection and LCCA analysis sheets are given in Appendix 6. The results are summarized in Table 7.4.1.

**Table 7.4.1 Life Cycle Cost Analysis – Summary**

Option	Initial Cost (\$)	Life Cycle Cost (\$)	Rating Based on Life Cycle Cost
1. Pulverization and Pave	271,755	336,737	2
2. Full Depth Asphalt Removal and Pave	308,775	418,568	4
3. Cold In-place Recycling and Pave	216,555	299,347	1
4. Mill and Pave	266,925	416,227	3

The Summary of LCCA, as shown in Table 7.4.1, indicates that Option 1 (Pulverization) and Option 3 (Cold in-place Recycling) shows the most economical options. Table IV in Appendix 6 provides advantages and disadvantages of each pavement alternative. Option 3 (Cold in-place recycling and pave) has the lowest initial and life cycle costs as compared to Option 1 (Pulverization). CIR, however, has shorter construction season, compared to Pulverization. Pulverization option eliminates pavement distresses by full depth asphalt treatment and thus eliminate reflective cracking. On the other hand, CIR can mitigate reflective cracking by selective milling of thick asphalt and deeper (120 mm) processing depth, which could practically eliminate reflective cracking. In addition, the existing granular base is considered "clean", which is favorable for CIR.

Based on these and for the following reasons below, we recommend adopting Option 3 (Cold In-place Recycling and Pave) as a preferred alternative for the rehabilitation of Hwy 6:

- Lowest initial and life cycle costs.
- Exceeds required SN resulting in a longer pavement life.
- Practically eliminates pavement distress and reflective cracking.
- Re-use of pavement material (environmental benefit).
- Reduced material off-site hauling.
- Public not traveling on gravel road during construction.

## **8.0 DESIGN CONSIDERATIONS**

### **8.1 REHABILITATION OF EXISTING HIGHWAY 6**

Based on the life cycle cost analysis presented in Section 7.4 of this report, the recommended rehabilitation method for the existing Highway 6 is cold in-place recycling (CIR) followed by two lifts of hot mix asphalt overlay.

### **8.2 REHABILITATION OF VARNEY SECTION OF HIGHWAY 6 (STATION 28+040-28+380)**

Considerations must be given to avoid grade raise within the Varney section (Station 28+040 to 28+380, Township of Normanby). Two options, Deep Strength and Reconstruction, were considered for rehabilitation/reconstruction of the existing pavement structure. Considering the constructability (like traffic and/or construction staging) and the relatively small section (only 250 m long) of no grade raise, the deep strength option is recommended. The recommended method will be to first remove existing asphalt (about 185 mm) and 25 mm granular base course, and then pave 210 mm of HMA (40 mm SP 12.5 FC1 surface course over 50 mm SP 19.0 upper binder course over two lifts of 60 mm SP 19.0 middle and lower binder course).

### **8.3 WIDENING OF HIGHWAY 6**

Different pavement design alternatives were initially considered for widening of Highway 6 which were all rejected in favor of conventional pavement type. Alternatives such as deep strength or full depth asphalt did not seem practical for widening next to an existing conventional pavement. The main reason was the necessity to provide positive lateral drainage across the highway by matching (as a minimum) the existing granular thickness. Moreover, for a subgrade with moderate to high susceptibility to frost heave, a conventional pavement with relatively thick granular layer deems more appropriate. Based on the above, it was decided to consider a conventional pavement type for the widening of Highway 6.

### **8.4 SUPERPAVE HOT MIX TYPES**

The current Ministry policy requires the adoption of Superpave asphaltic concrete mixes for freeways and selected King's highways. For this project, the following Superpave hot mix types are considered suitable:

Surface Course: Superpave 12.5 FC 1

Binder Course: Superpave 19.0

## 8.5 CUT SECTIONS

There are minor cut sections within the project limits. A 2H:1V side slope with seeding/mulching is suitable.

## 8.6 FILL SECTIONS

Fills within the project limits are or will be underlain by generally competent non-cohesive and cohesive soils consisting of fine to medium sand, silty sand, sandy silt, silt and clayey glacial tills. Comments on fill stability at structure approaches will be included in foundation Investigation and design reports for such structures. All fills should be constructed with 2H:1V side slopes or flatter. Any embankment fill greater than 8 m in height shall be benched.

## 9.0 RECOMMENDATIONS

### 9.1 HIGHWAY 6 –MAIN LANES

#### 9.1.1 NEW PAVEMENT DESIGN (IN CULVERTS REPLACEMENT AREAS)

Based on the traffic data from the PDR (5850 AADT in 2002, 6845 AADT in 2012, 10.8 % Commercial) and an 18-year design life, the required minimum pavement structure for new construction is as follows:

140 mm HMA (40 mm SP 12.5 FC1, over two lifts of 50 mm SP 19.0 )  
150 mm Granular 'A'  
650 mm Granular 'B' Type III (minimum thickness for structural requirements)  
940 mm Minimum Pavement Depth

#### 9.1.2 PAVEMENT REHABILITATION

Based on the results of LCCA, we recommend Cold In-Place Recycling (CIR) and Pave for rehabilitation / reconstruction of the existing pavement structures as follows:

- Mill existing asphalt at selected locations (as shown in Table 9.1.2.1)
- Remove the partially paved shoulder (PPS) and part of existing shoulder granular to provide for new 150 mm of Granular "A" beneath the new PPS
- Cold in-place recycle (CIR) the existing asphalt to a processing depth of 120 mm
- Pave 90 mm of HMA (40 mm SP 12.5 FC1 surface course over one (1) lift of 50 mm SP 19.0 binder course), including PPS
- Add 90 mm Granular "A" on the shoulders.

Average grade raise is 90 mm.

Crossfall correction and/or grade adjustments can be carried out by variable milling, padding (using SP 19.0) or increasing the thickness of the binder course up to 70 mm. Table 9.1.2.1 presents the pre-milling depths along Highway 6 before CIR.

Between Station 11+675 and 11+855 (near the north limit), a grade raise of up to 500 mm is proposed. In this case, we recommend to remove asphalt full depth (average 150 mm in thickness) and adjust the grade using Granular "A" and pave with 140 mm of hot mix (40 mm SP 12.5 FC1 over two lifts of 50 mm SP 19.0) between Station 11+675 and 11+905 (north limit).



**Table 9.1.2.1 CIR Pre-milling Depths along Highway 6**

Station		SB/NB	Length (m)	Pre-milling Depth (mm)
From	To			
21+300	21+400	SB	100	50
22+050	22+400	SB & NB	350	50
22+500	22+900	SB & NB	400	50
24+300	24+400	SB	100	50
23+300	25+650	NB	2350	30
25+550	25+650	SB	100	40
25+750	26+650	SB & NB	900	30
27+300	28+040	SB	740	30
28+380	29+350	SB & NB	970	30

**9.1.3 PAVEMENT WIDENING OF PROPOSED NORTHBOUND PASSING LANE  
(STATION 24+200 TO 26+460, NORMANDY TWP)**

It is recommended that the proposed northbound passing lane be widened as follows:

- Excavate at 1.0 to 1.5 m from the existing edge of pavement (1.0 m in areas with guide rail and 1.5 m in areas without guide rail) to provide for:
  - 140 mm HMA (40 mm SP 12.5 FC1 surface course over two (2) lifts of 50 mm SP 19.0 binder course).
  - 200 mm of Granular A base material.
  - Average of 800 mm of Granular B Type III subbase material.

A minimum of 200 mm of Granular "A" should be provided within the widening section. In addition, a minimum of 800 mm of the Granular B subbase material is recommended to match the existing depth of granular material in order to ensure positive drainage. See Table 9.1.3.1 for specific station-to-station excavation/ granular thickness requirements for NB passing lane (widening) from Station 24+200 to 26+460.

**Table 9.1.3.1 Excavation Depth Based on Drainage Requirements**

From Station	To Station	Minimum Excavation Depth (from proposed pavement surface at EP)	Subbase Thickness (mm) * (HMA 140 mm, Base 200 mm)
24+200	24+235	1590	1250
24+235	24+600	1140	800
24+600	24+700	1490	1150
24+700	24+800	1140	800
24+800	25+200	1140	800
25+200	25+500	1290	950
25+500	25+800	1140	800

From Station	To Station	Minimum Excavation Depth (from proposed pavement surface at EP)	Subbase Thickness (mm) * (HMA 140 mm, Base 200 mm)
25+800	26+050	1390	1050
26+050	26+150	1140	800
26+150	26+250	1590	1250
26+250	26+460	1140	800

\* A 4-5 m transition length should be provided for varying Granular B depths.

## 9.2 HIGHWAY 6 EXISTING SOUTHBOUND PASSING LANE (STATION 29+100 TO 29+691.722 AND STATION 10+000 TO 11+705)

### 9.2.1 NEW PAVEMENT DESIGN

For the vertical cut section within this area (Station 29+350 to 10+020), due to grade revision of maximum 600 mm, the pavement structure for new construction is recommended. Based on the traffic data provided and an 18-year design life, the required minimum pavement structure for new construction in the vertical realignment area is as follows:

40 mm SP 12.5 FC1 surface course  
100 mm (2x50) SP 19.0 binder course  
150 mm Granular 'A'  
650 mm Granular 'B' Type III  
940 mm Minimum Pavement Depth

### 9.2.2 PAVEMENT REHABILITATION (VERTICAL REALIGNMENT AREAS)

In areas north of the vertical realignment (Station 10+020 to 11+675), considering the fact that the southbound passing lane was originally built in 1999 and that the main lanes were also resurfaced at that time, only one lift overlay of 50 mm SP 12.5 FC1 surface course was suggested by MTO in the Pavement Selection Meeting. It should be noted that this section is expected to deteriorate earlier than the rest of the project and will be rehabilitated/maintained under MTO capital works program, when required.

There will be a 50 mm grade raise for this section.

To the south of the vertical cut from Station 29+100 to 29+350 within the existing southbound passing lane, considering the relatively short section of only about 250 m, CIR is also recommended to be utilized and extended north to Station 29+350.

Similarly, from Sta. 11+675 to 11+705 (north end of southbound passing lane), considering its short length (30 m), full depth asphalt removal is recommended (instead of overlay only).

### 9.3 HIGHWAY 6 – VARNEY SECTION (STATION 28+040 TO 28+380)

Considering the requirement of no or minimal grade raise in Varney Section, deep strength asphalt is recommended for rehabilitation/reconstruction of the existing pavement structure as follows:

- Remove existing asphalt (about 185 mm) and 25 mm granular base course.
- Pave 210 mm of HMA (40 mm SP 12.5 FC1 surface course over 50 mm SP 19.0 upper binder course over two (2) lifts of 60 mm SP 19.0 middle and lower binder course.

### 9.4 INTERSECTION IMPROVEMENTS (RADIUS ADJUSTMENTS AND TURNING LANES)

For proposed radius adjustment or turning lanes (along Highway 6) at intersecting side roads, excavation may start from 1.5 m (mid-shoulder) beyond edge of existing pavement of Highway 6 (if granular shoulder is present). Where granular shoulder is not present or is not wide enough, excavation shall start from EP. The recommended pavement structure, as a minimum, for the widening of Highway 6 at these locations shall be as follows:

- 40 mm Superpave 12.5FC 1 surface course.
- 50 mm Superpave 19.0 binder course.
- 50 mm Superpave 19.0 binder course.
- 150 mm Granular A base.
- Minimum 650 mm Granular B Type III.

To accommodate positive drainage across the highway, the granular materials within the pavement widening shall be placed to a depth matching (or exceeding) the thickness of adjacent existing granular. Field investigation revealed that there are instances where recommended pavement thickness does not match the existing granular. Table 9.4.1 shows the side roads, where granular subbase (Granular 'B' Type III) depth needs to be increased to match the existing granular depth.

For platform widening, use inorganic indigenous earth fill or borrow material as specified hereafter in this report.

**Table 9.4.1 Locations where thicker granular subbase is required within the widening**

Township	Side Road	Subbase Thickness (mm)
Township of Normanby	Southgate Road 22	650
	Normanby Road 21	750
	Southgate Road 24	750
	Maplewood Road	800
	Varney Road	800
Township of Bentinck	Normanby-Bentinck Townline	750

Note that the above recommended pavement structure only applies to widening along Highway 6 and radius adjustments up to the end of radii. Where widening is required along the side roads, the following pavement design shall be used (unless otherwise different pavement design for side road is specified elsewhere in this report):

- 40 mm Superpave 12.5FC 1. Surface course shall be stepped over the existing pavement by 0.5 m.
- 50 mm Superpave 19.0. Binder course may be butt jointed to the existing pavement.
- 150 mm Granular A base.
- Minimum 300 mm Granular B Type III subbase. Granular subbase shall be transitioned to the existing granular depth in side road/Hwy 6 over a maximum length of 10 m.

## 9.5 SIDE ROADS

It is understood that the pavements of side roads to 15 m beyond end of radii are to be rehabilitated. The following recommendations are provided for the treatment of side roads.

### Side Roads (Existing Hot Mix Asphalt Less Than 90 mm)

- Remove asphalt full depth and replace with 40 mm Superpave 12.5 FC1 over 50 mm Superpave 19.0.

### Side Roads (Existing Hot Mix Asphalt Greater Than Or Equal To 90 mm)

- Mill existing pavement to a depth of 50 mm.
- Pave 50 mm Superpave 12.5 FC1 surface course.

Details of transition for side roads can be found in Appendix 8.

## 9.6 COMMERCIAL ENTRANCES ALONG HIGHWAY 6

Field investigation revealed that there are sufficient amount of granular material present at the commercial entrances. Hence, it is recommended to:

- Remove the existing asphalt full depth to the MTO right of way limit,
- Grade and compact the underlying granular and pave with:
  - 40 mm Superpave 12.5FC 1 surface course over 50 mm Superpave 19.0 binder course.
- Top of the surface course to be flush with the existing pavement in the commercial property.

## 9.7 PRIVATE ENTRANCES ALONG HIGHWAY 6

For the private entrances, it is recommended to:

– Paved entrances:

- ♦ Remove the existing asphalt full depth to the MTO right of way limit,
- ♦ Use Granular A for grade adjustment. Grade and compact the granular and pave with:
  - ♦ 50 mm Superpave 12.5 FC1 surface course top of which to be flush with the existing pavement in the private entrance.

– Unpaved entrances:

- ♦ Use Granular A for grade adjustment. Grade and compact the granular and pave with:
  - ♦ 50 mm Superpave 12.5 FC1 surface course top of which to be flush with the existing pavement in the private entrance.

## 9.8 PROPOSED GRADE ADJUSTMENT ALONG HIGHWAY 6

Two crest vertical curves are considered for grade adjustment as follows:

Station 29+350 to 10+020 (Vertical Cut)

Grade adjustment in this section will result in a maximum cut of 0.6 m. The recommended pavement structure can be found in Section 9.2.2.

Station 11+675 to 11+855 (Township of Bentinck)

Grade adjustment in this section will result in a maximum grade raise of 0.5 m. It is recommended to:

- Remove existing asphalt full depth (average 150 mm in thickness);

- Raise the grade using Granular A base, where required;
- Pave 40 mm Superpave 12.5FC 1 surface course over two (2) lifts of 50 mm Superpave 19.0 binder course.

The above pavement recommendation shall apply to the north limit of project, i.e. Sta.11+905.

#### 9.9 USE OF SHOULDERS AS DETOUR

From the findings of the boreholes the existing granular thickness in the shoulders is generally considered adequate for detour (up to two seasons) during construction. As a minimum, place 100 mm hot mix asphalt on the existing shoulders to be used for detour.

#### 9.10 USE OF EXCAVATED MATERIAL

Granular material excavated from the shoulders, where truck climbing lane is being constructed, marginally meets the gradation requirements for granular B Type I and may be re-used as granular subbase, only within bottom 300 mm of subbase layer, provided that it is not contaminated with any underlying organic, cobbles, subgrade soil, or deleterious material. The moisture content of this material at the time of construction shall be within 2% of the optimum moisture content. Estimated range of standard proctor densities and optimum moisture contents for excavated granular material encountered at the site are as follows:

- Sand and gravel: 18.5 to 21 kN/m<sup>3</sup> @ 7 to 11% moisture.

Excavated inorganic soils from within pavement widening of Highway 6 (where truck climbing lane is to be constructed) or from earth cut sections may be re-used for earth fill below pavement structure provided that they are similar to the adjacent existing subgrade soil. Excessive organic content will disqualify the soil from being re-used.

The moisture content of the excavated material may be above the allowable moisture limit for fill. If so, reconditioning (dry-up) or mixing with drier material is required prior to placement. The soil may need to be spread out and dried sufficiently before use.

Excavated topsoil or any soil containing excessive organics shall not be re-used for fill.

#### 9.11 EARTH FILL

As mentioned earlier, excavated inorganic CL, ML or SM soils may be used for fill below the pavement structure provided that they are similar to the adjacent or underlying subgrade soil.

If extra fill material is required to be imported, suitable soils complying with borrow material as specified elsewhere in this report are to be used.

Earth fill shall be placed in lifts of not exceeding 200 mm compacted to at least 95 % Standard Proctor Maximum Dry Density (SPMDD). The moisture content of the fine-grained fill material at the time of construction shall be within 2% of the optimum moisture content. Reconditioning (dry-up) of the material with exceeding moisture content is required prior to placement. The soil may need to be spread out and dried sufficiently before use.

#### 9.12 BORROW MATERIAL

Imported borrow material for the project, shall consist of competent inorganic soils similar to existing underlying and adjacent materials complying with borrow material specified in OPSS 212.

#### 9.13 HIGH EMBANKMENTS

High embankment widening exists for the proposed northbound passing lane from Station 24+200 to Station 26+460 in Township Normanby. Embankment stability at this location will be covered under Foundation Investigation and Design Report prepared by S&P.

#### 9.14 DEEP EARTH CUT

There are no deep cut widening sections within limits of the project. The maximum cut depth for two locations, i.e. from Station 29+350 to Station 10+020, and from Station 11+675 to Station 11+885, is only 0.6 m. Foundation Investigation and Design Report will be prepared by S&P at the proposed earth cut between Station 29+350 and 10+020.

#### 9.15 STRIPPING

Refer to pavement Borehole Logs provided in Appendix 4 for topsoil thickness.

Boreholes drilled within the pavement widening for the northbound passing lane (Station 24+200 to 26+460) indicate that topsoil thickness varies between 100 mm and 500 mm with an average of 250 mm. Such topsoil shall be completely removed prior to pavement construction. For estimation purpose, assume average stripping depth of 250 mm.

Topsoil thickness within the minor pavement widening on curves and other areas of the project varies from 50 mm to 700 mm with an average of 220 mm. Stripping shall include full depth removal of such topsoil. For estimation purpose, assume average stripping depth of 250 mm for any minor widening.

Up to 50% of the stripped topsoil may be re-used as topsoil for landscaping.

#### 9.16 TRANSITION POINT TREATMENT

Transition zones from earth cut to earth fill or from earth fill to earth cut shall be treated as per current OPS standards. Transition treatment depth,  $t$ , shall be 1.5 m.

#### 9.17 SUBGRADE PREPARATION AND INSPECTION

The subgrade, within the proposed widening of Highway 6, shall be adequately prepared to receive the sub-base course. Disturbed and wet subgrade materials shall be removed and the top of the subgrade shall then be inspected and approved, by proof rolling, by qualified geotechnical personnel. Cavities created by the removal of unsuitable materials shall be back filled with approved, inorganic indigenous fill materials. Finished subgrade surface shall be compacted to at least 95% Standard Proctor Maximum Dry Density (SPMDD).

#### 9.18 PARTIALLY AND FULLY PAVED SHOULDERS

There is a 0.5 m wide partially paved shoulder for Highway 6. Partially paved shoulders shall consist of 40 mm Superpave 12.5 FC1 over 50 mm Superpave 19.0. The contaminated upper portion of granular on the existing shoulder shall be removed and replaced with new granular materials prior to paving new asphalt.

For the areas where guide rails are present and fully paved shoulders are required, fully paved shoulders shall consist of 40 mm Superpave 12.5 FC1 or Superpave 12.5 (where large amount of asphalt mix are needed) surface course over 50 mm Superpave 19.0 binder course over minimum 150 mm Granular A.

#### 9.19 GRANULAR MATERIALS

All granular materials shall be placed full width. Granular base and sub-base materials shall satisfy the requirements of current OPSS for Granular A and Granular B Type III, respectively. Granular base and subbase layers have to be compacted to minimum 100% SPMDD.

#### 9.20 ASPHALT CEMENT GRADE

The performance grade of the asphalt cement shall be:

Surface Course and Binder Course: PGAC 58-28



## 9.21 ASPHALT JOINTS AND TRANSITION

See Appendix 8 for details of transitions at project limits.

## 9.22 TACK COATING

All milled surfaces or asphalt surfaces shall be tack coated prior to placement of the surface course.

## 9.23 FROST PENETRATION DEPTH

The frost penetration depth is,  $f = 1.6$  m.

## 9.24 APPLICABLE STANDARDS AND SPECIFICATIONS

The applicable standards and specifications for this project are the most current versions of OPS Standards and Specifications.

## 9.25 SOIL ERODIBILITY

The erodibility of the soil types encountered in this study are shown in Table 9.25.1.

**Table 9.25.1 Erodibility Factor**

Soil Type	'K' Factor	Erodibility
Fine Sand	0.05 to 0.2	Non-erodible to slightly erodible
Silty Sand	0.2 to 0.4	Slightly to moderately erodible
Clayey Silt	0.3 to 0.5	Slightly to moderately erodible
Sandy Silt to Silt	0.4 to 0.6	Moderately to highly erodible

For design purposes, the soils encountered at the site should be considered generally moderately erodible and therefore, seeding and mulching should be applied to cut and fill slopes as soon as feasible after slope trimming operation. Ditches with slopes less than 3% should be hydro-seeded; ditches with slopes between 3% and 5% could be treated with erosion control blanket and seed and mulch; ditches with slopes greater than 5% should have rip rap underlain by geotextile (Class II, non-woven with FOS of 50 to 100  $\mu$ m). For earth back slopes higher than about 3 m, erosion control blanket should be provided in conjunction with the seeding and mulching.

## 9.26 OHSA SOIL TYPES

For purposes of the Ontario Occupational Health and Safety Act and its regulations and requirements, the excavated inorganic soils are classified as Type 3; excavated topsoil is classified as Type 3; excavated granular material and sandy soil are classified as Type 3.

## 9.27 SUBDRAIN


We do not anticipate any new subdrain for this project except probably in Varney area and at vertical revision section between Station 29+350 and 10+020.

## 10.0 CLOSURE

Included with this report are Appendices 1 to 9.

We trust that this report addresses all the RFP requirements for pavement design and infrastructure management prepared by MTO Southwestern Region. Should any question or comments arise, please feel free to contact the undersigned.

### SHAHEEN & PEAKER LIMITED

  
for Joshua Jiewu Li, M.A.Sc., M.Eng.

  
Ramon Miranda, P.Eng.

RM:jl(t drive)



## SHAHEEN & PEAKER LIMITED

### LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environmental aspects of this project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Geotechnical Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in testholes. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction, should, therefore, make own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Shaheen & Peaker Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

## Appendix 1

# Design Criteria, Pavement Performance and Existing Pavement/Shoulder Widths



G.W.P. NO: 338-97-00 (a) OPERATIONAL SERVICES Owen Sound HWY NO: 6  
TYPE OF PROJECT: Grading, Drainage, Granular Base, Paving, Structural Culvert LENGTH: 10.5 km  
Replacements/Rehabilitations and a New Northbound Passing Lane  
LOCATION: From 1.1 km South of Grey County Road 9 (North Junction) Northerly to Durham South Limits

COUNTY of: Grey  
MUNICIPALITIES/TOWNSHIPS of: West Grey and Southgate

LIMITS: FROM STATION 21+100 PLAN 157-6/22-0 TO STATION 29+691.722 PLAN 157-6/41-0  
LIMITS: FROM STATION 10+000 PLAN 198-6/5-0 TO STATION 11+870 PLAN 198-6/11-0

	PRESENT CONDITIONS	DESIGN STANDARDS	PROPOSED STANDARDS	
HIGHWAY CLASSIFICATION	RAU 100	RAU 100	RAU 100 (b)	Manager, Operational Services
MIN STOPPING SIGHT DIST	123m	185m	123m (c)	
EQUIVALENT MIN 'K' FACTOR	Sag 20 Crest 30	Sag 45 Crest 70	Sag 20 (c) Crest 30	
GRADES MAXIMUM	5 %	6-8%	5 %	
MINIMUM RADIUS	249.482m	420m	249.482m (d)	
PAVEMENT WIDTH	7.50 - 11.25m	7.50 - 11.00m	7.50 - 11.25m (e)	Manager, Contracts
SHOULDER WIDTH	2.50m	3.00m	3.00m (e)	
SHOULDER ROUNDING	0.50 - 1.0m	0.50 - 1.0m	0.50 - 1.0m (e)	
MEDIAN WIDTH	N/A	N/A	N/A	Manager, Engineering
R.O.W. WIDTH	Varies from 18m minimum	N/A	Varies from 18m minimum (f)	
POSTED SPEED	80 km/h	N/A	80 km/h (g)	

\_\_\_\_\_  
Regional Director, Date of Approval



G.W.P. NO: 338-97-00 (a)

OPERATIONAL SERVICES Owen Sound

HWY NO: 6

TYPE OF PROJECT: Grading, Drainage, Granular Base, Paving, Structural Culvert  
Replacements/Rehabilitations and a New Northbound Passing Lane

LENGTH: 10.5 km

LOCATION: From 1.1 km South of Grey County Road 9 (North Junction) Northerly to Durham South Limits

**TRAFFIC DATA:**

Location: Hwy	Distance Km	2002 AADT	2002 SADT	2012 AADT	2012 SADT	% DHV	% COMM	2001 A.R.
Mount Forest North Limits								
	21.4	5850	7150	6845	8365	12.7	10.8	0.6
Durham South Limits								

**COLLISION SUMMARY:**

In the 5-year period from 1999 to 2003 there were a total of 75 motor vehicle collisions reported. Of these collisions, 56% (42) reported less than ideal conditions, 16% (12) were animal (deer) related and 1 was related to an impaired driver. Property damage only was reported in 60 of the collisions while the remaining 15 collisions reported personal injuries. There were no fatalities over this period. In conclusion, there appears to be no patterns relating to collision type or location within the limits of the project.

**LEVEL OF SERVICE:**

Location	LOS 2002 Existing	LOS 2012 Existing	LOS 2002 Proposed Improvements	LOS 2010 Proposed Improvements
Mount Forest North Limits				
	D	D	D	D
Durham South Limits				

**Notes:**

a) **Group Work Project 338-97-00** includes the work and limits as described below:

W.P. 338-97-01 - Rehabilitation of Highway 6 from 1.1 km south of Grey County Road 9 (North Junction) northerly to Durham south limits.

W.P. 338-97-02 - Construct a new northbound passing lane (2.26 km) from station 24+200 to station 26+460; LHRs 13670/01.970 to LHRs 13670/04.230

W.P. 338-97-03 - Rehabilitation/Replacement of the Kemp Creek Concrete Culvert Site # 8-450-C; LHRs 13670/09.200

W.P. 338-97-04 - Rehabilitation/Replacement of the Camp Creek Concrete Culvert Site # 8-449-C; LHRs 13670/05.800

W.P. 338-97-05 - Reconstruct vertical crest at the intersection of Normanby-Bentinck Townline/Southgate-Glenelg Townline Roads from station 29+300+/- to station 10+100+/-; LHRs 13670/07.058 to LHRs 13670/07.550

b) This section of Highway 6 is identified as a Class III Special Controlled Access Highway as determined by the M.T.O. Corridor Control Section in the 2003 System for Provincial Highway Access Controls, and has a Functional Classification as a Rural Arterial Undivided 100 (2005).

c) There are ten (10) sag curves and nine (9) crest curves within the project limits that do not meet the requirements of a 100 km/h design speed.



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HWY NO: 6

TYPE OF PROJECT: Grading, Drainage, Granular Base, Paving, Structural Culvert  
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LENGTH: 10.5 km

LOCATION: From 1.1 km South of Grey County Road 9 (North Junction) Northerly to Durham South Limits

Station 11+750 (K-20 Sag); it is proposed to retain this curve for the following reasons:

- This curve meets a design speed of 62 km/h.
- This curve is located in a reduced speed zone immediately south of Durham, which will remain posted at 70 km/h.
- There are no accidents or operational problems attributed to the geometrics of this vertical curve.
- An increase in the fill over the existing concrete culvert could compromise the structural integrity of the culvert.
- The cost/benefit analysis does not support reconstruction.

Stations 23+850, 25+500 and 10+700 (K-30 Sags); it is proposed to retain these curves for the following reasons:

- These curves meet a design speed of 80 km/h, which is equivalent to the posted speed.
- There are no accidents or operational problems attributed to the geometrics of these vertical curves.
- The cost/benefit analysis does not support reconstruction.

Stations 22+350, 23+350, 24+450, 26+750, 28+250, and 28+950 (K-40 Sags); it is proposed to retain these curves for the following reasons:

- These curves all meet a design speed of 90 km/h, which exceeds the posted speed of 80 km/h.
- The curve at 28+250 is located in a reduced speed zone in the Hamlet of Varney, which will remain posted at 70 km/h.
- There are no accidents or operational problems attributed to the geometrics of these vertical curves.
- The cost/benefit analysis does not support reconstruction.

Station 11+850 (K-30 Crest); it is proposed to retain this curve for the following reasons:

- This curve meets a design speed of 75 km/h.
- This curve is located in the reduced speed zones at the south limits of Durham, which will remain posted at 50 and 70 km/h.
- There are no accidents or operational problems attributed to the geometrics of this vertical curve.
- The cost/benefit analysis, which would include reconstruction to Douglas Street, does not support reconstruction.

Stations 22+800 and 24+150 (K-40 Crest); it is proposed to reconstruct these curves pending the final recommendations of the Pavement Design Report. The extent of the improvements will be limited to the exclusion of property acquisitions for the following reasons:

- These curves meet a design speed of 84 km/h, which exceeds the posted speed of 80 km/h.
- There are no accidents or operational problems attributed to the geometrics of these vertical curves.
- The cost/benefit analysis does not support reconstruction.

Station 29+600 (K-40 Crest); it is proposed to reconstruct this curve (K-Factor pending) for the following reasons:

- This curve only exceeds the posted speed of 80 km/h by 4 km/h, is located at the intersection with Normanby-Bentinck Townline/Southgate-Glenelg Townline Roads and does not meet the Design Speed requirements for stopping sight distance.
- Site distance southerly is restricted to a 5-7 second vehicle approach/vehicle departure time for approaching passenger vehicles and 7 to 10 second vehicle approach/vehicle departure time for approaching commercial vehicles.
- Although the collision records do not indicate an occurrence problem at this location, MTO maintenance, the public and the O.P.P. have indicated that this location is of concern and has experienced many "near misses".



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Replacements/Rehabilitations and a New Northbound Passing Lane

LENGTH: 10.5 km

LOCATION: From 1.1 km South of Grey County Road 9 (North Junction) Northerly to Durham South Limits

Station 11+300 (K-45 Crest); it is proposed to reconstruct this curve pending the final recommendations of the Pavement Design Report. The extent of the improvement will be limited to the exclusion of property acquisition for the following reasons:

- This curve meets a design speed of 87 km/h, which exceeds the posted speed of 80 km/h.
- There are no accidents or operational problems attributed to the geometrics of this vertical curve.
- The cost/benefit analysis does not support reconstruction.

Stations 25+950, 27+500 and 10+950 (K-50 Crest); it is proposed to retain these curves for the following reasons:

- These curves meet a design speed of 90 km/h, which exceeds the posted speed of 80 km/h.
- There are no accidents or operational problems attributed to the geometrics of these vertical curves.
- The cost/benefit analysis does not support reconstruction.

Station 24+850 (K-60 Crest); it is proposed to retain this curve for the following reasons:

- This curve meets a design speed of 95 km/h, which exceeds the posted speed of 80 km/h.
- There are no accidents or operational problems attributed to the geometrics of these vertical curves.
- The cost/benefit analysis does not support reconstruction.

- d) There is one (1) horizontal curve within the project limits that does not meet the requirements of a 100 km/h design speed.

Station 11+850 (R-249.482m); it is proposed to retain this curve for the following reasons:

- This curve meets a design speed of 80 km/h.
- This curve is located in reduced speed zones immediately south of Durham, which will remain posted at 50 and 70 km/h.
- There are no accidents or operational problems attributed to the geometrics of this vertical curve.
- The cost/benefit analysis does not support reconstruction.

- e) Within the resurfacing limits it is proposed to retain the existing lane widths of 3.75 m. The existing overbuilt southbound passing lane of 3.75 m and the 2.50 m shoulder will be retained and zone painted to reflect a lane width of 3.50 m. The new northbound passing lane will be constructed to 3.50 m. Due to the commercial percentage, shoulders, other than adjacent to the southbound passing lane, will be reconstructed to a width of 3.0 m with a 0.50 m rounding and 0.50 m partially paved shoulders as required. It is anticipated that the existing platform will support the proposed shoulder widening. Shoulder roundings shall be 1.0 m at all guiderail locations.

In addition, it is proposed to reconstruct:

- The right-turn lane and taper on Highway 6 from the northbound approach to Grey County Road 9 (North Junction).





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LOCATION: From 1.1 km South of Grey County Road 9 (North Junction) Northerly to Durham South Limits

f) The posted speed is generally 80 km/h throughout the project. However, there are reduced speed zones at the following locations:

- Posted at 70 km/h within the Hamlet of Varney:

(Regulatory description verbatim) That part of the King's Highway known as No. 6 in the Townships of Egremont and Normanby in the County of Grey beginning at the point at which it intersects with the northerly limits of the road allowance between lots 3 and 4 in Concession 1 and extending northerly therealong for a distance of 2200 feet, more or less.

- Posted at 70 km/h immediately south of Durham:

(Regulatory description verbatim) That part of the King's Highway known as No. 6 in the Townships of Bentinck and Glenelg in the County of Grey beginning at the point at which it intersects the boundary line between lots 27 and 28 in Concession 1 and extending southerly therealong for a distance of 2000 feet, more or less.

#### Remarks:

#### 1) Scope of Work

The following improvements are proposed for this project:

- Rehabilitate the existing pavement throughout, retain the pavement widths of 7.50 m and 11.25 m, and construct 3.00 m shoulders including 0.50 m partially paved shoulders where required. The detail design consultant will undertake the geotechnical investigations and will issue the Pavement Design Report. The Regional preliminary geotechnical recommendations indicate combinations of milling, pulverization and paving of the mainline with an overlay of the surface of the southbound passing lane. Preliminary recommendation also included the pavement structures for the widening and the vertical curve revisions.
- Construct a new northbound passing lane (2.26 km) from station 24+200 to station 26+460 with a 3.50 m lane width.
- Reconstruction of the vertical crest at station 29+600 and other vertical curves as required pending final recommendations of the Pavement Design Report.
- Reconstruction/rehabilitation of the structural concrete culverts at Camp and Kemp Creeks. Final assessments and recommendations to be completed during detailed design.
- Crossing, sideroad and entrance culvert replacements as required. The Region's Bridge Co-ordinator has completed the field assessments of the concrete culverts and has provided preliminary findings and recommendations. The structural integrity of all concrete culverts under 3.0m spans will be re-evaluated by the design consultant during detail design.
- Minor intersection improvements as required including reconstruction of the right-turn lane and taper at Grey County Road 9 (North Junction).
- All existing concrete curb and gutter will be removed. Concrete curb and gutter will not be replaced on the sideroad radii unless required for drainage purposes.
- Apply approach shoulder treatments at sideroads as per OPSD 304.01.
- Pavement and shoulder crossfalls, and superelevation, will be corrected to current ministry standards.
- Apply pavement widening on curves as required.
- Upgrade private and commercial entrances as required.
- Fully paved shoulders at select curb and gutter locations, all guiderail locations, and within specific urban sections.
- Drainage improvements throughout as required.
- Culverts will be evaluated for extensions during detail design.
- Erosion, sedimentation controls and storm water quality will be addressed as required throughout.



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- xvi. All existing guiderail and end treatments will be removed and the project will be assessed throughout for removal and/or protection of roadside hazards in accordance with the Ministry's Roadside Safety Manual. Also, in accordance with ministry policy issued (November 18, 2002), where protection is required, slope flattening or steel-beam guiderail shall be considered on the inside of horizontal curves. Three-cable guiderail will not be permitted on the inside of horizontal curves.

2) Limits of Project

South Limit: Station 21+800; LHRS 13665/11.000

The south limit of the project is located 0.4 km south of the intersection with Grey County Road 9 (North Junction).

North Limit: Station 11+870; (Community of Durham) LHRS 13670/09.300

The north limit of the project is located at the south limit of the Connecting Link of the Community of Durham (Municipality of West Grey).

3) Adjacent Projects

G.W.P. 191-89-00 - Highway 6: Three (3) site-specific structural concrete culvert locations between Mount Forest and Dornoch consisting of two (2) rehabilitations and one (1) replacement.

4) Construction Staging and Detours

The detailed design consultant will be responsible for all construction staging. The use of local road detours is not anticipated.

5) Property

Property will be required to accommodate the proposed new northbound passing lane and the reconstruction of the vertical crest at station 29+600. It is anticipated that Temporary Limited Interests will be required at the structural culvert sites. Preliminary Property Request and Plan 338-97-00-PR-01 has been initiated to address any acquisitions.

6) Assumptions, Designations, Transfers and Road Closings

There are no assumptions or road closings associated with this project. Designations and transfers, if required, will be part of the property acquisition process.

7) Illumination

There is no ministry owned illumination within the project limits and the Regional Traffic Section has indicated that there are no illumination warrants. There is municipal illumination located:

- Near the south limit of the project in the Hamlet of Orchard;
- At the intersection of Highway 6 and Grey County Road 9 (North Junction); and
- Within the Hamlet of Varney;

The municipalities will be contacted regarding any upgrades under a cost-sharing agreement. Partial illumination may be required, pending the final construction staging recommendations.



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8) **Traffic Control Signals and Signal Devices**

There are no traffic signals or signal devices located within the project limits and the Regional Traffic Section has indicated that there are no warrants for either. Temporary traffic signals may be required, pending the final construction staging recommendations.

9) **Traffic Classification Stations**

There are no existing or recommended traffic classification stations within the project limits.

10) **Structures**

The following two (2) structural concrete culverts are located within the limits of the project.

- Camp Creek Concrete Culvert (Site # 8-449-C); at the south limits of the Hamlet of Varney; LHRS 13670/05.800
- Kemp Creek Concrete Culvert (Site # 8-450-C); immediately south of Durham south limits; LHRS 13670/09.200

The TPM Consultant will be responsible for the final assessment of the integrity of the Camp Creek Concrete Culvert (Site # 8-449-C) and the Kemp Creek Concrete Culvert (Site # 8-450-C) and any associated design and construction staging.

11) **Northbound Passing Lane**

A warrant for a northbound passing lane has been achieved within this section of Highway 6. The location selected for the passing lane is from immediately north of the intersection with Southgate Road 22, northerly for 2.26 km. The primary contributing factors to the warrant is the rolling terrain (multiple 5% gradients), the no-passing opportunities (52% averaged, 64% northbound), the traffic volumes (6845 AADT) and the amount of slow moving commercial vehicles (10.8%). These factors translate into an existing Assured Passing Opportunity (APO) range of 11% to 4%, which does not meet the ministry's criteria for the required APO range of 22% to 25%.

12) **Railways**

There are no railway crossings within the project limits. There are two (2) former crossings (abandoned and rails removed) that are now used as trail and snowmobile crossings.

13) **Private/Commercial Entrances**

All entrances were reviewed with Owen Sound Operational Services and to-date, six (6) entrances have been identified for removal and/or reconstruction. All existing private and commercial entrances shall be upgraded as required. Planning and Design, and Owen Sound Operational Services will contact all affected owners.

14) **Utilities**

Various utility plants exist within the right-of-way throughout the project limits, including one (1) high-voltage Hydro tower line. The detailed design consultant will assess the impacts, and identify and co-ordinate all utility relocations. Planning and Design has made the initial utility company contacts.



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**15) Pipe Lines**

There are no pipeline crossings within the project limits.

**16) Municipal Drains**

There are no municipal drains identified within the project limits. The municipalities will be contacted for confirmation.

**17) Legal Agreements**

Currently there are no legal agreements associated with this project.

**18) Connecting Links**

There are no Connecting Links within the project limits. The Durham Connecting Link (now within the Municipality of West Grey) is immediately north of the north limits of the project. The municipality will be contacted regarding any concurrent works.

**19) Trail Crossings Including Associations and/or Clubs**

Planning and Design has identified two (2) Snowmobile/Trail Crossings within the limits of the project:

- Station 28+300+/- (Varney): Abandoned railway right-of-way crossing Highway 6.
- Station 11+760+/- (Immediately south of Durham): Abandoned railway right-of-way crossing Highway 6.

Owen Sound Operational Services, the Ontario Federation of Snowmobile Clubs and the municipalities will be contacted regarding confirmation and/or identification of Trail Crossings, Associations or Clubs that may be impacted by the proposals. No alteration to the proposed cross-section is anticipated as a result of any potential external involvement.

**20) Developments**

The ministry's Corridor Control section and the appropriate municipalities will be contacted regarding any current or potential development proposals that may affect the project. To-date, none have been identified.

**21) Permanent Highway Signage**

All highway signage will be assessed for upgrading. The TPM Consultant will co-ordinate this with the Regional Traffic staff and the Regional Sign Co-ordinator.



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**22) Tourist Oriented Directional Signs**

The detailed design consultant shall notify the Canadian Tourist Oriented Directional Signs (CTODS) Limited of the upcoming project and shall include the appropriate special provisions in the contract documents.

**23) Environmental Assessment**

This project falls within Environmental Assessment Group (B) and is subject to compliance with MTO's Class Environmental Assessment for Provincial Transportation Facilities (2000). For Group B projects, compliance with the Class EA includes preparation of a Transportation Environmental Study Report.

**24) Preliminary Design Report**

A Preliminary Design Report will be prepared for this project.



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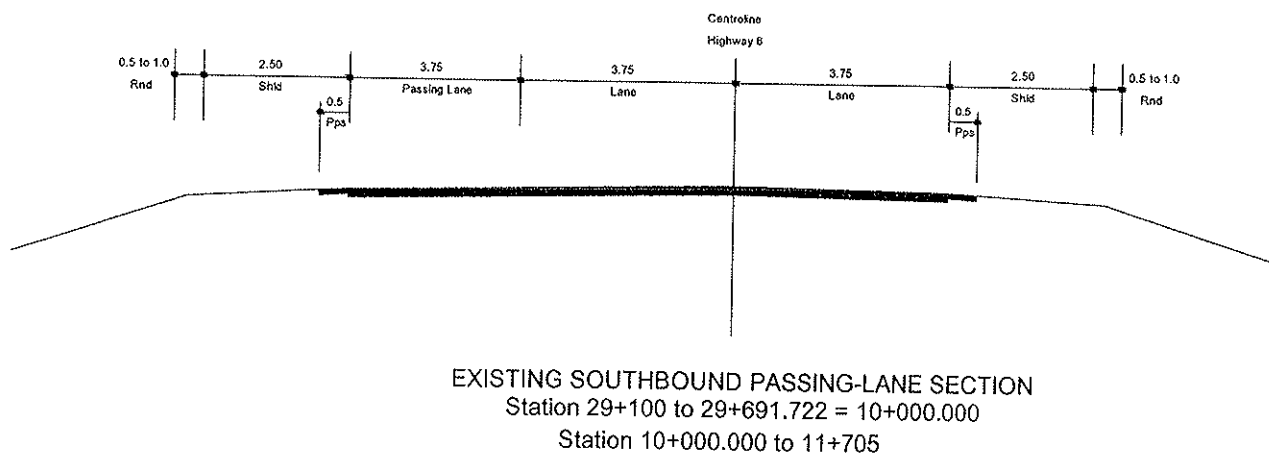
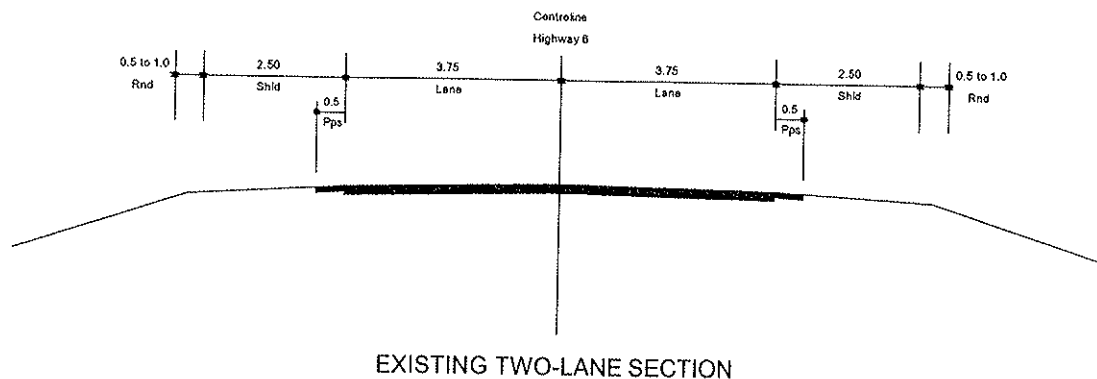
TYPE OF PROJECT: Grading, Drainage, Granular Base, Paving, Structural Culvert  
Replacements/Rehabilitations and a New Northbound Passing Lane

LENGTH: 10.5 km

LOCATION: From 1.1 km South of Grey County Road 9 (North Junction) Northerly to Durham South Limits

### Existing Typical Sections Highway 6

NTS





G.W.P. NO: 338-97-00 (a)

OPERATIONAL SERVICES Owen Sound

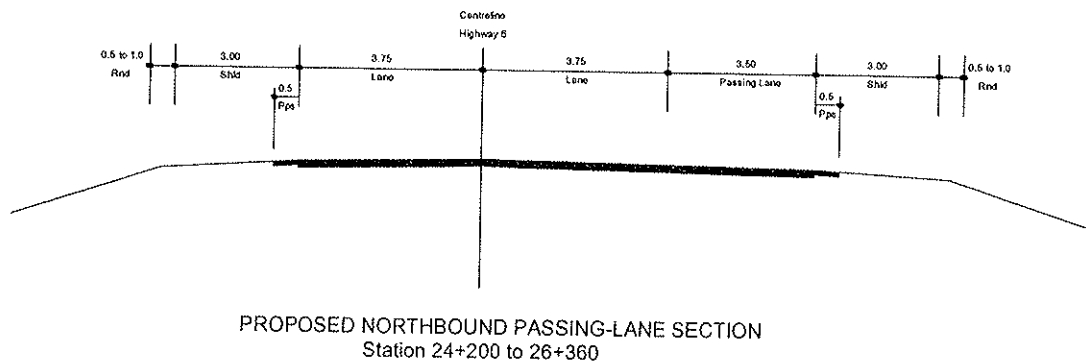
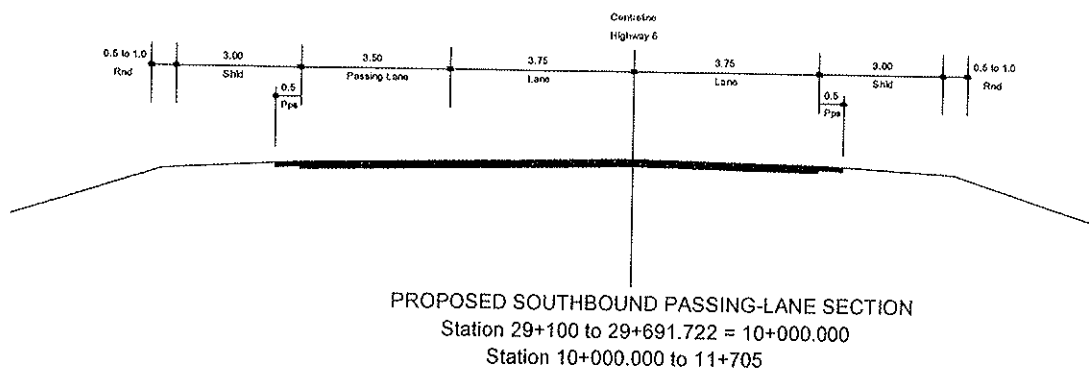
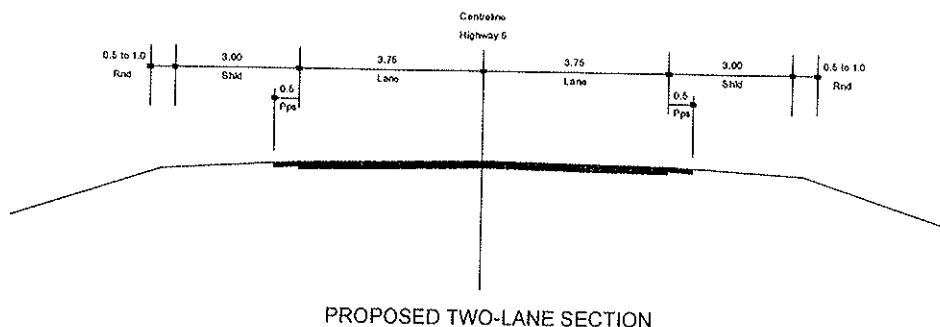
HWY NO: 6

TYPE OF PROJECT: Grading, Drainage, Granular Base, Paving, Structural Culvert  
Replacements/Rehabilitations and a New Northbound Passing Lane

LENGTH: 10.5 km

LOCATION: From 1.1 km South of Grey County Road 9 (North Junction) Northerly to Durham South Limits

### Proposed Typical Sections Highway 6 NTS





G.W.P. NO: 338-97-00 (a) OPERATIONAL SERVICES Owen Sound

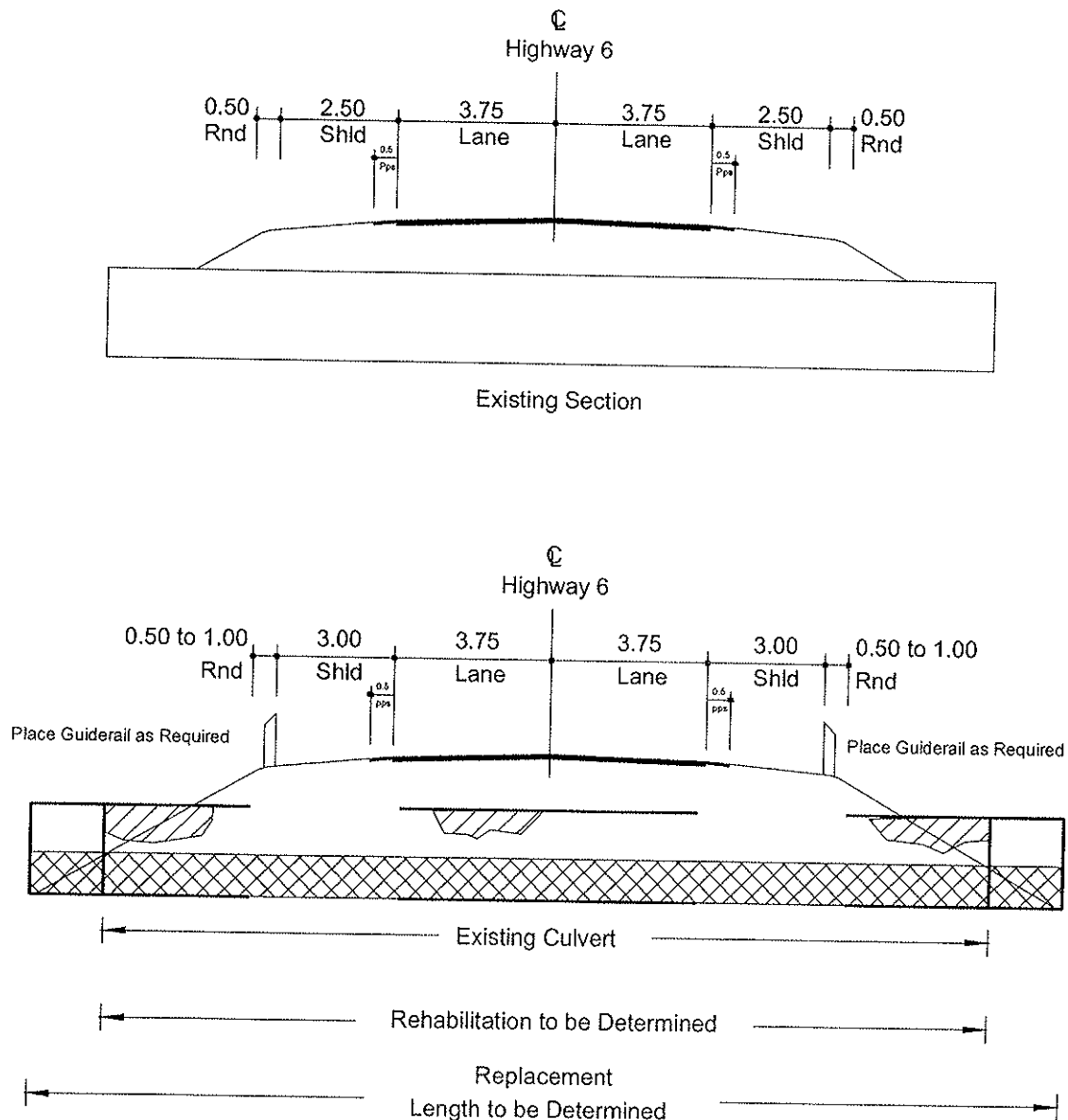
HWY NO: 6

TYPE OF PROJECT: Grading, Drainage, Granular Base, Paving, Structural Culvert  
Replacements/Rehabilitations and a New Northbound Passing Lane

LENGTH: 10.5 km

LOCATION: From 1.1 km South of Grey County Road 9 (North Junction) Northerly to Durham South Limits

**Typical Sections at the Structural Concrete Culvert**  
**Replacement/Rehabilitation Locations Site # 8-449-C and Site # 8-450-C**  
NTS







G.W.P. NO: 338-97-00 (a)

OPERATIONAL SERVICES Owen Sound

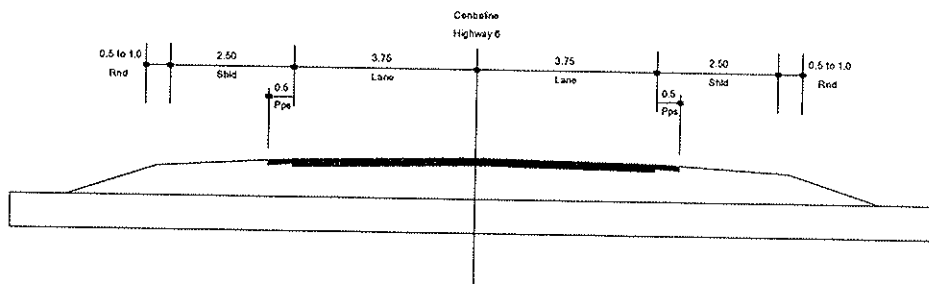
HWY NO: 6

TYPE OF PROJECT: Grading, Drainage, Granular Base, Paving, Structural Culvert Replacements/Rehabilitations and a New Northbound Passing Lane

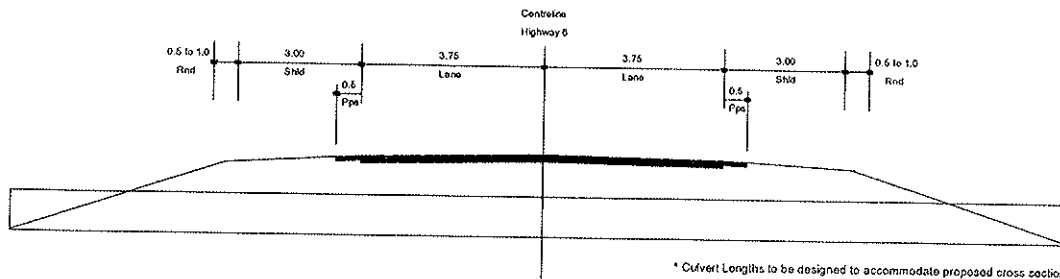
LENGTH: 10.5 km

LOCATION: From 1.1 km South of Grey County Road 9 (North Junction) Northerly to Durham South Limits

**Typical Sections at the Culvert Replacement Locations (Under 3m)**  
NTS

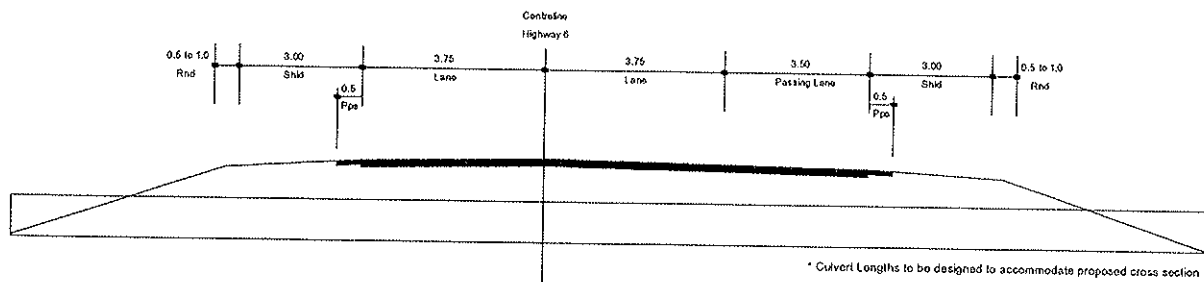


EXISTING TWO-LANE SECTION



\* Culvert Lengths to be designed to accommodate proposed cross section

PROPOSED TWO-LANE SECTION



\* Culvert Lengths to be designed to accommodate proposed cross section

PROPOSED NORTHBOUND PASSING-LANE SECTION  
Station 24+200 to 26+360



G.W.P. NO: 338-97-00 (a) OPERATIONAL SERVICES Owen Sound

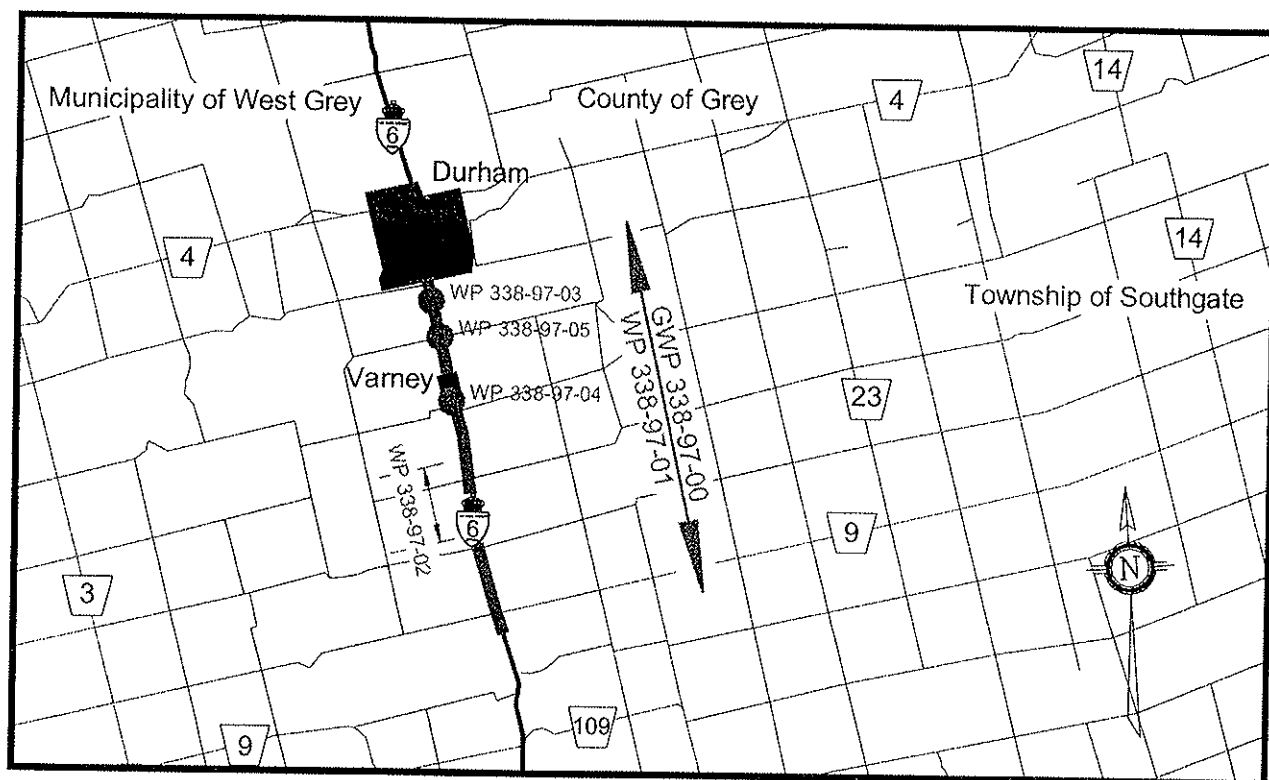
HWY NO: 6

TYPE OF PROJECT: Grading, Drainage, Granular Base, Paving, Structural Culvert  
Replacements/Rehabilitations and a New Northbound Passing Lane

LENGTH: 10.5 km

LOCATION: From 1.1 km South of Grey County Road 9 (North Junction) Northerly to Durham South Limits

**Key Map**  
NTS





REGIONAL GEOTECHNICAL  
PAVEMENT CONDITION REPORT

DISTRICT OWEN SOUND	HWY. NO. 6	W.P. NO. 338-97-00	LENGTH 9.3 km
LOCATION: County Road 9 to Durham South Limits, Douglas St.			
FROM L.H.R.S. 13670	OFFSET 0.00	LAST CONTRACT NO. 84-08, 99-123	
TO L.H.R.S. 13670	OFFSET 9.3	R.C.R. 5.0	
PAVEMENT: Hot Mix HL-4	Width 7.5 m	SHOULDER: Width P. Paved 0.5, Gravel 2.3	
TRAFFIC: Year 2003	A.A.D.T. 5,950	S.A.D.T. 7,250	%Trucks 10.8

**SOILS DATA:**

Located in a drumlinized till plain and spillway formation. The main soil types are: Harriston loam and silt loams (generally well drained clay loams and tills), Pike Lake loam (well drained sandy loams, gravels and tills), Donnybrook sandy loams and short length of Gilford and Burford loam (sandy loams over gravels) are encountered. Muck is found in many of the poorly drained depressions.

**PAVEMENT STRUCTURE DATA:**

MTO records show that this section of Highway 6 is a conventional pavement structure originally constructed under Contracts 61-010 and 62-46. Resurfacing under Contract 84-08 consisted of 35 mm HL-4 binder and a 40 mm HL-4 surface course. The 0.5 m partial paved shoulders are part of the surface course. The granular sub-base is full width. Contract 99-123 involved milling the existing asphalt 50 mm and resurfacing with 50 mm HL-4. Passing lanes and widenings consisted of 50 mm HL-4 surface, 40 mm HL-4 upper binder and 50 mm HL-4 lower binder over 150 mm Granular "A" and 650 mm Granular "B".

**MAINTENANCE HISTORY:**

1990 - Preservation management rout & sealed all transverse, mid lane, pavement edge, and centreline cracks.

Cold mix patching at partial paved shoulder break-up areas and to the inside of curves to hold pavement edge alligatored sections.

2000 - A 600m Strip repair along the west edge of pavement was completed in 2000.

2004 Minor Capital Contract 2004-3250, rout and sealed the passing lanes that were constructed under Contract 99-123, 2.5km south of Durham to south limit of Durham.

**PERFORMANCE AND CONDITION:**

The performance of the pavement is poor in the older section south of the TCL constructed in 1999. Course aggregate loss is slight and throughout. Course aggregate appears polished. Wheel track rutting is slight and extensive. Distortion is moderate and throughout due mostly from cupped transverse cracking. Longitudinal wheel track cracking is slight and few. Centreline cracking is moderate and frequent with slight and few alligators. Pavement edge slight and throughout. Transverse cracks are very severe and throughout with cupping, which produces a noticeable bump, and alligator cracking slight and intermittent. Longitudinal meander and midlane cracks are moderate and intermittent. Severe cracking is evident in the partial paved shoulders with break-up and edge breaking. Most cracking is an extension of previously rout and sealed transverse cracks; however, there are now slight full width transverse cracks between the more severe transverse cracks noted in 2003.

**REMARKS:**

Transverse cracks are no longer sealed. Continuing to propagate and become multiple. New unsealed cracks appearing. Transverse cracks are cupped severely, lowering the ride. The older section ride is poor. The TCL needs to be rout and sealed in 2004, completed.

**PROPOSED REMEDIAL MEASURES:**

Holding: N/A.

Preferred: Pulverize the older section of pavement pave 3. Resurface the passing lane with one lift due to surface course change, no milling required.

**PROGRAM YEAR:** 2007

**Suggested:** 2001

**DATE OF SURVEY:** July 27, 2005

**Prepared by:** Dave Harris

YEAR: 2003 PAVEMENT PERFORMANCE RECORD  
 ASPHALTIC CONCRETE PAVEMENT HIGHWAY: 6

DISTRICT: 33

PAV TYPE: AC

FROM: N GREY RD 9

TO: DURHAM S LTS - DOUGLAS ST

LHRS	OFFSET	LENGTH	WIDTH	DIRECTION	FACILITY	CLASS	LANES	AADT	SADT	% COMM	LOAD RESTN
13670	0	9.31	7.3	B	A	ARTERIAL	2	5750	6400	10	

## OVERALL PAVEMENT PERFORMANCE HISTORY

YEAR	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03
AGE	4	5	6	7	8	9	10	11	12		14		16	2	3	4
PCR	80		81		80		80		66		61		57	61	58	56
PCI	87		85		83	78	76	70	67	71	66	69	65	69	65	60
RCR	7.9		7.9		7.9		6.9		5.6		5.5		5.0	4.9	4.9	5.5
RCI	8.1		7.5		7.3	6.5		5.6		6.3	6.5	7.2	6.3	6.4	6.5	6.4
DMI	20.5		18.5		20.5		26.3		34.8		50.0		50.0	40.0	50.5	63.0
Avg Rut																
10% Rut																

## DETAILED PAVEMENT PERFORMANCE HISTORY

	1994		1995		1996		1998		2000		2001		2002		2003	
	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.
Ravelling & C. Agg. Loss	1	3			1	3	2	5	2	5	2	4	2	4	2	5
Flushing																
Rippling and Shoving	2	5														
Wheel Track Rutting	1	3			1	3	2	1	2	1	2	1	2	3	2	4
Distortion					1	3	2	5	2	5	2	4	2	4	2	5
Wheel Track Single & Mult. (Long.)							2	1	2	1	2	1	2	1	2	1
Alligator																
Centreline Single & Mult.					3	3	2	3	2	3	2	3	3	3	3	3
Alligator																
Pav't Edge Single & Mult.	2	3			3	3	2	4	2	4	2	4	2	4	2	4
Alligator	1	2			1	2	2	2	2	2						
Transverse Half, Full & Mult.	2	1			3	3	3	5	3	5	4	3	4	4	5	5
Alligator													2	1	2	1
Meander & Midlane	1	1			2	2	2	1	2	1	2	1	2	1	3	2
Random																

## PERFORMANCE HISTORY FOR SHOULDER TYPE:

		1994		1995		1996		1998		2000		2001		2002		2003	
		Sev.	Ext.	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.	Sev.	Ext.
Cracking	Right	1	2			2	2	1	2	2	2	2	2	2	2	2	2
	Left	1	2			2	2	1	2	2	2	2	2	2	2	2	2
Pav. Edge/	Right																
Curb Sep.	Left																
Distortion	Right																
	Left																

## PAVEMENT DISTRESS CODES

## SHOULDER DISTRESS CODES

## EXTENT OF MAINTENANCE TREATMENT IN 2003

Codes	Sev.	Ext.	Codes	Sev.	Ext.	PAVEMENT	SHOULDER
1	Very Slight	<10%	1	Moderate	10-30%	MANUAL PATCHING	0
2	Slight	10-20%	2	Severe	>30%	MACHINE PATCHING	1
3	Moderate	20-50%				SPRAY PATCHING	0
4	Severe	50-80%				ROUT & SEAL CRACKS	3
5	Very Severe	80-100%				CHIP SEAL	0

## DISTRESS COMMENTS:

Transverse cracks are no longer sealed are continuing to propagate and become multiple. R&S truck climbing lane in 2003-2004. Strip repair PPS.

## MAINTENANCE COMMENTS:

Transverse cracks are no longer sealed. Edge repair made on west side in 2000 for 0.6 km.

Date: 2003/12/09

YEAR: 2003  
HIGHWAY: 6

## PAVEMENT ACTION PLAN FACT SHEET

DISTRICT: 33

FROM: N GREY RD 9

TO: DURHAM S LTS - DOUGLAS ST

PAV TYPE: AC

LHRS	OFFSET	LENGTH	WIDTH	DIRECTION	FACILITY	CLASS	LANES	AADT	SADT	% COMM	LOAD RESTN
13670	0	9.31	7.3	B	A	ARTERIAL	2	5750	6400	10	

Contract No.: 84008

%Extent:

Surface Type: HL-4

Added Overlay Thickness, mm: 75

Mill, Remove Thickness, mm:

Total A.C. Thickness, mm: 110

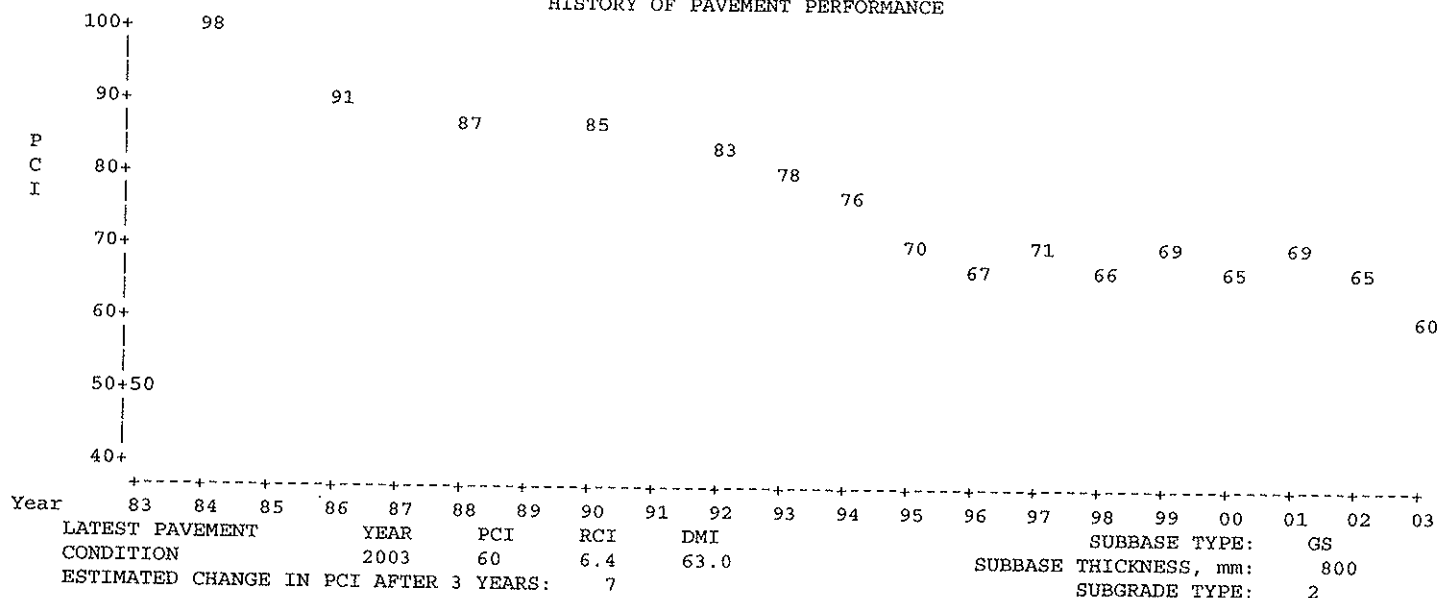
Total PCC Thickness, mm:

Base Type:GB

Base Thickness, mm:150

Structural Comment:

## HISTORY OF PAVEMENT PERFORMANCE



WP 338-97-00 HIGHWAY 6 - 500m Interval Lane and Shoulder Information

Station	Exst Lane Width Left (m)	Exst Lane Width Right (m)	Exst Shldr Width Left (m)	Exst Shldr Width Right (m)	Exst PPS Width Left (m)	Exst PPS Width Right (m)	Exst Lane Slope Left (%)	Exst Lane Slope Right (%)	Exst Shldr Slope Left (%)	Exst Shldr Slope Right (%)
21+100	3.41	3.96	3.65	3.97	0.47	0.41	1.84	1.62	6.66	1.74
21+600	3.75	3.58	3.94	0.51	0.37	0.51	2.99	2.49	5.60	3.82
22+100	3.94	4.54	3.47	3.02	0.54	0.33	1.88	1.78	6.66	3.77
22+600	3.89	3.76	3.45	2.96	0.45	0.38	2.31	2.85	5.65	6.21
23+100	3.91	3.83	3.45	3.43	0.55	0.37	3.73	3.03	13.33	6.44
23+600	3.99	3.70	3.38	3.98	0.42	0.33	1.60	2.32	7.54	5.18
24+100	4.27	3.39	3.29	3.96	0.19	0.70	2.41	0.18	3.13	6.64
24+600	3.67	3.90	3.42	4.27	0.46	0.68	5.48	7.92	2.49	6.81
25+100	4.19	3.42	3.36	5.01	0.48	0.49	7.30	5.85	7.26	5.23
25+600	3.72	4.05	3.36	3.87	0.45	0.18	0.94	4.27	7.62	6.18
26+100	4.05	3.80	3.29	3.70	0.25	0.32	2.53	0.53	7.63	6.92
26+600	3.99	3.89	3.52	4.48	0.18	0.35	4.16	2.39	3.89	7.75
27+100	4.06	3.80	3.18	4.05	0.28	0.45	4.11	1.84	5.85	7.16
27+600	3.85	3.85	4.53	4.45	0.47	0.39	2.39	3.04	5.06	8.49
28+100	3.93	3.92	2.81	4.56	0.29	0.32	2.16	2.24	4.41	3.03
28+600	3.89	3.82	3.55	3.72	0.38	0.40	3.11	2.20	7.18	3.74
29+100	4.02	3.82	3.98	4.18	0.33	0.41	2.76	3.22	9.70	12.72
29+600	7.58	3.57	3.88	3.84	0.52	0.75	2.86	1.10	9.61	5.47
10+400	7.50	3.78	3.68	3.66	0.49	0.67	2.03	2.41	11.17	6.42
10+900	7.46	3.63	3.15	3.89	0.57	0.72	1.31	2.95	6.63	5.69
11+400	7.79	3.44	2.97	3.50	0.31	0.38	2.05	4.51	5.25	5.20
11+900	6.93	4.84	-	-	-	-	4.73	4.03	-	-

## Appendix 2

# Site and Pavement Distress Photographs





**Sta. 11+887 North Limit of Project (Town of Durham), Looking North**



**Sta. 11+887 North Limit of Project, Looking South**





**Sta. 21+100 South Limit of Project, Looking South**



**Sta. 21+100 South Limit of Project, Looking North**





**Slight, Throughout Coarse Aggregate Loss**



**Severe, Extensive Cracks in the PPS along Highway 6**





**Severe Transverse Crack, Highway 6**



**Severe Multiple Transverse Crack, Highway 6**





**North limit of Southbound Passing Lane at Sta. 11+705, looking south**



**South limit of Southbound Passing Lane at Sta. 29+100, looking south**





**Typical Pavement Distress on Southbound Passing Lane**



**Northbound lane in Southbound Passing Lane section, looking north**





**Sta. 28+400 Varney North Limit, Looking South**



**Sta. 28+400 Varney North Limit, Looking North**





**Sta. 28+000 Varney South Limit, Looking North**



**Sta. 28+000 Varney South Limit, Looking South**





**Typical Transverse Crack in Varney Section**



**New Patch at Sta. 28+100, Varney Section**





**Sta. 24+200 South Limit of NB Passing Lane, Looking North**



**Sta. 25+400 NB Passing Lane, Looking South**





**Sta. 26+460 North Limit of NB Passing Lane, Looking North**



**Gravel Side Road**

# Appendix 3

## Pavement Core Logs and Core Photographs





**shaheen & peaker limited**  
**consulting engineers**  
 20 Meteor Drive  
 Toronto, Ontario, M9W 1A4  
 T: 416.213.1255, F: 416.213.1260  
 info@shaheenpeaker.ca

## CORE LOGS

**S&P PROJECT NUMBER:** SPT 1174

**PROJECT DESCRIPTION:** Highway 6 Durham

**DATE CORED:** September 1, 2006

Station	Direction (NB/SB)	Core No.	Offset (m)	Total Asphalt Thickness (mm)	Asphalt Mix Types and Thickness (mm)	Remarks
21+102	NB	M1	2 Rt from CL	130	60 HL4, 70 HL4	Transverse crack, 2mm at top and goes 25mm down
21+350	SB	M2	1.1 Lt from CL	185	55 HL4, 40 HL4, 35 HL4, 55 HL4	
21+605	NB	M3	2 Rt from CL	155	55 HL3, 35 HL2, 65 HL4	crack
21+850	SB	M4	2 Lt from CL	125	80 HL4, 45 HL4	
22+100	NB	M5	2 Rt from CL	220	70 HL4, 35 HL4, 40 HL3, 75 HL8	
22+160	NB	TL	5.75 Rt from CL	145	70 HL4, 40HL3, 35 HL4	
22+350	SB	M6	3.6 Lt from CL	190	35 HL4, 40 HL4, 40 HL4, 75 HL4	
22+600	NB	M7	1.5 Rt from CL	140	55 HL4, 35 HL3, 50 HL4	
22+850	SB	M8	1 Lt from CL	180	45 HL4, 35 HL4, 40 HL4, 60 HL4	
23+100	NB	M9	0.67 Rt from CL	160	35 HL4, 35 HL4, 90 HL4	longitudinal and transverse crack; starts from top and goes 80mm down; 5mm at top and 10mm at top
23+350	SB	M10	3.1 Lt from CL	140	60 HL4, 35 HL3, 45 HL4	
23+600	NB	M11	2.3 Rt from CL	180	50 HL4, 35HL4, 35HL3, 60 HL3	serious bleeding from the depth of 120mm to 100mm
23+850	SB	M12	3.3 Lt from CL	150	80 HL4, 70 HL4	crack
24+100	NB	M13	2.3 Rt from CL	185	45 HL4, 50 HL4, 35 HL3, 55 HL4	
24+350	SB	M14	3.1 Lt from CL	190	35 HL4, 55 HL4, 45 HL4, 55 HL4	superelevation section
24+600	NB	M15	2 Rt from CL	160	40 HL4, 40 HL4, 80 HL4	transverse crack, about 5mm at top and 8mm at bottom
24+850	SB	M16	0.75 Lt from CL	135	65 HL4, 70 HL4	transverse crack, goes from surface to the depth of 65mm, about 5mm at top and 2mm at bottom
25+100	NB	M17	2 Rt from CL	170	30 HL4, 50 HL4, 40 HL3, 50 HL4	
25+350	SB	M18	1.4 Lt from CL	145	40 HL4, 40 HL4, 35 HL4, 30HL4	
25+600	NB	M19	0.25 Rt from CL	170	40 HL4, 45 HL4, 85 HL4	transverse crack, 3mm at top and 8mm at bottom; goes from top to bottom
25+850	SB	M20	2 Lt from CL	165	45 HL4, 40 HL4, 35 HL4, 45 HL4	
26+100	NB	M21	3.1 Rt from CL	160	75 HL4, 85 HL4	
26+350	SB	M22	3 Lt from CL	185	50 HL4, 40 HL4, 45 HL4, 50 HL4	transverse crack goes from top to bottom and about 10mm at top and 19mm at bottom
26+600	NB	M23	2.75 Rt from CL	175	45 HL4, 40 HL4, 30 HL3, 60 HL4	
26+850	SB	M24	0.65 Lt from CL	150	35 HL4, 45 HL4, 35 HL3, 35 HL4	crack is about 5mm at top and 8mm at bottom
27+100	NB	M25	0.85 Rt from CL	155	45 HL4, 30 HL4, 80 HL4	
27+350	SB	M26	0.1 Lt from CL	150	35 HL4, 45 HL4, 35 HL4, 35HL4	centerline crack, crack goes from surface down to 80mm
27+600	NB	M27	3.15 Rt from CL	130	50 HL4, 80 HL4	crack goes from bottom to top; about 2mm at top and 4 mm at bottom
27+850	SB	M28	2.25 Lt from CL	155	65 HL4, 40 HL4, 50 HL8	
28+098	NB	M29	1.15 Rt from CL	140	45 HL4, 20 HL4, 75 HL4	crack
28+350	SB	M30	2.7 Lt from CL	230	50 HL4, 30 HL4, 65 HL4, 85 HL4	
28+600	NB	M31	1.84 Rt from CL	160	75 HL4, 85 HL4	
28+850	SB	M32	2.7 Lt from CL	150	65 HL4, 35 HL3, 50 HL4	crack
29+100	NB	M33	0.8 Rt from CL	195	65 HL4, 40 HL4, 45 HL2, 45 HL4	
29+350	SB	M34	1.9 Lt from CL	200	50 HL4, 35 HL4, 50 HL4, 65 HL4	Lane 1
29+600	NB	M35	1.1 Rt from CL	170	50 HL4, 40 HL4, 30 HL4, 50 HL4	
10+150	SB	M36	1 Lt from CL	140	60 HL4, 40 HL4, 40HL4	
10+400	NB	M37	1.3 Rt from CL	150	75 HL4, 75 HL4	
10+650	SB	M38	1.8 Lt from CL	155	65 HL4, 40 HL3, 50 HL4	
10+900	NB	M39	2 Rt from CL	120	45 HL4, 75 HL4	
11+150	SB	M40	5.8 Lt from CL	155	55 HL4, 40 HL4, 60 HL4	
11+400	NB	M41	2.3 Rt from CL	150	55 HL4, 45 HL3, 50 HL3	
11+650	SB	M42	4.5 Lt from CL	160	60 HL4, 40 HL4, 60 HL4	
11+887	NB	M43	1.1 Rt from CL	135	45 HL4, 90 HL4	
Count				44		
Min				120		
Max				230		
Mean				161		
Std Deviation				24		





## CORE LOGS

September 1, 2006

[illegible]





Photograph 1- Core No.M37 at 10+400, NBL, Highway 6



Photograph 2- Core No.M42 at 11+650, SBL, Highway 6





Photograph 3- Core No.M2 at 21+350, SBL, Highway 6



Photograph 4- Core No.M7 at 22+600, NBL, Highway 6





**Photograph 5- Core No.M10 at 23+350, SBL, Highway 6**



**Photograph 6- Core No.M13 at 24+100, NBL, Highway 6**





Photograph 7- Core No.M16 at 24+850, SBL, Highway 6



Photograph 8- Core No.M20 at 25+850, SBL, Highway 6





**Photograph 9- Core No.M22 at 26+350, SBL, Highway 6**



**Photograph 10- Core No.M28 at 27+850, SBL, Highway 6**





Photograph 11- Core No.M31 at 28+600, NBL, Highway 6



Photograph 12- Core No.M34 at 29+350, SBL, Highway 6

# Appendix 4

## Pavement Structure Spreadsheet and Borehole Logs



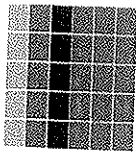
HIGHWAY 6 - From 1.1 km South of Grey County Road 9, Northerly to Durham South Limits

Station	Southbound Lane										Northbound Lane										Station
	Shoulder (mm)				Type of S/grade	Edge of Pavement (mm)				Type of S/grade	Edge of Pavement (mm)				Type of S/grade	Shoulder (mm)				Type of S/grade	
	Asph	Base	Sub Base	Total Gran		Asph	Base	Sub Base	Total Gran		Asph	Base	Sub Base	Total Gran		Asph	Base	Sub Base	Total Gran		
21+100		450	750	1200	Cl Si Tr Sa W Org	140	160	800	960	Sa Si to Si Sa Tr Gr	130	170	400	570	Sa Tr Gr Tr Org						21+100
21+350						185					100	250	1150	1400			450	500	950		21+350
21+786											100	250	1150	1400							21+786
21+600		450	1050	1500		150	150	650	800	Sa Some to Tr Gr	155										21+600
21+800																	250	850	1100	Dk Br Cl Si Tr Sa Tr Gr	21+800
21+850						125															21+850
22+086											200	200	1100	1300							22+086
22+100		300	1200	1500		200	250	750	1000	Sa Tr Gr	225										22+100
22+130											200	200	600	800	Sa Tr Gr						22+130
22+160											150	150	550	700	Sa						22+160
22+180											200	200	1100	1300							22+180
22+220											180	250	1070	1320							22+220
22+260																	800	700	1500		22+260
22+270											150	300	750	1050	Sa Tr Gr Tr Cob						22+270
22+300											230	270	500	770	Sa Si Tr Gr		800	700	1500		22+300
22+350						200	210	900	1110	Sa Some Gr	120	230	650	880	Sa Tr Gr						22+350
22+600		250	650	900	Sa Tr Gr	180	220	700	920	Sa Tr Gr	210										22+600
22+650		250	550	800	Sa																22+650
22+675																	400	1100	1500	Sa Tr Gr	22+675
22+700		250	650	900	Sa Tr Gr																22+700
22+725																	300	1000	1300	Si Sa to Sa Si	22+725
22+750		200	550	750	Sa Tr Gr																22+750
22+775																	250	950	1200	Sa Tr Gr	22+775
22+800		250	500	750	Sa Tr Gr																22+800
22+825											180	220	500	720	Sa Tr Gr		400	800	1200	Sa Tr Gr	22+825
22+850		300	1200	1500	Sa Tr Si	180															22+850
22+875																	400	800	1200	Sa Tr Gr	22+875
22+925																	300	900	1200	Sa Tr Gr	22+925
22+950		200	1300	1500																	22+950
23+100		200	1300	1500		100	150	700	850	Sa Tr Gr	165	200	600	800	Si Sa Tr Gr						23+100
23+350						140					220	280	450	730	Br Sa Tr Gr W Org		400	800	1200	Dk Br Cl Si Some Sa	23+350
23+600		400	1100	1500		160	290	550	840	Dk Br Si Sa Tr Gr	180										23+600
23+850						150					200	150	850	1000	Dk Br Cl Si Tr Gr		400	800	1200	Sa Tr Gr	23+850
24+025		350	950	1300	Sa Si Some Gr																24+025
24+055																	250	950	1200	Dk Br Sa Some Gr	24+055
24+100						100	200	700	900	Gr(y) Sa Tr Cob	185										24+100
24+125																	250	1250	1500	Sa Tr Gr	24+125
24+175																	250	1250	1500	Sa Tr Gr	24+175
24+225											60*	290	750	1040	Si Sa Tr Gr						24+225
24+275																					24+275
24+350						195	150	750	900	Dk Br Cl Si Tr Gr	50*	300	750	1050	Sa Tr Gr Tr Cob		400	600	1000	Si Some Sa Tr Gr	24+350
24+400																	0	950	950	Blk Cl Si Tr Gr	24+400
24+450											60*	240	700	940	Sa Tr Gr						24+450
24+500											100	250	550	800	Dk Br Si Sa Tr Cl Tr Gr						24+500
24+550																	250	710	960	Sa Tr Gr	24+550
24+600		600	500	1100	Sa Si W Org	150	150	800	950	Sa Tr Gr	180										24+600
24+650																	350	1050	1400	Blk Si Some Sa	24+650
24+700											70*	230	700	930	Sa Tr Gr						24+700
24+750																	150	350	500	Si Sa to Sa Si	24+750
24+800											90	260	650	910	Sa Si						24+800
24+850						145											250	650	900	Dk Br Si Sa Tr Gr	24+850
24+900											90	310	800	1110	Dk Br Sa Tr Gr						24+900
24+950																	400	500	900	Dk Br Si Sa Tr Gr	24+950
25+050																	400	500	900	Si Some Sa Tr Gr	25+050
25+100		300	1200	1500		70 *	250	880	1130	Sa Tr Gr	170	190	550	740	Si Sa Tr Gr						25+100
25+150																	300	600	900	Si Some Sa Tr Gr	25+150
25+200											180	220	700	920	Sa Tr Gr						25+200
25+250																					25+250
25+350						150											300	900	1200	Si Sa Some Gr	25+350
25+450																					25+450
25+500																	300	900	1200	Sa Some Cl Tr Gr W Org	25+500
25+550	60	290	850	1140	Dk Br Sa Si Tr Gr						170	280	420	700	Dk Br Si Sa Tr Gr						25+550
25+600		350	850	1200	Dk Br Si Sa Tr Gr	190	210	700	910	Blk Si Tr Gr	180						200	800	1000	Sa Some Gr W Org	25+600



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### GEOTECHNICAL SURVEY DATA

DATE OF SURVEY	TYPE OF SURVEY
August to December, 2006	Power Auger Drilling

### NOTES

1. Conditions (soil/pavement) and pavement depths apply only to the date of survey.
2. The boundaries between the strata have been established only at core and borehole locations. Between cores/boreholes the boundaries are assumed and may be subject to error.
3. Soils are described according to the MTO Soils Classification System.
5. Dimensions are in metres and/or millimetres unless otherwise shown. Stations in kilometres + metres.
6. Abbreviations are per OPSD 100.060

### ADDITIONAL ABBREVIATION:

FMC          Field Moisture Content

WP 338-97-00	Highway 6, From 1.1 km South of Grey County Road 9 Northerly to Durham South Limits
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Accep	acceptable	Gry	grey	Quant	quantity
Agg	aggregate	H	heavy	Reinf	reinforced
Amor	amorphous	Hi	highly	RF	rock fill
Asph	asphalt	HM	hot mix	RSS	remoulded shear strength
BH	borehole	HP	high plasticity	Sa (y)	sand (y)
Bl	blue	Ip	plasticity index	Sat	saturated
Bld (y)	boulder (y)	L	loose	SH	shale
Blds	boulders	Liq	liquid	Sh Rk	shot rock
Blk	black	Lo	loam	Si (y)	silt (y)
Br	brown	Lt	light	Sl (y)	slight (ly)
BR	bedrock	Matl	material	SP	slight plasticity
BU	break up	Max	maximum	SSM	select subgrade material
CF	channel face	MDD	maximum dry density	St	sensitivity
Cl (y)	clay (ey)	Med	medium	Stn (y)	stone (y)
Co	coarse	Mod	moderate	Stks	streaks
Cob	cobbles	Mott	mottled	Surf	surface
Comp	compact	MP	medium plasticity	Temp	temperature
Conc	concrete	Mri	marl	TH	test hole
Contam	contaminated	Mul	mulch	TP	test pit
Cord	corduroy	MWD	maximum wet density	Tps	topsoil
Cr	crushed	NFP	no further progress	Tr	trace
D	dense	NFP (blds)	no further progress (boulders)	Unrein	unreinforced
Decomp	decomposed	Num	numerous	USS	undisturbed shear strength
Dk	dark	Ob	overburden	Varv	varved
Dr	relative density	Occ	occasional	VF	very fine
E	earth	Ora	orange	w	field moisture content
F	fine	Org	organic	w	with
FB	frost boil	Org M	organic matter	WL	liquid limit
FH	frost heave	Pavt	pavement	Wd (y)	wood (y)
Fib	fibrous	Pedo	pedological	Weath	weathered
Fr Wat	free water	Pen Mac	penetration macadam	Wopt	optimum moisture content
Gr (y)	gravel (ly)	Poss	possible	Wp	plastic limit
Gran	granular	PST	prime and surface treated	WT	water table
Grn	green	Psty	polystyrene	Yel	yellow



Nov 2006	Rev 1
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# ONTARIO PROVINCIAL STANDARD DRAWING **ABBREVIATIONS** GEOTECHNICAL

SUSCEPTIBILITY TO FROST HEAVING

HSFH - High

MSFH - Medium

LSFH - Low

## BOREHOLE LOGS

Note: Offset measured from centerline of existing roadway.

### HIGHWAY 6

#### TOWNSHIP OF NORMANBY

##### 21+100, 5.2 m Lt (Sh)

0 - 450 Br Sa and Gr,Damp to Moist  
 450 - 1.2 Br Sa Tr Gr, Moist  
 1.2 - 1.5 Blk Cl Si Tr Sa W Org

AS1  
AS2  
AS3

##### 21+100, 3.75 m Lt (EP)

0 - 140 Asph  
 140 - 300 Dk Br Sa and Gr, Moist  
 300 - 1.1 Br Gr(y) Sa, Moist  
 1.1 - 1.5 Br Sa Si to Si Sa Tr Gr, Moist

AS1  
AS2  
AS3

##### 21+350, 3.7 m Rt (EP)

0 - 100 Asph  
 100 - 350 Br Sa and Gr, Moist  
 350 - 1.5 Br Sa Tr Gr, Moist

AS1  
AS2

##### 21+350, 5.2 m Rt (Sh)

0 - 450 Br Sa and Gr, Damp  
 450 - 1.0 Dk Br to Blk Si Some Sa Tr Gr, Damp  
 1.0 - 1.5 Br Sa Tr Gr, Damp

AS1  
AS2  
AS3

Sample AS1  
 FMC

3.0 %

Sample AS2  
 FMC

11.3 %

Sample AS3  
 FMC

7.6 %

##### 21+600, 3.75 m Lt (EP)

0 - 150 Asph  
 150 - 300 Br Sa and Gr, Moist  
 300 - 950 Br Sa Some Gr, Moist  
 950 - 1.5 Br Sa Some to Tr Gr, Moist

AS1  
AS2  
AS3

##### 21+786, 3.7 m Rt (EP)

0 - 100 Asph  
 100 - 350 Br Sa and Gr, Moist  
 350 - 1.5 Br Sa Tr Gr, Moist

AS1  
AS2

##### 21+800, 5.2 m Rt (Sh)

0 - 250 Br Sa and Gr, Damp  
 250 - 1.2 Br Sa Tr Gr tr Cob, Moist  
 1.2 - 1.5 Dk Br CL Si Some to Tr Sa Tr Gr

AS1  
AS2  
AS3

Sample AS1

FMC

3.2%

% Passing 4.75 mm

57.5

% Passing 75 µm

11.5

Lab Class

Not acceptable as Granular A

Sample AS2

FMC

2.9%

% Passing 4.75 mm

35

% Passing 75 µm

9

Lab Class

Marginally acceptable as Granular B  
 Type I

Sample AS3

FMC

18.4 %

# BOREHOLE LOGS

## 22+086, 4.0 m Rt (EP)

0 - 200 Asph  
200 - 400 Br Sa and Gr, Moist  
400 - 1.5 Br Sa Tr Gr Tr Cob

AS1  
AS2

## 22+130, 6.0 m Rt (EP)

0 - 200 Asph  
200 - 400 Br Sa and Gr, Moist  
400 - 1.0 Br Sa Some Gr, Moist  
1.0 - 1.5 Br Sa Tr Gr, Moist

200 - 450 Dk Br Sa and Gr, Moist  
450 - 1.2 Dk Br to Br Sa Some Gr, Moist  
1.2 - 1.5 Br Sa Tr Gr, Moist

AS1  
AS2  
AS3

## 22+180, 7.0 m Rt (EP)

0 - 200 Asph  
200 - 400 Br Sa and Gr, Moist  
400 - 1.5 Br Sa Tr Gr, Moist

AS1  
AS2

## 22+100 8.0 m Lt (Sh)

0 - 760 Br Gr and Sa Some Org and Rootlets  
N @ 0.3 m = 12  
760 - 3.5 Br Gr and Sa, Damp to Moist (Fill)  
N @ 1.1 m = 59  
N @ 1.8 m = 60  
N @ 2.6 m = 63  
N @ 3.4 m = 54

SS1

## 22+220, 9.0 m Lt, D-0.30

0 - 330 Tps with Dk Br Si Sa Tr Gr Damp  
330 - 1.0 Br F-Med Sa, Damp

AS1  
AS2

## 22+260, 5.5 m Rt (Sh)

0 - 800 Br Sa Some Gr, Moist  
800 - 1.5 Br Sa Tr Gr, Moist

AS1  
AS2

## Sample SS1

FMC 5.6 %

## Sample SS2

FMC 4.2 %

## Sample SS3

FMC 4.3 %

## Sample SS4

FMC 7.8 %

## Sample SS5

FMC 5.5 %

## 22+270, 3.5 m Rt (EP)

0 - 150 Asph  
150 - 450 Br Sa and Gr, Moist  
450 - 1.2 Br Sa Some Gr, Moist  
1.2 - 1.5 Br Sa Tr Gr Tr Cob

AS1  
AS2  
AS3

## 22+300, 3.5 m Rt (EP)

0 - 230 Asph  
230 - 500 Br Sa and Gr, Moist  
500 - 1.0 Br Sa Some Gr, Moist  
1.0 - 1.5 Br Sa Si Some Gr, Moist

AS1  
AS2  
AS3

## Sample AS1

FMC 3.2%  
% Passing 4.75 mm 47.5

## BOREHOLE LOGS

% Passing 75 µm Lab Class	8 Acceptable as Granular A	120 - 350 350 - 1.0 1.0 - 1.5	Br Sa and Gr, Moist Br Gr Sa, Moist Br Sa Tr Gr, Moist	<u>AS1</u> <u>AS2</u> <u>AS3</u>
<u>Sample AS2</u> FMC	3.3% 49	<b>22+350, 5.0 m Rt (Sh)</b>		
% Passing 4.75 mm	8	0 - 250	Br Sa and Gr, Moist	
% Passing 75 µm	8	250 - 900	Br Sa Some Gr, Moist	
Lab Class	Acceptable as Granular B Type I	900 - 1.5	Br Sa Tr Gr, Moist	
<u>Sample AS3</u> FMC	6.0%	<b>22+600, 3.75 m Lt (EP)</b>		
% Passing 4.75 mm	69	0 - 180	Asph	
% Passing 75 µm	53	180 - 400	Br Sa and Gr, Moist	<u>AS1</u>
% Passing 5 µm	13	400 - 1.1	Br Sa Some Gr, Moist	<u>AS2</u>
Comment	MSFH	1.1 - 1.5	Br Sa Tr Gr, Moist	<u>AS3</u>
<b>22+300, 5.5 m Rt (Sh)</b>		<b>22+650, 12.0 m Lt (Top of Slope)</b>		
0 - 800	Br Sa and Gr, Moist	0 - 210	Asph	
800 - 1.5	Br Sa Some Si Tr Gr, Moist	210 - 360	Br Sa and Gr, Moist	<u>AS1</u>
<u>Sample AS1</u> FMC	3.1 %	360 - 760	Br Si Sa Tr Gr, Moist	<u>AS2</u>
		760 - 2.0	Br Sa, Damp	<u>SS3/4</u>
			N @ 1.1 m = 34	
			N @ 1.8 m = 31	
<u>Sample AS2</u> FMC	3.8 %	<b>22+675, 5.5 m Rt (Sh)</b>		
		0 - 400	Br Sa and Gr, Moist	<u>AS1</u>
<b>22+350, 2.5 m Lt (EP)</b>		400 - 1.5	Br Sa Tr Gr Tr Cob, Moist	<u>AS2</u>
0 - 190	Asph	1.5 - 2.5	Br Sa Tr Gr, Moist	<u>AS3</u>
190 - 400	Br Sa and Gr, Moist		N @ 2.3 m = 35	
400 - 1.2	Br Sa Some Gr, Moist			
1.2 - 1.3	Asph			
1.3 - 1.5	Br Sa and Some Gr, Moist			
<b>22+350, 3.7 m Rt (EP)</b>		<u>Sample AS1</u> FMC	2.3 %	
0 - 120	Asph	<u>Sample AS2</u> FMC	2.8%	

## BOREHOLE LOGS

<b>22+700, 12.0 m Lt (Top of Slope)</b>			
0 - 200	Asph		
200 - 350	Br Sa and Gr		
350 - 2.3	Br Sa Tr Gr, Damp		
	N @ 0.9 m = 19		
	N @ 1.8 m = 37		
2.3 - 2.9	Br Si to Si Sa, Wet		
	N @ 2.6 m = 39		
		<u>AS1</u>	
		<u>AS2</u>	
		<u>SS3/4</u>	
			<u>SS6</u>
<b>22+725, 5.5 m Rt (Sh)</b>			
0 - 300	Br Sa and Gr, Moist		
300 - 1.3	Br Sa Some to Tr Gr, Moist		
1.3 - 1.5	Br Cl Si, Moist		
1.5 - 2.4	Br Si Sa to Sa Si, Moist		
	N @ 1.8m = 32		
2.4 - 3.3	Br Coarse Sa Some to Tr Gr, Damp		
	N @ 3.1 = 46		
		<u>AS1</u>	
		<u>SS2</u>	
		<u>SS3</u>	
			<u>AS1</u>
			<u>SS1/2</u>
		Sample <u>AS1</u>	
		FMC	18.6 %
		Sample <u>SS4</u>	
		FMC	20.7 %
		Sample <u>AS5</u>	
		FMC	1.8 %
<b>22+750, 15.0 m Lt (Top of Slope)</b>			
0 - 200	Asph		
200 - 1.5	Br Sa and Gr, Damp		
	N @ 1.1 m = 54		
1.5 - 2.3	Br Sa and Gr Some Si, Damp		
	N @ 1.8 M = 76		
2.3 - 3.1	Br Si Sa Some Gr, Damp		
		<u>AS1/2/3</u>	
		<u>SS4</u>	
		<u>SS5</u>	
			<u>SS1</u>
			<u>SS2/3/4</u>
<b>22+775, 5.5 m Rt (Sh)</b>			
0 - 250	Br Sa and Gr, Moist		
250 - 1.2	Br Gr(y) Sa, Moist		
1.2 - 2.3	Br Sa Tr Gr, Moist		
	N @ 1.8 m = 24		
2.3 - 3.7	Br Sa, Moist		
	N @ 2.8 m = 31		
	N @ 3.4 m = 33		
		Sample <u>AS4</u>	
		FMC	3.3 %
		Sample <u>AS5</u>	
		FMC	3.4 %
		Sample <u>AS6</u>	
		FMC	3.7 %
<b>22+775, 5.5 m Rt (Sh)</b>			
0 - 250	Br Sa and Gr, Moist		
250 - 1.2	Br Gr Sa, Moist		
1.2 - 1.5	Br Sa Tr Gr, Moist		
<b>22+800, 15.0 m Lt (Top of Slope)</b>			
0 - 200	Asph		
200 - 400	Sa and Gr		
400 - 760	Br Si to Si Sa Tr Gr, Moist		
	N @ 0.5 m = 19		
760 - 3.1	Br Si Sa Tr Gr, Moist		
	N @ 1.1 m = 15		





## BOREHOLE LOGS

350 - 1.2	Br Sa Some Gr, Moist				
1.2 - 1.5	Dk Br Cl Si Tr Gr, Moist	<u>AS2</u>	<u>Sample AS1</u> FMC	2.6%	
<b>23+990, 8.0 m Lt (Sh)</b>					
0 - 760	Br Gr and Sa W Org, Moist (Fill) N @ 0.3 m = 14	<u>SS1</u>	<u>Sample AS2</u> FMC	3.1%	
760 - 1.5	Br Sa Si to Si Sa and Gr (Fill) N @ 1.1 m = 13	<u>SS2</u>	<u>Sample AS3</u> FMC	5.5%	
1.5 - 2.3	Br Sa and Gr, Moist (Fill) N @ 1.8 m = 19	<u>SS3</u>	<u>Sample SS4</u> FMC	8.2%	
2.3 - 2.8	Br Sa and Gr, Damp N @ 2.6 m = 73 / 200 mm	<u>SS4</u>	<u>Sample SS5</u> FMC	9.5%	
<u>Sample SS1</u> FMC	4.0 %				
<u>Sample SS2</u> FMC	10.8 %		<b>24+100, 3.75 m Lt (EP)</b>		<u>AS1</u> <u>AS2</u> <u>AS3</u>
<u>Sample SS3</u> FMC	4.4 %		0 - 100	Asph	
			100 - 300	Br Sa and Gr, Damp	
			300 - 1.0	Br Sa Some Gr, Damp	
			1.0 - 1.5	Br Gr Sa Tr Cob, Moist	
<u>Sample SS4</u> FMC	3.2 %		<u>Sample AS1</u> FMC	5.4 %	
<b>24+055, 5.5 m Rt (Sh)</b>					
0 - 250	Br Sa and Gr, Damp	<u>AS1</u>	<u>Sample AS2</u> FMC	3.0 %	
250 - 1.2	Br Sa Some Gr Tr Cob, Moist	<u>AS2</u>			
1.2 - 1.5	Dk Br Sa Some Gr, Moist	<u>AS3</u>	<u>Sample AS3</u> FMC	2.4 %	
1.5 - 2.1	Br Sa Tr Gr, Moist	<u>SS4</u>			
2.1 - 3.2	Br Sa Tr Gr Tr Cl, Moist N @ 1.8 m = 43 N @ 2.9 m = 17	<u>SS5</u>	<b>24+125, 5.5 m Rt (Sh)</b>		<u>AS1</u> <u>AS2</u> <u>AS3/4/5</u>
			0 - 250	Br Sa and Gr, Damp	
			250 - 1.5	Br Sa Some Gr, Damp	
			1.5 - 3.7	Br Sa Tr Gr, Moist	



## BOREHOLE LOGS

<u>Sample AS1</u> FMC	2.3%		<u>Sample SS3</u> FMC	8.1 %
<u>Sample AS2</u> FMC	2.3%		<u>Sample SS4</u> FMC	5.8 %
<u>Sample AS3</u> FMC	2.4%		<u>Sample SS5</u> FMC	2.5 %
<u>Sample AS4</u> FMC	3.5%		<u>Sample SS6</u> FMC	2.6 %
<u>Sample AS5</u> FMC	5.0%		<b>24+175, 5.5 m Rt (Sh)</b>	
			0 - 250	Br Sa and Gr, Damp
			250 - 1.5	Br Sa Some Gr Sa, Damp
			1.5 - 2.1	Br Sa Tr Gr Tr Si, Moist
			2.1 - 3.0	Br Sa Tr Gr Tr Cl, Moist
			3.0 - 3.6	Br Cl Si Some Sa Tr Gr, Moist
<b>24+150, 16.0 m Lt ( Top of Slope )</b>				<u>AS1</u> <u>AS2</u> <u>AS3</u>
0 - 200	Tps			
200 - 3.1	Br Si Sa Tr Gr, Damp to Moist	<u>SS1/2/3/4</u>	<u>Sample AS1</u> FMC	8.3 %
	N @ 0.3 m = 13			
	N @ 1.1 m = 32			
	N @ 1.8 m = 23		<u>Sample AS2</u> FMC	8.4 %
	N @ 2.1 m = 50 / 80 mm (Poss Bld)			
3.1 - 3.8	Br Gr and Sa, Damp to Moist	<u>SS5</u>	<u>Sample AS3</u> FMC	10.8 %
	N @ 3.2 m = 71 / 200 mm			
3.8 - 4.1	Br Si Sa and Gr, Damp	<u>SS6</u>		
	N @ 4.0 m = 71 / 200 mm			
<u>Sample SS1</u> FMC	13.7 %		<b>24+200, 19.0 m Lt ( Top of Slope )</b>	
			0 - 230	Tps
			230 - 3.4	Br Si Sa and Gr, Moist to Damp
				N @ 0.3 m = 11
				N @ 1.1 m = 28
				N @ 1.8 m = 15
				N @ 2.6 m = 50 / 130 mm
<u>Sample SS2</u> FMC	6.6 %			<u>SS1-5</u>

## BOREHOLE LOGS

N @ 3.2 m = 50 / 80 mm

Sample SS1

FMC

24.4 %

Sample SS2

FMC

9.4 %

Sample SS3

FMC

5.0 %

Sample SS4

FMC

5.0 %

Sample SS5

FMC

2.4 %

**24+215, 5.5 m Rt (Sh)**

0 - 400 Br Sa and Gr, Damp  
400 - 1.0 Br Sa Tr Si Some Gr, Damp  
1.0 - 1.2 Br Si Some Sa Tr Gr, Damp

**24+225, 3.5 m Rt (EP)**

0 - 60 Asph  
60 - 350 Br Sa and Gr, Moist  
350 - 1.1 Br Sa Some Gr, Moist to Damp  
1.1 - 1.5 Br Si ,some Sa and Gr, Moist

Sample AS1

FMC

4.4%

% Passing 4.75 mm

% Passing 75 µm

Lab Class

53  
13.5  
Not acceptable as Granular A

Sample AS2

FMC

3.2%

% Passing 4.75 mm

% Passing 75 µm

Lab Class

37.5  
8  
Acceptable as Granular B Type I

Sample AS3

FMC

8.2%

% Passing 4.75 mm

% Passing 75 µm

% Passing 5 µm

Comment

10  
HSFH

**24+248, 12.0 m Lt (Top of Slope )**

0 - 200 Tps

200 - 2.3 Br Si Sa W Gr, Moist

N @ 0.3 m = 10

N @ 1.1 m = 9

N @ 1.8 m = 27

2.3 - 2.8 Br Si Sa, Wet

SS1/2/3

SS4

**24+250, 15.0 m Lt ( Top of Slope )**

0 - 1.2 Br Sa and Gr, Moist

N @ 0.3 m = 31

N @ 1.1 m = 28

1.2 - 2.0 Br Sa Tr Gr, Moist

N @ 1.8 m = 46

N @ 3.4 m = 26

SS1/2

SS3

Sample SS1

FMC

4.8 %

Sample SS2

FMC

4.9 %

## BOREHOLE LOGS

<u>Sample SS3</u> FMC	8.8 %				
<b>24+275, 5.5 m Rt (Sh)</b>					
0 - 400	Br Sa and Gr, Damp				
400 - 1.0	Br Sa Some Gr Tr Si, Damp				
1.0 - 1.2	Br Si Some Sa Tr Gr, Damp				
1.2	NFP, Poss Bld				
<b>24+275, 9.0 m Rt ( Ditch ) D- 0.15m</b>					
0 - 300	Br Sa Tr Gr Tps W Rootlets, Damp				
300 - 1.5	Br Sa Tr Gr, Moist				
<b>24+350, 2.7 m Lt</b>					
0 - 200	Asph				
200 - 350	Br Sa and Gr, Moist				
350 - 1.1	Br Sa Some Gr, Moist				
1.1 - 1.5	Dk Br Cl Si Tr Gr, Moist				
<b>24+350, 11.5 m Rt ( Ditch ) D- 0.7m</b>					
0 - 200	Dk Br Si Sa Tr Gr Tps W Rootlets, Moist				
200 - 1.5	Br Sa Tr Gr, Moist				
<b>24+350, 3.7 m Rt (EP)</b>					
0 - 50	Asph				
50 - 350	Br Sa and Gr, Moist				
350 - 1.1	Br Sa Some Gr, Moist				
1.1 - 1.5	Br Sa Tr Gr Tr Cob, Moist				
<b>24+400, 11.0 m Rt ( Ditch ) D- 0.6m</b>					
0 - 250	Dk Br Si Sa Tr Gr Tps W Rotlets, Moist				
250 - 1.5	Br Sa Tr Gr, Moist				
<b>24+400, 5.5 m Rt (Sh)</b>					
<u>Sample AS1</u> FMC	9.5 %				
0 - 250	Br Sa Si to Si Some Sa Tr Gr, Damp to Moist				<u>AS1</u>
250 - 1.2	Br Sa Si Some Gr Tr Cob, Damp				<u>AS2</u>
1.2 - 2.4	Blk Si Tr Gr, Moist				<u>AS2</u>
	N @ 1.8 m = 32				
<u>Sample AS2</u> FMC	16.8%				
<b>24+450, 3.7 m Rt (EP)</b>					
0 - 60	Asph				
60 - 300	Br Sa and Gr, Moist				
300 - 1.0	Br Sa Some Gr, Moist				
1.0 - 1.5	Br Sa Tr Gr, Moist				
<b>24+450, 11.5 m Rt ( Ditch ) D- 0.7m</b>					
0 - 460	Dk Br Sa Si Tr Gr Tps W Rootlets, Moist				<u>AS1</u>
460 - 1.5	Br Cl Sa Tr Gr, Moist to Wet				<u>AS2</u>
<b>24+500, 3.7 m Rt (EP)</b>					
0 - 100	Asph				
100 - 200	RAP				
200 - 350	Br Sa and Gr, Moist				<u>AS1</u>
350 - 900	Br Sa Some Gr Tr Cob				<u>AS2</u>
900 - 1.5	Dk Br Si Sa Tr Cl Tr Gr, Moist				<u>AS3</u>
					<u>AS4</u>
<b>24+550, 5.5 m Rt (Sh)</b>					
0 - 250	Br Sa and Gr, Moist				
250 - 290	Blk Si Tr Gr, Moist				
290 - 1.0	Br Sa Some Gr, Moist				<u>AS1</u>
1.0 - 1.5	Br Sa Tr Gr, Moist				

## BOREHOLE LOGS

<b>24+600, 3.7 m Rt (EP)</b>					
0 - 70	Asph			0 - 350	TPS with Dk Br Si Sa Tr Gr Tr Rootlets, Damp to Moist
70 - 400	Br Sa and Gr, Moist			350 - 1.0	Br Si Sa Tr Gr Tr Cl, Moist
400 - 1.0	Br Sa Some Gr, Moist	<u>AS1</u>			
1.0 - 1.5	Dk Br to Gry Sa Some Gr, Moist	<u>AS2</u>			
		<u>AS3</u>			
<b>24+600, 3.75 m Lt (EP)</b>					
0 - 150	Asph			<b>24+700, 8.6 m Rt, D-0.54</b>	
150 - 300	Br Sa and Gr, Moist			0 - 150	Tps
300 - 950	Br Sa Some Gr, Moist			150 - 450	Dk Br Si Sa Tr Gr, Damp
950 - 1.1	Br Sa Tr Gr, Moist			450 - 1.0	Br F-Med Sa, Damp
					<u>AS1</u>
					<u>AS2</u>
					<u>AS3</u>
<b>24+650, 5.5 m Rt (Sh)</b>					
0 - 350	Br Sa and Gr, Damp	<u>AS1</u>		<b>24+700, 3.7 m Rt</b>	
350 - 1.4	Br Sa Some to Tr Gr, Moist	<u>AS2</u>		0 - 70	Asph
1.4 - 1.5	Blk Si Some Sa, Moist	<u>AS3</u>		70 - 300	Br Sa and Gr, Moist
				300 - 1.0	Br Sa Tr Gr Tr Cob, Moist
				1.0 - 1.5	Br F Sa Tr Gr, Moist
<b>24+500, 9.6 m Rt, D-0.6</b>					
0 - 280	Tps with Dk Br Si Sa Tr Gr Damp	<u>AS1</u>		<b>24+750, 8.6 m Rt, D-0.50</b>	
280 - 1.0	Br Si Sa Tr Gr, Moist	<u>AS2</u>		0 - 100	Tps
				100 - 350	Dk Br Si Sa Tr Gr, Damp
				350 - 1.0	Br F-Med Sa Tr Gr, Damp
					<u>AS1</u>
					<u>AS2</u>
					<u>AS3</u>
<b>24+550, 9.2 m Rt, D-0.6</b>					
0 - 100	Tps with Dk Br Si Sa Tr Gr Damp	<u>AS1</u>		<b>24+750, 5.5 m Rt (Sh)</b>	
100 - 400	Dk Br Si Sa Tr Rootlets, Damp	<u>AS2</u>		0 - 150	Br Sa and Gr, Damp
400 - 1.0	Br Si Sa Tr Gr, Damp	<u>AS3</u>		150 - 500	Br Sa Some to Tr Gr, Moist
				500 - 1.5	Br Si Sa to Sa Si, Moist
<b>24+600, 9.0m Rt, D-0.70</b>					
0 - 200	Tps			<b>24+800, 8.50 m Rt, D-0.50</b>	
200 - 400	Dk Br Si Sa Tr Gr Tr Rootlets, Damp to Moist	<u>AS1</u>		0 - 300	Tps with Dk Br Si Sa Tr Gr Damp
400 - 1.0	Br Si Sa Tr Gr, Damp to Moist	<u>AS2</u>		300 - 700	Dk Br Si Sa Tr Gr Tr Rootlets, Damp
		<u>AS3</u>		700 - 1.	Br Cl Si, Damp
					<u>AS1</u>
					<u>AS2</u>
					<u>AS3</u>
<b>24+650, 9.2 m Rt, D-0.70</b>					
				<b>24+800, 3.7 m Rt (EP)</b>	
				0 - 90	Asph
				90 - 350	Br Sa and Gr, Moist
				350 - 1.0	Br Sa Some Gr, Moist

## BOREHOLE LOGS

1.0 - 1.5	Br Si, Moist	<u>AS1</u>	90 - 400	Br Sa and Gr, Moist	<u>AS1</u>
<b>24+850, 8.5 m Rt, D-0.50</b>					
0 - 300	Tps with Dk Br Si Sa Tr Gr Damp	<u>AS1</u>	400 - 1.2	Br Sa Some Gr, Moist	
300 - 500	Dk Br Si Sa Tr Cl Tr Gr Tr Rootlets, Damp	<u>AS2</u>	1.2 - 1.5	Blk to Dk Br Sa Tr Gr, Moist	
500 - 1.0	Br Si Sa Tr Gr Tr Cl, Moist	<u>AS3</u>			
<b>24+850, 5.5 m Rt (Sh)</b>					
0 - 250	Br Sa and Gr, Moist to Damp	<u>AS1</u>	<b>24+900, 11.50m Rt, D-2.0</b>		
250 - 900	Br Sa Some to Tr Gr, Damp	<u>AS2</u>	0 - 300	Tps with Dk Br Si Sa Tr Gr Damp	<u>AS1</u>
900 - 1.5	Dk Br Si, some Sa and Cl Tr Gr, Damp	<u>AS3</u>	250 - 460	Dk Br Si Sa Tr Gr Tr Cl Tr Rootlets, Damp	<u>AS2</u> <u>AS3</u>
<u>Sample AS1</u>					
FMC	2.5%		460 - 1.0	Br Si Sa Tr Gr Tr Cl, Moist	
% Passing 4.75 mm	46.5		<b>24+950, 5.5 m Rt (Sh)</b>		
% Passing 75 µm	11		0 - 400	Br Sa and Gr, Damp	
Lab Class	Marginally acceptable as Granular A		400 - 900	Br Sa Tr to Some Gr, Damp	
<u>Sample AS2</u>					
FMC	3.9%		900 - 1.5	Dk Br to Blk Si Sa Tr Gr, Damp	
% Passing 4.75 mm	72.5		<b>24+950, 12.0 m Rt, D-2.20</b>		
% Passing 75 µm	14.5		0 - 200	Tps	<u>AS1</u>
Lab Class	Not acceptable as Granular B Type I		200 - 400	Dk Br Si Sa Tr Gr Tr Rootlets, Damp	<u>AS2</u> <u>AS3</u>
<u>Sample AS3</u>					
FMC	9.1 %		460 - 1.0	Br Si Sa Tr Gr Tr Cl, Moist	
% Passing 4.75 mm	91		<b>25+000, 3.7 m Rt (EP)</b>		
% Passing 75 µm	75		0 - 200	Asph	<u>AS1</u> <u>AS2</u> <u>AS3</u> <u>AS4</u>
% Passing 5 µm	17		200 - 450	Br Sa and Gr, Moist	
Comment	HSFH		450 - 1.0	Br Sa Some Gr, Moist	
<u>Sample AS4</u>					
FMC	9.1 %		1.0 - 1.4	Dk Br Sa Some Gr, Moist	
% Passing 4.75 mm	91		1.4 - 1.5	Br Sa Tr Gr, Moist	
% Passing 75 µm	75		<b>25+000, 12.10 m Rt, D-2.0</b>		
% Passing 5 µm	17		0 - 250	Tps	
Comment	HSFH		250 - 400	Dk Br Si Sa Tr Gr Tr Cl Tr Rootlets, Damp	<u>AS1</u>
<b>24+900, 3.7 m Rt (EP)</b>					
0 - 90	Asph		400 - 1.0	Br Si Sa Tr Gr Tr Cl, Damp	<u>AS2</u>



## BOREHOLE LOGS

### 25+350, 13.0 m Rt, D-7.9

0 - 300 Tps with Blk Br Cl Si Tr Gr Tr rootlets, org Moist AS1  
 250 - 1.0 Blk Br Cl Si Tr Gr Tr rootlets, Tr wood pieces, org, Moist AS2

### 25+400, 12.3 m Rt, D-7.0

0 - 600 Tps Blk Br Cl Si Tr Gr Tr Sa Tr rootlets Moist AS1  
 600 - 1.0 Grn Gry Sa Si to Si Sa Tr Gr, Moist AS2

### 25+450, 5.5 m Rt (Sh)

0 - 300 Br Sa and Gr, Damp AS1  
 300 - 1.2 Br Sa Some Gr, Damp AS2  
 1.2 - 1.5 Br Sa Some Cl Tr Gr, Moist AS3-1  
 W Blk Si Tr Gr, Moist AS3-2

### 25+450, 9.0 m Rt, D-2.1

0 - 360 Tps with Dk Br Cl Si Tr Gr Tr Sa Tr rootlets Damp AS1  
 360 - 1.0 Dk Br Sa Cl Si Tr Gr Tr Sa Damp to Moist AS2

### 25+500, 3.7 m Rt (EP)

0 - 170 Asph  
 170 - 450 Br Sa and Gr, Damp AS1  
 450 - 870 Br Sa Tr Gr, Damp AS2  
 870 - 1.5 Dk Br to Blk Si Sa Tr Gr, Moist AS3

### 25+500, 9.6 m Rt, D-0.5

0 - 330 Tps Dk with Br Si SaTr Gr Tr Cl Tr rootlets Damp AS1  
 330 - 1.0 Br Sa Si Tr Gr Some Cl, Damp AS2

### 25+550, 5.5 m Rt (Sh)

0 - 200 Br Sa and Gr, Moist  
 200 - 1.0 Br Sa Some Gr, Damp  
 1.0 - 1.1 Blk Si Tr Sa Tr Gr, Moist AS1  
 1.1 - 1.5 Br Sa Some Gr, Damp

### 25+550, 6 m Lt (Entrance, Paved)

0 - 60 Asph  
 60 - 350 Br Sa & Gr, Dry  
 350 - 1.2 Br Sa Tr Sa Tr Cob, Moist  
 1.2 - 1.5 Dk Br Sa Si Tr Gr , Some Org, Moist

### 25+550, 9.6 m Rt, D-0.5

0 - 360 Tps with Dk Br Si SaTr Gr Tr rootlets Damp AS1  
 360 - 1.0 Br Sa Si Tr Gr Some Cl, Damp AS2

### 25+600, 3.75 m Lt (EP)

0 - 190 Asph  
 190 - 400 Br Sa and Gr, Moist AS1  
 400 - 1.1 Br Sa Tr Gr, Moist AS2  
 1.1 - 1.5 Dk Br to Blk Si Tr Gr, Moist AS3

### Sample AS1

FMC 10.7 %

### 25+600, 9.5 m Rt, D-1.0

0 - 230 Tps with Dk Br Si SaTr Gr Tr Cl Tr rootlets, Damp AS1  
 230 - 1.0 Br Cl Si Tr Sa Tr Gr , Damp to Moist AS2

### 25+650, 5.5 m Rt (Sh)

0 - 200 Br Sa and Gr, Moist  
 200 - 1.0 Br Sa Some Gr, Moist AS1  
 1.0 - 1.1 Blk Si Tr Sa Tr Gr, Moist





## BOREHOLE LOGS

<b>26+050, 11.9 m Rt, D-2.0</b>		850 - 1.5	Br Sa Some Gr, Moist
0 - 240	Tps with Dk Br Cl Si Tr Sa Some Gr Tr rootlets Damp		
240 - 1.0	Br Sa Si Some Cl Tr Gr, Moist		
<b>26+100, 3.7 m Lt (EP)</b>			
0 - 100	Asph		
100 - 300	Br Sa and Gr, Moist		
300 - 950	Br Sa Some Gr, Moist		
950 - 1.5	Br Sa Si Some Gr, Moist		
<b>Sample AS1</b>			
FMC	2.8 %		
% Passing 4.75 mm	54		
% Passing 75 µm	8		
Lab Class	Acceptable as Granular A		
<b>Sample AS2</b>			
FMC	3.4%		
% Passing 4.75 mm	57.5		
% Passing 75 µm	8		
Lab Class	Acceptable as Granular B Type I		
<b>Sample AS3</b>			
FMC	8.0 %		
% Passing 4.75 mm	75		
% Passing 75 µm	57.5		
% Passing 5 µm	9		
Comment	MSFH		
<b>26+100, 5.0 m Rt (Sh)</b>			
0 - 250	Br Sa and Gr, Moist		
250 - 700	Br Sa Some Gr, Moist		
700 - 850	Blk Cl Si Some Sa Tr Gr, Moist		
<b>26+100, 15.5 m Rt, D-2.6</b>			
0 - 310	Tps with Dk Br Cl Si Tr Gr Tr rootlets, Damp		
310 - 1.0	Br Sa Si Some Cl Tr Gr, Damp to Moist		
<b>26+150, 15.1 m Rt, D-4.0</b>			
0 - 250	Tps with Dk Br Si Sa Some Gr Tr rootlets, Damp		
250 - 1.0	Br Cl Si Some Sa Tr Gr, Damp		
<b>26+200, 5.0 m Rt (Sh)</b>			
0 - 250	Br Sa and Gr, Moist		
250 - 1.5	Br Sa Some Gr Tr Cob, Moist		
<b>26+200, 12.1m Rt, D-3.1</b>			
0 - 230	Tps with Dk Br Si Sa Some Cl TrGr Tr rootlets, Damp		
230 - 1.0	Br Cl Si Some Sa Tr Gr, Moist		
<b>26+250, 3.7 m Rt (EP)</b>			
0 - 180	RAP		
180 - 450	Br Sa and Gr Cob, Damp		
450 - 1.2	Br Sa Some Gr Tr Cob, Moist		
1.2 - 1.5	Br Sa Tr Gr, Moist		
<b>26+250, 12.2 m Rt, D-2.0</b>			
0 - 290	Tps with Dk Br Cl Si Some Sa Tr Gr Tr rootlets, Damp		
290 - 1.0	Dk Br Cl Si Tr Sa Tr Gr, Damp to Moist		
<b>26+300, 5.5 m Rt (Sh)</b>			
0 - 200	Br Sa and Gr, Moist		

## BOREHOLE LOGS

200 - 950 Br Sa Some Gr, Moist  
950 - 1.5 Dk Br to Blk Si Tr Sa Tr Gr, Moist

### 26+300, 10.8 m Rt, D-1.3

0 - 230 Tps with Dk Br Si Sa to Sa Si Tr Cl Tr Gr Tr rootlets, Damp AS1  
230 - 1.0 Br Cl Si Tr Sa Tr Gr, Damp to Moist AS2

### 26+350, 3.7 m Rt (EP)

0 - 50 Asph  
50 - 200 Br Sa and Gr, Moist  
200 - 1.0 Br Sa Tr Gr Tr Cob, Moist  
1.0 - 1.5 Dk Br to Blk Si Sa Tr Gr, Moist

### 26+350, 3.0 m Lt

0 - 190 Asph  
190 - 350 Br Sa and Gr, Moist  
350 - 1.0 Br Sa Some Gr, Moist AS1  
1.0 - 1.5 Br Si Sa Tr Gr, Moist AS2  
AS3

### 26+350, 9.5 m Rt, D-0.5

0 - 220 Tps with Dk Br Cl Si Tr to Some Sa Tr Gr Tr rootlets, Damp AS1  
220 - 1.0 Br Cl Si Some Sa Tr Gr, Damp to Moist AS2

### 26+400, 5.5 m Rt (Sh)

0 - 150 Br Sa and Gr, Moist  
150 - 1.0 Br Sa Some Gr, Moist  
1.0 - 1.5 Br Sa Tr Si Tr Gr, Moist

### 26+400, 8.5m Rt, D-0.4

0 - 360 Tps with Dk Br Si Sa Tr Cl Tr -Some Gr Tr rootlets, Damp AS1  
360 - 1.0 Br Sa Si Tr Gr, Damp To Moist AS2

### 26+450, 3.7 m Rt (EP)

0 - 100 Asph  
100 - 300 Br Sa and Gr Tr Cob, Damp AS1  
300 - 1.0 Br Sa Some Gr, Damp AS2  
1.0 - 1.5 Br Sa Tr Gr, Damp AS3

### 26+450, 9.0m Rt, D-0.8

0 - 300 Tps with Dk Br Si Sa Some Cl Tr Gr Tr rootlets, Damp to Moist AS1  
250 - 1.0 Br Si Sa Some Cl Tr Gr Tr rootlets, Moist AS2  
AS3

### 26+600, 3.7 m Lt (EP)

0 - 180 Asph  
180 - 300 Br Sa and Gr, Moist  
300 - 450 Br Sa Some Gr, Moist AS1  
450 - 1.2 Blk Sa Tr Gr, Moist AS2  
1.2 - 1.5 Gry to Dk Br Sa Tr Gr, Moist AS3

Sample AS1

FMC 3.2 %

Sample AS2

FMC 4.1 %

Sample AS3

FMC 14.3 %

### 26+890, 5.5 m Rt (Sh)

0 - 300 Br Sa and Gr, Moist  
300 - 1.3 Br Sa Some Gr, Moist  
1.3 - 1.5 Blk Si Some Sa Tr Gr, Moist

### 26+890, 3.7 m Rt (EP)

0 - 150 Asph

## BOREHOLE LOGS

150 - 400	Br Sa and Gr, Moist		2.1 - 3.0	Br Si Sa Tr Gr, Wet	SS5
400 - 1.2	Br Sa Some Gr, Moist				
1.2 - 1.5	Dk Br to Blk Si Sa Tr Gr W Org, Moist	AS1			
27+028 ( Commercial Entrance )					
0 - 80	Asph				SS1
80 - 300	Br Sa and Gr, Moist				SS2
300 - 800	Br Sa Some Gr, Moist				SS3
800 - 1.5	Bk to Gry Cl Si Tr Gr, Moist				
1.5 - 2.3	Bk to Gry Org Si Tr Gr, Moist	AS1			AS1
	N @ 1.8 m = 24	SS2			AS2
2.3 - 3.1	Dk Gry Sa Tr Gr, Moist	AS3			AS3
27+100, 1.0 m Rt					
0 - 150	Asph				
150 - 300	Br Sa and Gr, Moist	AS1			
300 - 600	Br Sa Some Gr, Moist	AS2			
600 - 750	Asph	AS3			
750 - 1.2	Br Sa Some Gr, Moist				
1.2 - 1.5	Dk Br Si Sa Tr Gr, Moist	AS4			
27+130, 3.7 m Lt (EP)					
0 - 50	Asph				AS1
50 - 100	Br Sa and Gr, Damp				AS2
100 - 150	Asph				AS3
150 - 300	Br Sa and Gr, Damp				
300 - 900	Br Sa Some Gr, Moist				
900 - 1.5	Gry to Blk Sa Tr Gr, Moist	AS1			
27+175, Lt ( Commercial )					
0 - 100	Asph				
100 - 250	Br Sa and Gr, Damp	AS1			
250 - 1.1	Br Sa Some Gr, Damp	AS2			
1.1 - 1.5	Gry Sa Tr Gr, Moist	AS3			
1.5 - 2.1	Br to Gr Sa Tr Gr, Moist	AS4			
27+175, 6 m Lt ( Environmental )					
0 - 600	Br Sa and Gr, Moist				
600 - 1.5	Br Sa Some Gr, Moist				
1.5 - 3.0	Br Sa Tr Gr, Moist				
27+350, 3.7 m Rt (EP)					
0 - 70	Asph				
70 - 300	Br Sa and Gr, Damp	AS1			AS1
300 - 1.1	Br Sa Some Gr, Damp	SS2			AS2
1.1 - 1.5	Dk Br Si Sa Tr Gr, Damp	AS3			AS3
27+350, 5.5 m Rt (Sh)					
0 - 200	Br Sa and Gr, Moist				
200 - 800	Br Sa Some Gr, Moist				
800 - 1.5	Gry to Dk Br Sa Some Gr, Moist				
27+600, 3.7 m Lt (EP)					
0 - 160	Asph				
160 - 350	Br Sa and Gr, Moist				
350 - 1.1	Br Sa Some Gr, Moist				
1.1 - 1.5	Br Sa Si Some Gr, Moist				
Sample AS1					
FMC			3.0 %		
% Passing 4.75 mm			39		
% Passing 75 µm			8		
Lab Class			Acceptable as Granular A		
Sample AS2					
FMC			3.7 %		
% Passing 4.75 mm			44		
% Passing 75 µm			8		
Lab Class			Acceptable as Granular B Type I		



## BOREHOLE LOGS

400 - 550	Br Sa Some Gr, Moist				
550 - 700	Blk Si Org, Moist	<u>AS1</u>			
700 - 1.5	Br Sa Some to Tr Gr Tr Cob, Moist				
1.5 - 2.1	Gry Sa Some Gr, Moist	<u>AS2</u>			
2.1 - 3.0	Gry Gr Cob Some Sa , Moist	<u>AS3</u>			
<b>28+275, 6.0 m Lt ( Commercial )</b>					
0 - 600	Br Sa and Gr, Moist				
600 - 1.3	Br Si Sa Tr Gr, Moist	<u>SS1</u>			
1.3 - 2.1	Dk Br to Br Sa Si to Si Sa Tr Gr, Moist	<u>SS2</u>			
2.1 - 3.0	Gr Some Sa, Wet	<u>SS3</u>			
		<u>SS4</u>			
<b>28+350, 5.5 m Rt (Sh)</b>					
0 - 200	Br Sa and Gr, Moist				
200 - 1.2	Br Sa Some Gr, Moist				
1.2 - 1.5	Br Sa Some Cl Tr Gr, Moist	<u>AS1</u>			
1.5 - 2.1	Blk Org	<u>AS2</u>			
	N @ 1.8 m = 5				
2.1 - 3.0	Gry Si Some Sa Tr Gr, Moist	<u>AS3</u>			
<b>28+350, 2.8 m Lt</b>					
0 - 260	Asph				
260 - 530	Br Sa Some Gr, Moist	<u>AS1</u>			
530 - 860	Br Sa Some Gr Tr Cob, Moist	<u>AS2</u>			
860 - 1.5	Br Sa Some Si Tr Gr, Moist	<u>AS2</u>			
<b>28+350, 3.7 m Rt (EP)</b>					
0 - 180	Asph				
180 - 400	Br Sa and Gr, Damp	<u>AS1</u>			
400 - 900	Br Sa Some Gr Tr Cob, Moist	<u>AS2</u>			
900 - 1.5	Br Sa Si Some Gr, Moist	<u>AS3</u>			
<b>Sample AS1</b>					
FMC					
% Passing 4.75 mm	2.4%				
	53				
<b>28+600, 3.75 m Lt (EP)</b>					
0 - 170	Asph				
170 - 400	Br Sa and Gr, Moist				<u>AS1</u>
400 - 900	Br Sa Some Gr, Moist				<u>AS2</u>
900 - 1.5	Blk Cl Si Tr Sa Tr Gr, Moist				<u>AS3</u>
<b>28+850, 5.5 m Rt (Sh)</b>					
0 - 200	Br Sa and Gr, Moist				
200 - 750	Br Sa Some Gr Tr Cob, Moist				
750 - 1.0	Blk Si Tr Sa, Moist				
1.0 - 1.5	Br Sa Some to Tr Sa, Moist				
<b>28+850, 3.7 m Rt (EP)</b>					
0 - 60	Asph				
60 - 250	Br Sa and Gr, Damp				<u>AS1</u>
250 - 700	Br Sa Tr Gr, Damp				<u>AS2</u>
700 - 1.5	Blk Si Tr Sa Tr Gr, Moist				<u>AS3</u>
<b>29+100, 3.75 m Lt (EP)</b>					

SPT 1174 : GWP 338-97-00 :Highway 6, from 1.1 km South of Grey County Road 9 (North Junction) Northly 10.5 km to Durham South Limit

# BOREHOLE LOGS

[illegible]

## TOWNSHIP OF BENTINCK

10+150, 3.7 m Rt (EP)		29+350, 3.75 m Rt (EP)	
0 - 70	Asph	0 - 100	Asph
70 - 270	Br Sa and Gr, Moist	100 - 270	Br Sa and Gr, Moist
270 - 930	Br Sa Some Gr Tr Cob, Moist	270 - 950	Br Sa Some Gr, Moist
930 - 1.5	Dk Br Sa Tr Gr, Moist	950 - 1.5	Br Sa Tr Gr, Moist
<b>10+150, 3.7 m Rt (EP)</b> 0 - 70 Asph 70 - 270 Br Sa and Gr, Moist 270 - 930 Br Sa Some Gr Tr Cob, Moist 930 - 1.5 Dk Br Sa Tr Gr, Moist		<b>29+350, 3.75 m Rt (EP)</b> 0 - 100 Asph 100 - 270 Br Sa and Gr, Moist 270 - 950 Br Sa Some Gr, Moist 950 - 1.5 Br Sa Tr Gr, Moist	
Sample AS1 FMC % Passing 4.75 mm 3.6% % Passing 75 µm 54.5 14 Lab Class Not acceptable as Granular A		AS1 AS2 AS3	

## BOREHOLE LOGS

<u>Sample AS2</u>		300 - 950	Br Sa Some Gr, Moist	<u>AS2</u>
<u>FMC</u>	3.6%	950 - 1.5	Br Sa Si Tr Gr, Moist	<u>AS3</u>
% Passing 4.75 mm	50			
% Passing 75 µm	8			
Lab Class	Acceptable as Granular B Type I			
<b>10+400, 3.7 m Lt (EP)</b>				
0 - 130	Asph			
130 - 300	Br Sa and Gr, Damp			
300 - 1.0	Br Sa Tr Gr, Moist			
1.0 - 1.5	Blk to Br Sa Tr Gr, Moist			
<b>10+475, 5.5 m Rt (Sh)</b>				
0 - 200	Br Sa and Gr, Moist to Damp			
200 - 650	Br Sa Some Gr, Moist			
650 - 800	Blk Br Si Sa to Sa, Moist			
800 - 1.5	Br Sa Tr Gr, Moist			
1.5 - 2.3	Br Sa, Moist			
2.3 - 3.1	N @ 1.8 m = 16 Br Sa Tr Gr, Moist			
	N @ 2.8 m =15			
<b>10+650, 5.5 m Rt (Sh)</b>				
0 - 150	Br Sa & Gr, Moist			
150 - 1.0	Br Sa Some to Tr Gr, Moist			
1.0 - 1.3	Blk Sa Tr Si Tr Gr, Moist			
1.3 - 1.5	Br Sa Tr Gr, Moist			
<u>Sample AS1</u>				
<u>FMC</u>	16.6 %			
<b>10+650, 3.7 m Rt (EP)</b>				
0 - 90	Asph			
90 - 300	Br Sa and Gr, Moist			
<b>10+900, 7.5 m Lt (EP)</b>				
0 - 165	Asph			
165 - 350	Br Sa and Gr, Damp			
350 - 1.2	Br Sa Tr Gr, Moist			
1.2 - 1.5	Dk Br Sa Tr Gr, Moist			
<b>11+150, 5.5 m Rt (Sh)</b>				
0 - 150	Asph			
150 - 250	Br Sa and Gr, Moist			
250 - 950	Br Sa Some Gr, Moist			
950 - 1.15	Blk Sa Tr Si Tr Gr, Moist			
1.15- 1.5	Br Sa Some to Tr Gr, Moist			
<b>11+150, 3.7 m Rt (EP)</b>				
0 - 150	Asph			
150 - 310	Br Sa and Gr, Moist			
310 - 800	Br Sa Tr Gr, Damp			
800 - 1.0	Dk Br Sa Si, Moist			
1.0 - 1.5	Br Sa Tr Gr, Moist			
<b>11+225, 5.5 m Rt (Sh)</b>				
0 - 300	Br Sa and Gr, Moist			
300 - 1.5	Br Sa Some Gr Tr Cob			
1.5 - 2.1	Br Cob Some Sa, Moist			
2.1 - 3.0	Br Sa Some Gr Tr Cob, Moist			

## BOREHOLE LOGS

<u>Sample AS1</u> FMC	3.9 %		<u>11+275, 5.5 m Rt (Sh)</u> 0 - 250 Br Sa and Gr, Moist 250 - 1.5 Br Sa Some Gr Tr Cob, Moist 1.5 - 2.1 Gr Some Sa Tr Cob, Moist 2.1 - 3.6 Gr Some Sa Some to Tr Cob, Moist	
<u>Sample AS2</u> FMC	3.8 %			
<u>Sample AS3</u> FMC	3.7 %		<u>11+280, 5.5 m Rt (Sh)</u> 0 - 250 Br Sa and Gr, Moist 250 - 1.5 Br Sa Some Gr Tr Cob, Moist 1.5 - 2.3 Gr Some Sa Tr Cob, Moist 2.3 - 3.7 Gr Some Sa Some to Tr Cob, Moist	
<u>11+250, 8.0 m Lt (Sh)</u> 0 - 300 Br Sa and Gr, Damp 300 - 1.5 Br Sa Some Gr Tr Cob, Damp 1.5 - 2.1 Br Sa Some Gr, Moist 2.1 - 3.0 Br Sa Tr Gr, Moist 3.0 - 3.6 Br Sa Some Gr, Damp N @ 3.4 = 30		<u>SS1</u>	<u>11+300, 8.0 m Lt (Sh)</u> 0 - 300 Br Sa and Gr, Damp 300 - 3.0 Br Sa Some Gr Tr Cob, Damp 3.0 - 3.6 Br Gr Some Sa, Damp N @ 3.4 m = 16	<u>SS1</u>
<u>11+260, 5.5 m Rt (Sh) ( Entrance Removal )</u> 0 - 200 Asph 200 - 1.3 Br Sa Some to Tr Gr, Moist 1.3 - 1.5 Br Sa Tr Cl to Some Tr Gr, Moist 1.5 - 3.6 Br Sa Tr Gr, Moist		<u>AS2/3/4</u>	<u>11+325, 5.5 m Rt (Sh)</u> 0 - 90 Asph 90 - 190 Br Sa and Gr, Moist 190 - 1.5 Br Sa Some to Tr Gr, Moist 1.5 - 2.1 Br Sa Some Gr, Damp 2.1 - 3.0 Br Sa Some Gr Tr Cob, Damp 3.0 - 3.6 Br Sa Some Gr, Moist	<u>AS1</u> <u>AS2</u> <u>AS3</u>
<u>Sample AS1</u> FMC	11.0 %		<u>Sample AS1</u> FMC	4.1 %
<u>Sample AS2</u> FMC	3.9 %		<u>Sample AS2</u> FMC	3.9 %
<u>Sample AS3</u> FMC	3.0 %		<u>Sample AS3</u> FMC	2.8 %
<u>Sample AS4</u> FMC	3.7 %			



## BOREHOLE LOGS

<b>11+350, 8.0 m Lt (Sh)</b>					
0 - 250	Br Sa and Gr, Moist to Damp				
250 - 1.5	Br Sa Some Gr Tr Cob, Damp				
1.5 - 2.1	Br Sa Some Gr Tr Cob, Damp				
	N @ 1.8 m = 53				
	N @ 2.8 = 58				
2.1 - 3.0	Br Sa Some Gr Tr Cob, Damp				
<b>11+375, 8.0 m Lt (Sh)</b>					
0 - 250	Br Sa and Gr, Moist				
250 - 1.5	Br Sa Some Gr Tr Cob, Moist				
1.5 - 3.0	Br Sa Tr Gr, Damp				
<b>11+375, 5.0 m Rt (Sh)</b>					
0 - 100	Asph				
100 - 400	Br Sa and Gr, Moist				
400 - 2.1	Br Sa Some Gr Tr Cob, Moist				
2.1 - 3.0	Br Sa Tr Gr, Moist				
<b>11+400, 8.5 m Lt (Sh)</b>					
0 - 250	Br Sa and Gr, Moist				
250 - 1.5	Br Sa Some Gr Tr Cob, Moist				
1.5 - 2.8	Br Sa Tr Gr, Moist				
<b>11+400, 7.5 m Lt (EP)</b>					
0 - 130	Asph				
130 - 275	Br Sa and Gr, Damp				
275 - 950	Br Sa Tr Gr, Moist				
950 - 1.5	Br Sa Tr Gr Tr Cob, Moist				
<b>11+400, 5.0 m Rt (Sh)</b>					
0 - 100	Asph				
100 - 300	Br Sa and Gr, Moist to Damp				
300 - 1.5	Br Sa Some Gr Tr Cob, Damp				
<b>11+350, 8.0 m Lt (Sh)</b>					
0 - 250	Br Sa and Gr, Moist to Damp				
250 - 1.5	Br Sa Some Gr Tr Cob, Damp				
1.5 - 2.1	Br Sa Some Gr Tr Cob, Damp				
	N @ 1.8 m = 53				
	N @ 2.8 = 58				
2.1 - 3.0	Br Sa Some Gr Tr Cob, Damp				
<b>11+375, 8.0 m Lt (Sh)</b>					
0 - 250	Br Sa and Gr, Moist				
250 - 1.5	Br Sa Some Gr Tr Cob, Moist				
1.5 - 3.0	Br Sa Tr Gr, Damp				
<b>11+375, 5.0 m Rt (Sh)</b>					
0 - 100	Asph				
100 - 400	Br Sa and Gr, Moist				
400 - 2.1	Br Sa Some Gr Tr Cob, Moist				
2.1 - 3.0	Br Sa Tr Gr, Moist				
<b>11+400, 8.5 m Lt (Sh)</b>					
0 - 250	Br Sa and Gr, Moist				
250 - 1.5	Br Sa Some Gr Tr Cob, Moist				
1.5 - 2.8	Br Sa Tr Gr, Moist				
<b>11+400, 7.5 m Lt (EP)</b>					
0 - 130	Asph				
130 - 275	Br Sa and Gr, Damp				
275 - 950	Br Sa Tr Gr, Moist				
950 - 1.5	Br Sa Tr Gr Tr Cob, Moist				
<b>11+400, 5.0 m Rt (Sh)</b>					
0 - 100	Asph				
100 - 300	Br Sa and Gr, Moist to Damp				
300 - 1.5	Br Sa Some Gr Tr Cob, Damp				

1.5 - 1.7	Br Sa Some Gr, Damp				<u>AS1</u>
1.7 - 3.0	Br Sa, Moist to Damp				<u>AS2</u>
<b>11+650, 4.5 m Rt (Sh)</b>					
0 - 100	Asph				
100 - 320	Br Sa and Gr, Moist				<u>AS1</u>
320 - 1.0	Br Sa Some Gr, Moist				<u>AS2</u>
1.0 - 1.3	Br Sa Tr Gr, Moist				
1.3 - 1.5	Blk Sa Tr Gr, Moist				<u>AS3</u>
<b>11+650, 3.75 m Rt (EP)</b>					
0 - 150	Asph				
150 - 300	Br Sa and Gr, Damp				
300 - 1.0	Br Sa Some Gr Tr Cob, Damp				
1.0 - 1.5	Br Sa Tr Gr Tr Cob, Damp				
<b>11+690, 4.5 m Rt (Sh)</b>					
0 - 140	Asph				
140 - 300	Br Sa and Gr, Moist				<u>AS1</u>
300 - 1.0	Br Sa Tr Gr, Moist				<u>AS2</u>
1.0 - 1.5	Dk Br to Gry Sa Tr Gr, Moist				<u>AS3</u>
<b>11+750, 5.5 m Rt (Sh)</b>					
0 - 100	Asph				
100 - 350	Br Sa and Gr, Moist				
350 - 1.5	Br Sa Some Gr Tr Cob, Moist				
1.5 - 2.1	Br to Blk Sa Tr Gr W Org				
2.1 - 3.0	Dk Br Sa W Org				<u>AS2</u>
<b>11+780, 5.0 m Rt (Sh)</b>					
0 - 100	Asph				
100 - 400	Br Sa and Gr, Moist				<u>AS1</u>
400 - 1.5	Br Sa Some to Tr Gr, Moist				<u>AS2</u>



**BOREHOLE LOGS****SIDEROADS**

400 - 800	Br Sa Tr to some Gr, Moist	<u>AS2</u>
800 - 1.5	Br Sa, Moist	<u>AS3</u>

Note: Offset measured from centerline of existing roadway.

**TOWNSHIP OF NORMANBY****Grey County Rd 9****22+227, 5.0 m Rt C/L of Co Rd 9 (Sh)**

0 - 250	Br Sa Some Gr, Moist	<u>AS1</u>
250 - 430	Dk Br Sa Some Si with Org, Moist	<u>AS2</u>
430 - 1.5	Br Sa, Moist	<u>AS3</u>

**22+230, 4.0 m Rt C/L of Co Rd 9 (EP)**

0 - 40	Asph	
40 - 290	Br Sa Tr Cob Tr Gr, Moist	<u>AS1</u>
290 - 1.5	Br Sa, Moist	

**22+237, 3.0 m Lt C/L of Co Rd 9 (EP)**

0 - 55	Asph	
55 - 300	Br Sa and Gr, Moist	<u>AS1</u>
300 - 900	Br Sa Tr Gr, Moist	<u>AS2</u>
900 - 1.5	Br Sa Tr Gr, Moist	<u>AS3</u>

Note: 10 mm old asphalt layer found at depth of 300 mm.

**22+240, 4.5 m Lt C/L of Co Rd 9 (Sh)**

0 - 250	Br Sa and Gr, Moist	
250 - 600	Br Sa Tr Gr Tr Cob, Moist	
600 - 1.5	Br Sa, Moist	

**22+230, 18 m Rt C/L of Hwy 6, 2.2 m Rt C/L of Co Rd 9**

0 - 200	Asph	
200 - 400	Br Sa and Gr, Moist	<u>AS1</u>

**Normanby Con Rd 12****22+227, 3.0 m Lt C/L of Normanby Con Rd 12 (EP)**

0 - 60	Asph	
60 - 310	Br Sa and Gr, Moist	
310 - 850	Br Sa Tr Gr, Moist	
850 - 1.5	Br Sa, Moist	

**22+230, 4.5 m Lt C/L of Normanby Con Rd 12 (Sh)**

0 - 250	Br Sa and Gr, Moist	<u>AS1</u>
250 - 800	Br Sa Tr Gr Tr Cob, Moist	<u>AS2</u>
800 - 1.5	Br Sa, Moist	<u>AS3</u>

**22+238, 3.0 m Rt C/L of Normanby Con Rd 12 (EP)**

0 - 60	Asph	
60 - 400	Br Sa and Gr, Moist	
400 - 1.2	Br Sa Tr Gr, Moist	
1.2 - 1.5	Br Sa, Moist	

**22+240, 5.5 m Rt C/L of Normanby Con Rd 12 (Sh)**

0 - 150	Dk Br Cl Si Some Sa Tps included, Moist	
150 - 400	Br Sa and Gr, Moist	
400 - 1.2	Br Sa Tr Gr, Moist	
1.2 - 1.5	Br Sa, Moist	

**22+230, 12 m Lt C/L of Hwy 6**

0 - 120	Asph	
120 - 250	Br Sa and Gr, Moist	<u>AS1</u>
250 - 800	Br Sa some Gr, Moist	<u>AS2</u>
800 - 1.5	Br Sa Tr Gr, Moist	<u>AS3</u>

## BOREHOLE LOGS

### Southgate Rd 22 (gravel road)

#### 24+080, 28m Rt C/L of Hwy 6 (EP), Rt 3.0m C/L of Southgate Rd 22

0 - 70	Asph	
70 - 220	Br Sa and Gr, Moist	AS1
220 - 1.2	Br Sa Tr Gr Tr Cob, Moist	AS2
1.2 - 1.5	Br Sa Tr Gr, Moist	AS3

#### 24+086, 38m Rt C/L of Hwy 6 (EP), Lt 3.0m C/L of Southgate Rd 22

0 - 25	Asph	
25 - 500	Br Sa Some Gr Tr Cob, Moist	AS1
500 - 1.2	Br Sa Tr Gr Tr Cob, Moist	
1.2 - 1.5	Br Sa Tr Gr, Moist	AS2

#### 24+080, 14m Rt C/L of Hwy 6 (EP), C/L of Southgate Rd 22

0 - 100	Asph	
100 - 250	Br Sa and Gr, Moist	AS1
250 - 850	Br Sa Some Gr, Moist	AS2
850 - 1.5	Br Sa Some Gr, Moist	AS3

### Normanby Rd 21 (gravel road)

#### 24+080, 13m Lt C/L of Hwy 6 (EP)

0 - 100	Asph	
100 - 250	Br Sa and Gr, Moist	AS1
250 - 950	Br Si Sa Some Gr, Moist	AS2
950 - 1.5	Br Si Sa Tr Gr, Moist	AS3

### Southgate Rd 24/Maplewood Rd (gravel road) (26+000)

#### 26+000, 25.0 m Rt C/L of Hwy 6 ( EP, Gr Rd)

0 - 625	Br to Dk Br Sa Si Tr Gr, Moist	AS1
625 - 1.5	Br Sa Tr Gr Tr Cob, Moist	AS2
1.5 - 2.1	Br Si Tr Gr Tr Cob	SS3
	N@0.3 m =23	
2.1 - 3.0	Br Si Sa Tr Gr, Moist	SS4

#### 26+003, 35 m Rt C/L of Hwy 6 (EP, Gr Rd)

0 - 150	Br Sa and Gr, Moist to Damp	AS1
150 - 400	Blk Si Tr Sa Tr Gr, Moist	AS2
400 - 1.5	Br Sa Tr Gr, Moist	AS3

#### 26+004, 14.0 m Rt C/L of Hwy 6, D-0.7m

0 - 600	Br Si Sa Tr Gr Tps W Rotlets, Damp	AS1
600 - 1.5	Br Si Sa Tr Gr Tr Cob, Moist	AS2

#### 26+010, 8.5 m Rt, D-0.5

0 - 290	Tps with Dk Br Cl Si Some Sa Tr Gr Tr rootlets Damp	AS1
290 - 1.0	Br Si Sa Tr Gr Some Cl, Damp to Moist	AS2

#### 26+000, 6 m Lt C/L of Hwy 6 (EP)

0 - 150	Asph	
150 - 300	Br Sa and Gr, Moist	AS1
300 - 1.0	Br Sa Some Gr, Moist	AS2
1.0 - 1.5	Br Si Sa Tr Gr, Moist	AS3

#### 26+000, 15 m Rt C/L of Hwy 6 (EP)

0 - 150	Asph	
150 - 350	Br Sa and Gr, Moist	AS1
350 - 950	Br Sa Some Gr Tr Cob, Moist	AS2
950 - 1.5	Br Sa Tr Gr Tr Cob, Moist	AS3

### Wilder Rd (Gr Rd) (27+850)

#### 27+845, 18 m Rt C/L of Hwy 6 (EP) BH SR7 (C + B)

## BOREHOLE LOGS

0 - 100 Asph  
 100 - 250 Br Sa and Gr, Damp  
 250 - 400 Br Sa Some Gr, Moist  
 400 - 1.2 Dk Br Si Sa to Sa Si Tr Gr, Moist  
 1.2 - 1.5 Br Sa Tr Gr, Moist

AS1  
AS2  
AS3  
AS4

### 27+830, 8.0 m Rt C/L of Hwy 6 (D), D-1.5

0 - 200 Tps with Dk Gry Si Sa Tr Gr Tr rootlets, Damp

AS1  
AS2

200 - 1.0 Gry Br Si Sa Tr Gr, Damp

### 27+845, 25 m Rt C/L of Hwy 6 (EP)

0 - 60 Asph  
 60 - 210 Br Sa and Gr, Damp  
 210 - 950 Br Sa Some Gr, Moist  
 950 - 1.5 Br Si Sa Tr Gr, Moist

AS1  
AS2  
AS3

### Field Street (Gr Rd) (28+130)

### 28+140, 5 m Lt C/L of Hwy 6, 4m E of SE Corner of Hourse

#### #313030

0 - 200 Br Sa and Gr, Dry  
 200 - 750 Br Sa Some to Tr Gr, Moist  
 750 NFP @ Bld

### 28+130, 5 m Lt C/L of Hwy 6

0 - 200 Br Sa and Gr, Dry  
 200 - 750 Br Sa Some Gr, Moist  
 750 - 1.5 Br Gr Sa Tr Cob, Moist

AS1  
AS2  
AS3

### 28+120, 5 m Lt C/L of Hwy 6, 3m E of NE Corner of Hourse

#### #313028

0 - 200 Br Sa and Gr, Dry  
 200 - 750 Br Sa Some Gr, Moist  
 750 - 1.5 Br Gr Sa Tr Cob, Moist

SS1  
SS2  
SS3  
SS4

### 28+130, 20 m Lt C/L of Hwy 6 (Gravel Rd)

0 - 200 Br Sa and Gr, Dry  
 200 - 1.5 Dk Br to Br Sa Some Gr Tr Cob, Moist

### Varney Rd (28+250)

### 28+260, 15.0 m Lt C/L of Hwy 6 ( Commercial )

0 - 200 Asph  
 200 - 400 Dk Br to Gry Sa and Gr, Moist  
 400 - 1.0 Gry Sa Some Gr Tr Cob, Moist  
 1.0 - 15 Br Sa Tr Gr, Moist

AS1  
AS2  
AS3

### 28+270, 4.5 m Lt ( Ditch ) D+ 0.1m

0 - 200 Dk Br Sa Tr Gr Tps Moist  
 200 - 1.0 Br Sa Some Gr, Moist  
 1.0 - 1.2 Dk Br Sa Si Tr Gr, Moist  
 1.2 - 2.1 Br Sa Tr Gr Tr Rock Fragments, Moist  
 2.1 - 3.0 Br Sa Tr Gr W Rock Pragments, Wet

AS1  
AS2  
AS3  
AS4  
SS5

### \*28+270, 5 m Rt (Paved Sh, Commercial )

0 - 60 Asph  
 60 - 400 Br Sa and Gr, Moist  
 400 - 550 Br Sa Some Gr, Moist  
 550 - 700 Blk Si Org, Moist  
 700 - 1.5 Br Sa Some to Tr Gr Tr Cob, Moist  
 1.5 - 2.1 Gry Sa Some Gr, Moist  
 2.1 - 3.0 Gry Gr Cob Some Sa , Moist

### \*28+275, 6.0 m Lt ( Unknown Commercial )

0 - 600 Br Sa and Gr, Moist  
 600 - 1.3 Br Si Sa Tr Gr, Moist  
 1.3 - 2.1 Dk Br to Br Sa Si to Si Sa Tr Gr, Moist  
 2.1 - 3.0 Gr Some Sa, Wet

## BOREHOLE LOGS

### 28+270, 30m Lt C/L of Hwy 6 ( Sh), 8m S. of House 313044

0 - 150 Br Sa & Gr, Damp  
150 - 280 Br Sa Some Gr, Moist  
280 - 1.5 Gry Cl Si Tr Sa Si Some Org, Moist

### 28+250, 20m Lt C/L of Hwy 6 ( Sh)

0 - 150 Br Sa & Gr, Damp  
150 - 1.5 Dk Br Sa Some Gr, Moist

AS1  
AS2

### 11+845, 17 m Lt (EP)

0 - 100 Asph  
100 - 350 Br Sa and Gr, Moist  
350 - 1.5 Br Sa Some to Tr Gr Tr Cob, Moist

### 11+852, 26 m Lt (Sh)

0 - 80 Tps  
80 - 300 Br Sa and Gr, Moist  
300 - 1.5 Br Sa Some to Tr Gr Tr Cob, Moist

## TOWNSHIP OF BENTINCK

### Southgate-Glenleg Townline/Normanby-Bentick Townline(26+691.722/10+000)

#### 10+000, 6.5 m Lt C/L of Hwy 6

0 - 70 Asph  
70 - 350 Br Sa and Gr, Moist  
350 - 950 Br Sa Some Gr, Moist  
950 - 1.5 Br Sa Tr Si Tr Gr, Moist

AS1  
AS2  
AS3

#### 10+000, 2.0 m Rt C/L of Hwy 6

0 - 100 Asph  
100 - 300 Br Sa and Gr, Damp  
300 - 800 Br Sa Some Gr, Moist  
800 - 1.5 Br Si Sa Tr Gr, Moist

AS1  
AS2  
AS3

### Douglas Street ( 11+850)

#### 11+850, 26 m Lt (EP)

0 - 100 Asph  
100 - 400 Br Sa and Gr, Moist  
400 - 1.5 Br Sa Some Gr Tr Cob, Moist

## COMMERCIAL/PRIVATE ENTRANCES

Note: Offset measured from centerline of existing roadway.

## TOWNSHIP OF NORMANBY

### West Grey Premium Beef Inc.(25+550 Rt)

#### 25+550, 6.0 m Lt C/L (Reconstruct)

0 - 60 Asph  
60 - 350 Br Sa & Gr, Dry  
350 - 1.2 Br Sa Tr Gr, Tr Cob, Moist  
1.2 - 1.5 Dk Br Sa Si Tr Gr Some Org, Moist

### Maplewood Cemetery (25+850 Lt)

#### 25+860, 5.5 m Lt C/L (Reconstruct)

0 - 300 Br Sa & Gr, Dry

AS1

## BOREHOLE LOGS

300 - 1.2 Br Sa Some Gr Tr Cob, Moist AS2  
 1.2 - 1.5 Br Sa Si Tr Gr, Moist AS3

### 25+950, 6.0 m Lt C/L (Entrance remove and relocate)

0 - 200 Br Sa & Gr, Moist to Dry  
 200 - 1.5 Br Sa Tr to Some Gr Tr Cob, Moist

### IMPAX Mfg. (26+900 Rt)

#### 26+900, 6.2 Rt C/L (Reconstruct)

0 - 80 Asph  
 80 - 600 Br Sa and Gr, Moist  
 600 - 1.6 Blk Org, Some Sa Tr Gr, Moist  
 1.6 - 2.1 Grey F Sa Tr Gr, Moist  
 2.1 - 3.0 Br Sa, Moist

### Varney Motor Speedway (27+025 Rt)

#### 27+028, 6 Rt C/L (Reconstruct)

0 - 80 Asph  
 80 - 300 Br Sa and Gr, Moist  
 300 - 800 Br Sa Some Gr, Moist  
 800 - 1.5 Bk to Gry Cl Si Tr Gr, Moist AS1  
 1.5 - 2.3 Bk to Gry Org Si Tr Gr, Moist SS2  
 N @ 1.8 m = 24  
 2.3 - 3.1 Dk Gry Sa Tr Gr, Moist AS3

### Kelly Joe's Roadhouse (27+150 Lt)

#### 27+150, 5.5 Lt C/L (Entrance Removal)

0 - 80 Asph  
 80 - 560 Br Sa Some Gr, Moist  
 560 - 1.3 Dk Br Sa Tr to Some Gr Tr Cob, Moist  
 1.3 - 1.5 Dk Br Sa Si Tr Gr, Moist

### 27+190, 5.5 Lt C/L (Reconstruct)

0 - 90 Asph  
 90 - 500 Br Sa & Gr Tr Org, Moist  
 560 - 1.2 Dk Br Sa Some Gr Tr Cob Tr Org, Moist  
 1.2 - 1.5 Grey Sa Si, Moist

### Private Entrance (23+275 Rt)

#### 23+270, 5.5 m Rt (Entrance Removal)

0 - 150 Br Sa and Gr, Moist AS1  
 150 - 1.2 Br Sa Some Gr, Moist AS2  
 1.2 - 1.5 Br to Dk Br Sa Tr Gr, Moist AS3

### Commercial Entrance (27+750 Rt)

#### 27+750, 5.5 m Rt (Entrance Removal)

0 - 70 Asph  
 70 - 300 Br Sa and Gr, Moist AS1  
 300 - 400 Br Sa Some Gr, Moist  
 400 - 500 Dk Br to Gry Sa Some to Tr Gr, Moist  
 500 - 1.5 Br Sa Some Gr, Moist AS2

### Private Entrance (28+280 Rt)

#### 28+270, Lt ( Entrance Removal )

0 - 60 Asph  
 60 - 400 Br Sa and Gr, Moist  
 400 - 550 Br Sa Some Gr, Moist AS1  
 550 - 700 Blk Si Org, Moist  
 700 - 1.5 Br Sa Some to Tr Gr Tr Cob, Moist  
 1.5 - 2.1 Gry Sa Some Gr, Moist AS2  
 2.1 - 3.0 Gry Gr Cob Some Sa , Moist AS3

## BOREHOLE LOGS

### TOWNSHIP OF BENTINCK

#### Private Entrance (11+260 Rt)

#### 11+260, 5.5 m Rt (Sh) ( Entrance Removal )

0 - 200 Asph  
 200 - 1.3 Br Sa Some to Tr Gr, Moist  
 1.3 - 1.5 Br Sa Tr Cl to Some Tr Gr, Moist  
 1.5 - 3.6 Br Sa Tr Gr, Moist

AS2/3/4

#### Sample AS1

FMC 11.0 %

#### Sample AS2

FMC 3.9 %

#### Sample AS3

FMC 3.0 %

#### Sample AS4

FMC 3.7 %

#### Explanation of Terms Used

Rt = Right  
 Lt = Left  
 EP= Edge of pavement  
 Sh = Shoulder  
 LSFH = Low Susceptibility Frost Heaving  
 MSFH = Moderate Susceptibility Frost Heaving  
 HSFH = High Susceptibility Frost Heaving  
 \* Hand-drilled borehole

N N-value (below/0.3 m) from Standard Penetration Test (SPT)  
 D = refers to datum, taken as the approximatel level of the existing road.  
 D- or D+ = refers to the position of the ground at the borehole location relative to the datum.

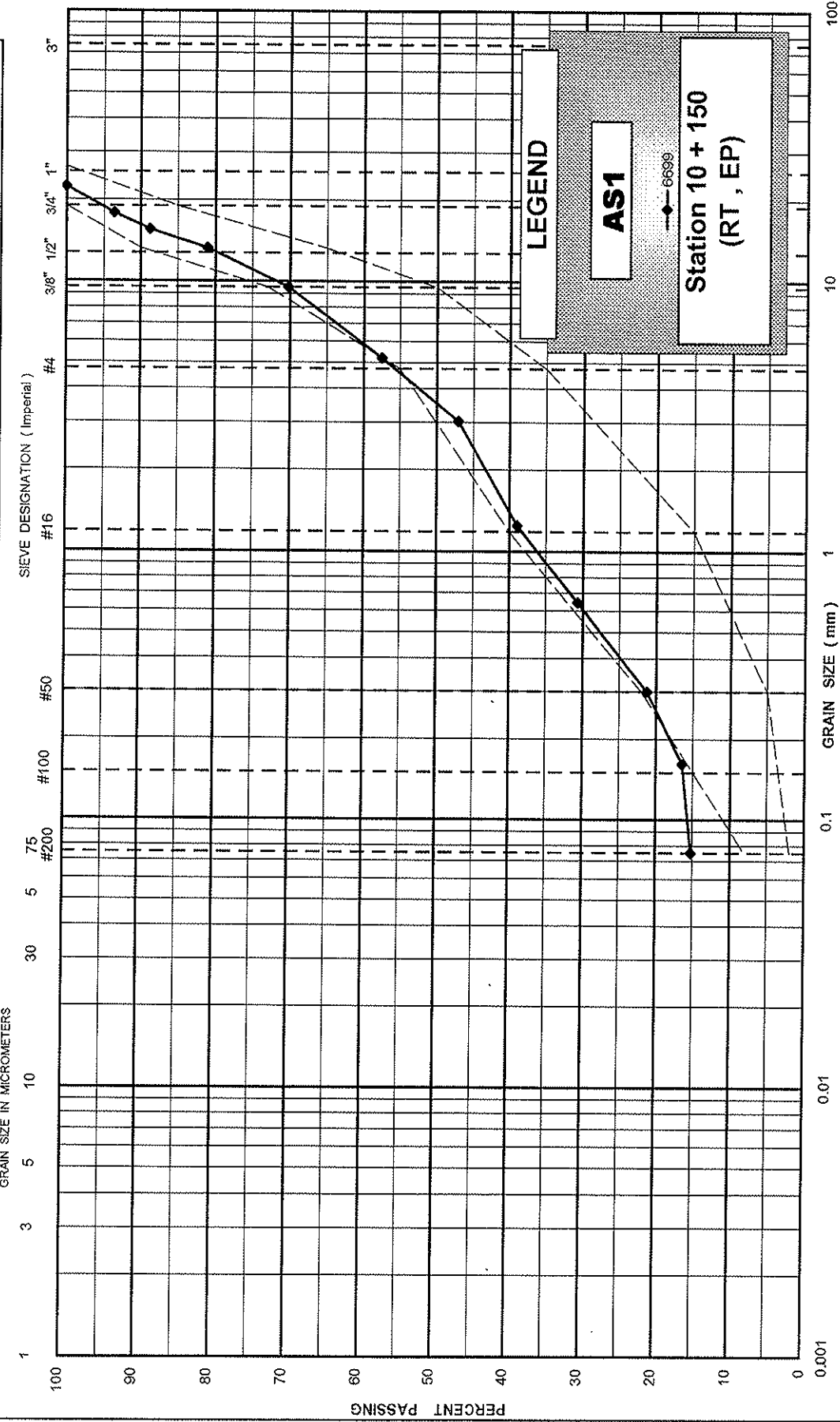


# Appendix 5

## Laboratory Test Results

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	



SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION  
Sand and Gravel some Silt

SAMPLE No.: 08

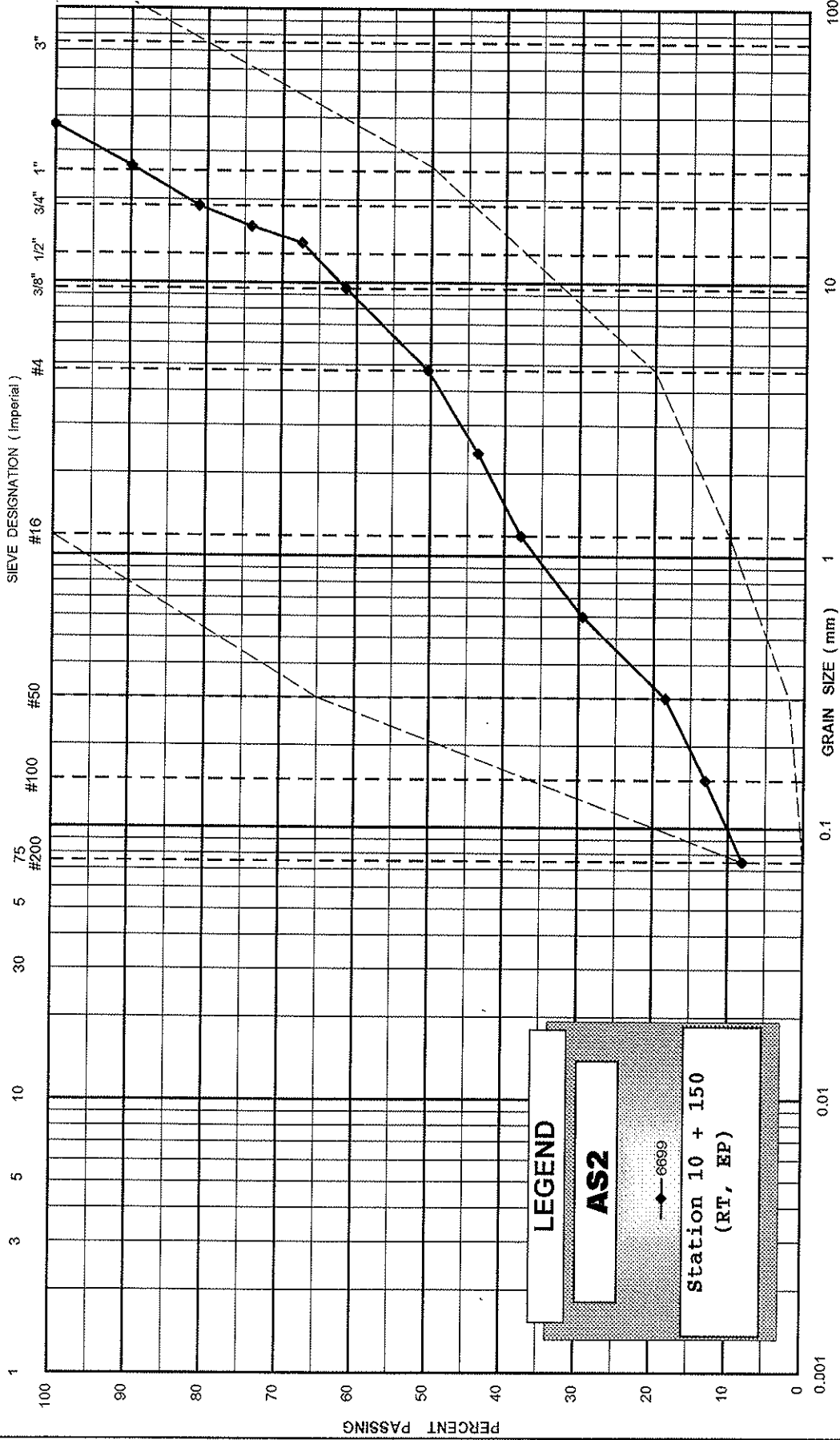
PROJECT No: SPT- 1174

Date: Dec 18, 2007

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS



SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION  
Sand and Gravel Trace Silt

SAMPLE No.: 09

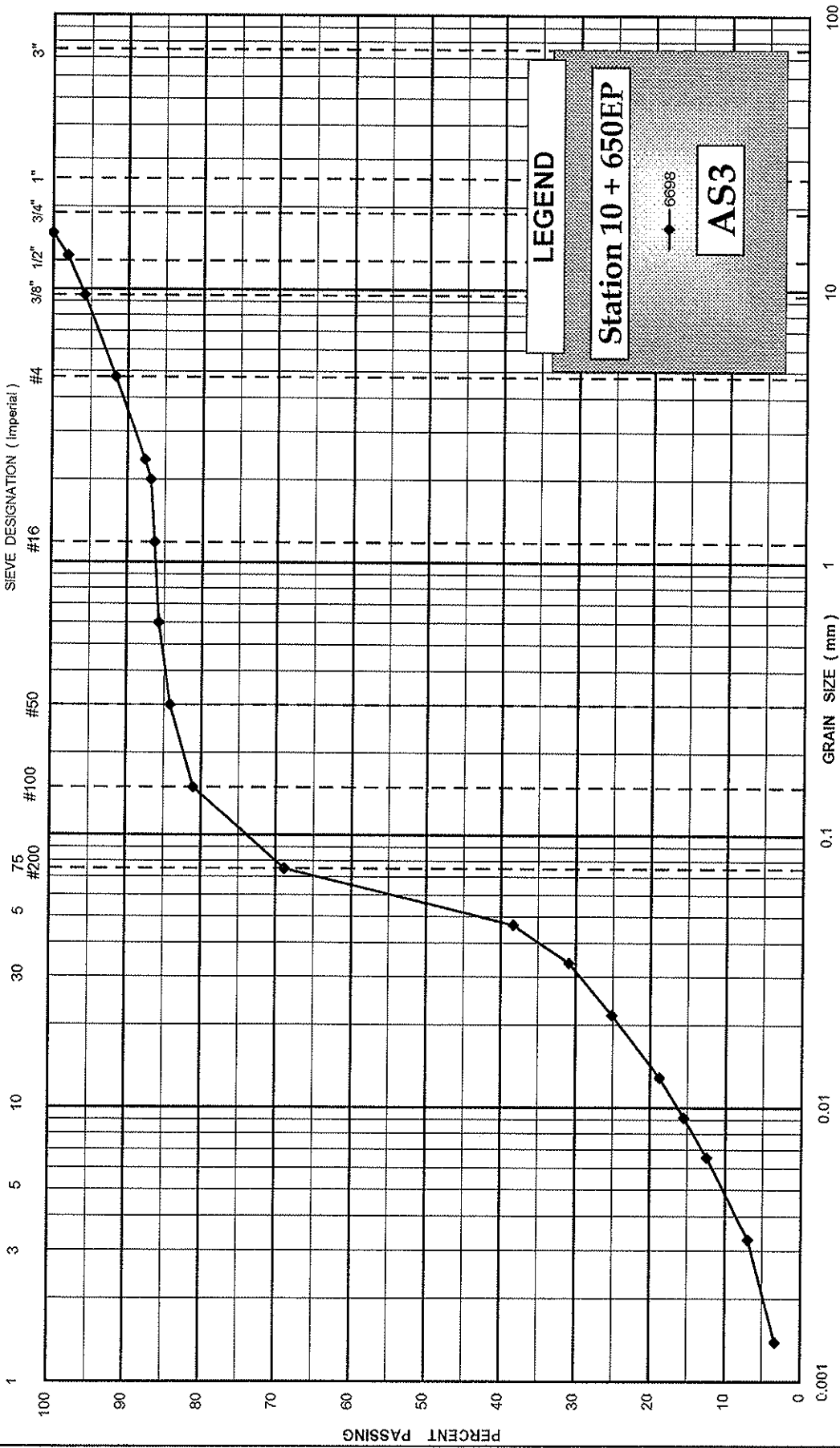
PROJECT No: SPT-1174

Date: October 05, 2006

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS



SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION

Sandy Silt, trace gravel

SAMPLE No.: 4

PROJECT No: SPT - 1174

Date: November 05, 2006

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT

GRAIN SIZE IN MICROMETERS

1

3

5

10

30

50

75

#200

#100

#50

#16

#4

3/8"

1/2"

3/4"

1"

3"

PERCENT PASSING

0

10

20

30

40

50

60

70

80

90

100

0.001

0.01

0.1

1

10

100

GRAIN SIZE (mm)

LEGEND

Sta. 21+800 RS2-AS1

Granular A

SHAHEEN & PEAKER LIMITED

FIGURE No.

REF. No. SPT 1174

DATE January, 2007

Grain Size Distribution

Sand and Gravel Trace Silt



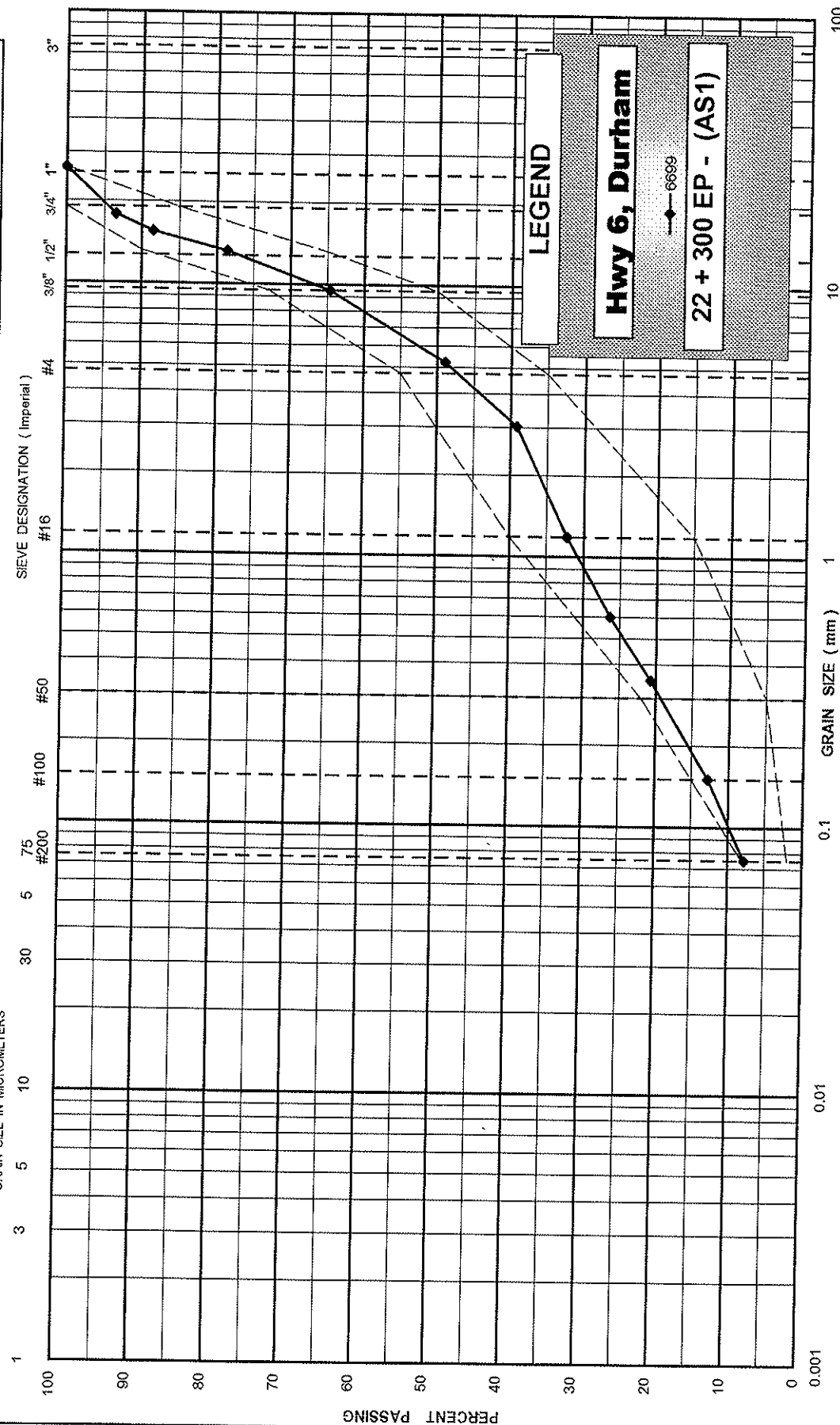
GRAVEL

٢٣



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	Coarse



## GRAIN SIZE DISTRIBUTION

Sand and Gravel trace Silt

SHAHEEN & PEAKER LIMITED

SAMPLE No.: 12

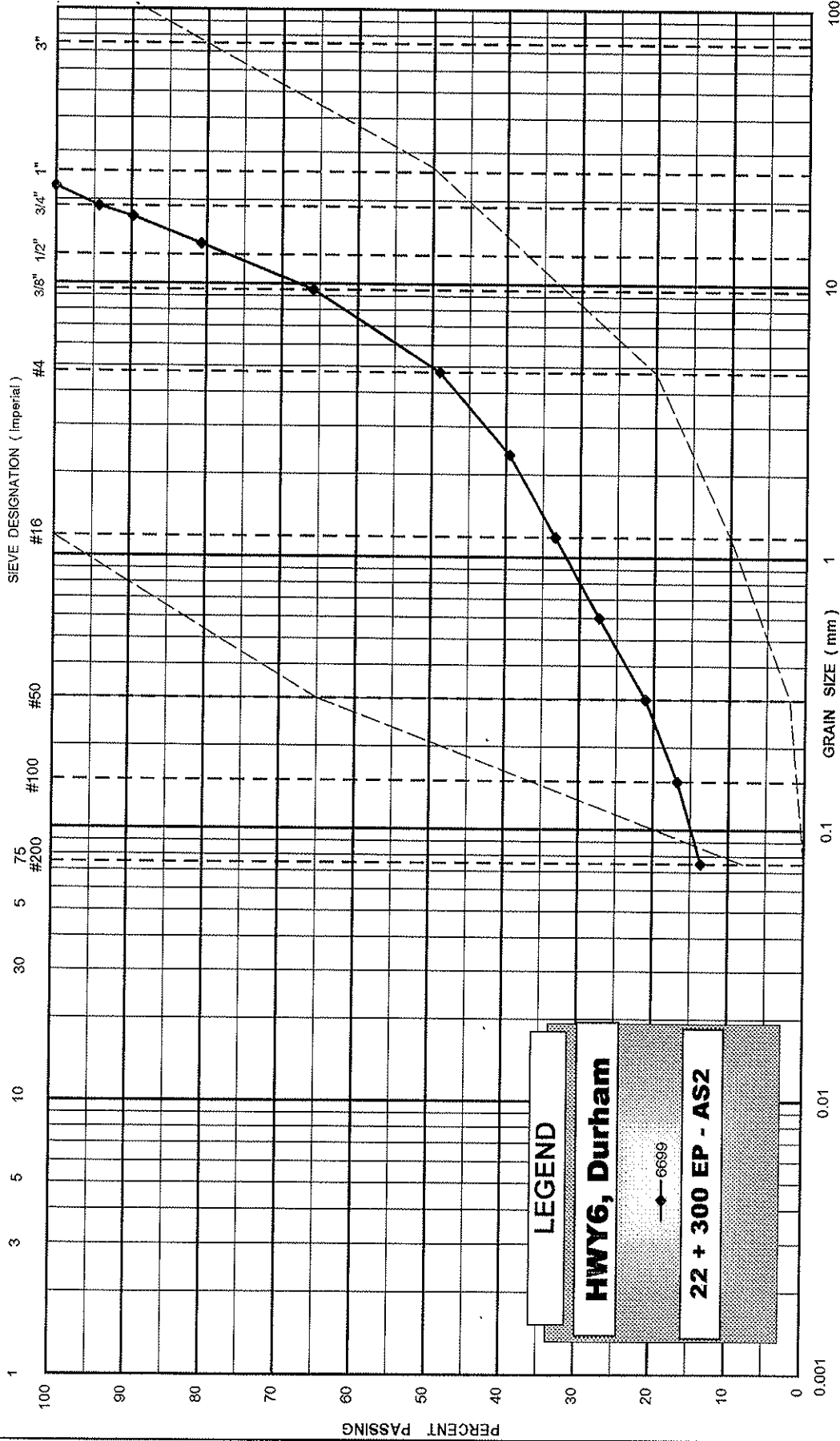
PROJECT No: SPT - 1174

Date: October 10, 2006

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS



## LEGEND

HWY6, Durham

22 + 300 EP - AS2

SHAHEEN & PEAKER LIMITED

## GRAIN SIZE DISTRIBUTION

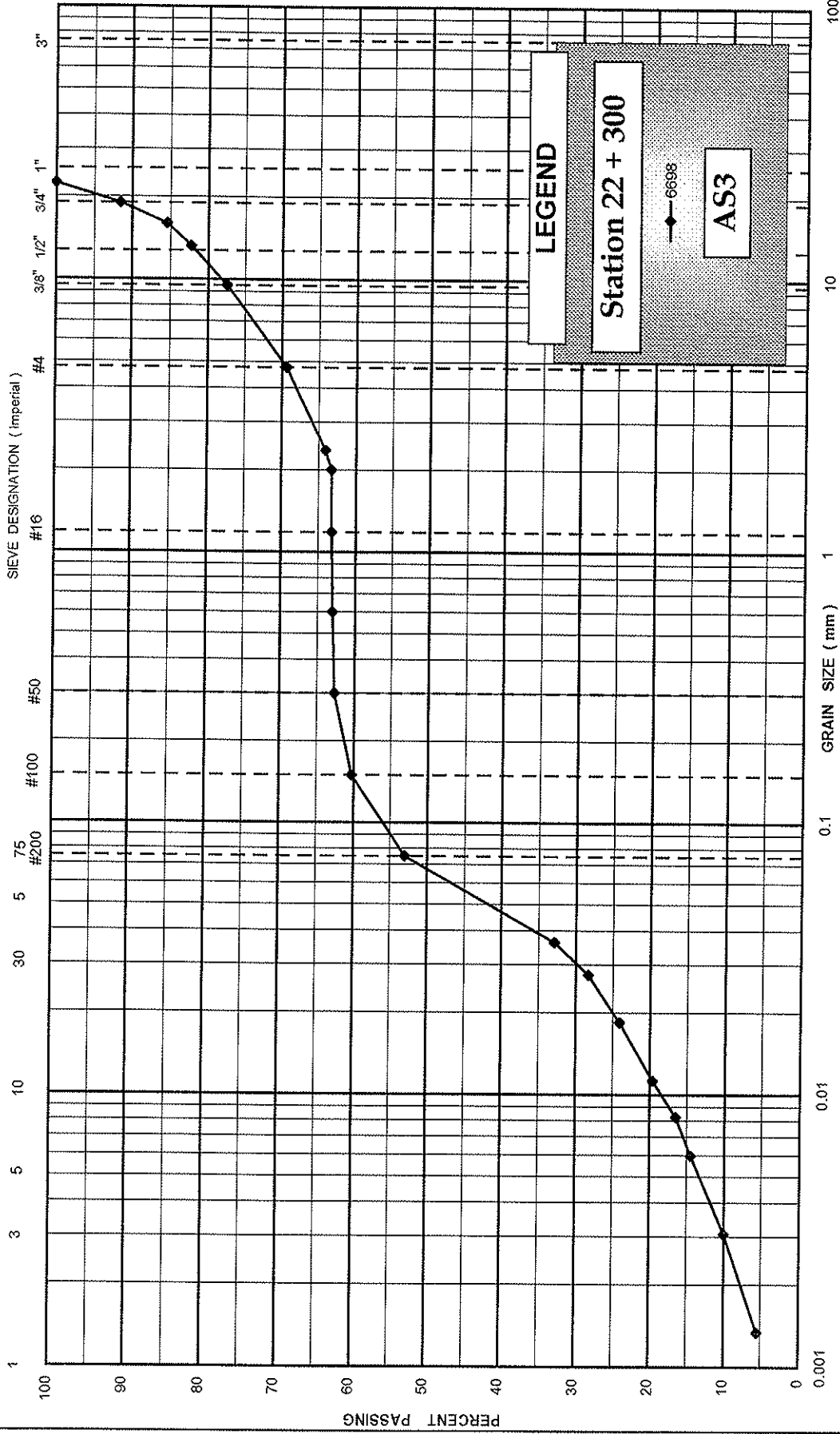
Sandy Gravel some Silt

SAMPLE No.: 13  
PROJECT No: SPT - 1174  
Date: Dec 18, 2007

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS

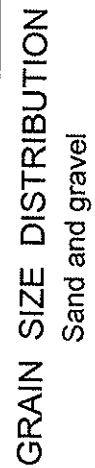


SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION  
Sandy Silt, Some Gravel

SAMPLE No.: 3  
PROJECT No: SPT - 1174  
Date: November 05, 2006

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse
	GRAIN SIZE IN MICROMETERS				



SHAHEEN & PEAKER LIMITED

SAMPLE No.: 01

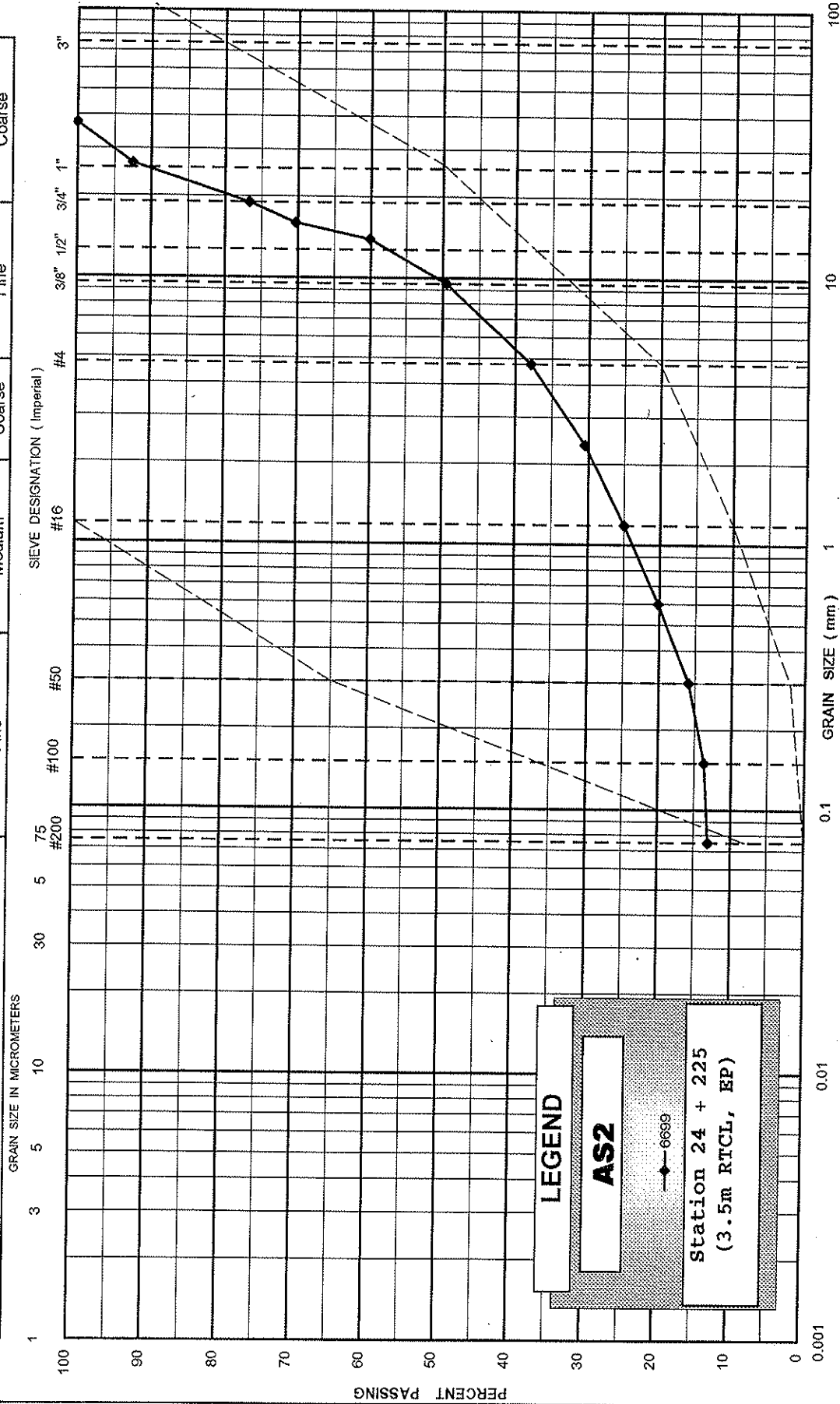
PROJECT No: SPT - 1174

Date: January 09, 2007



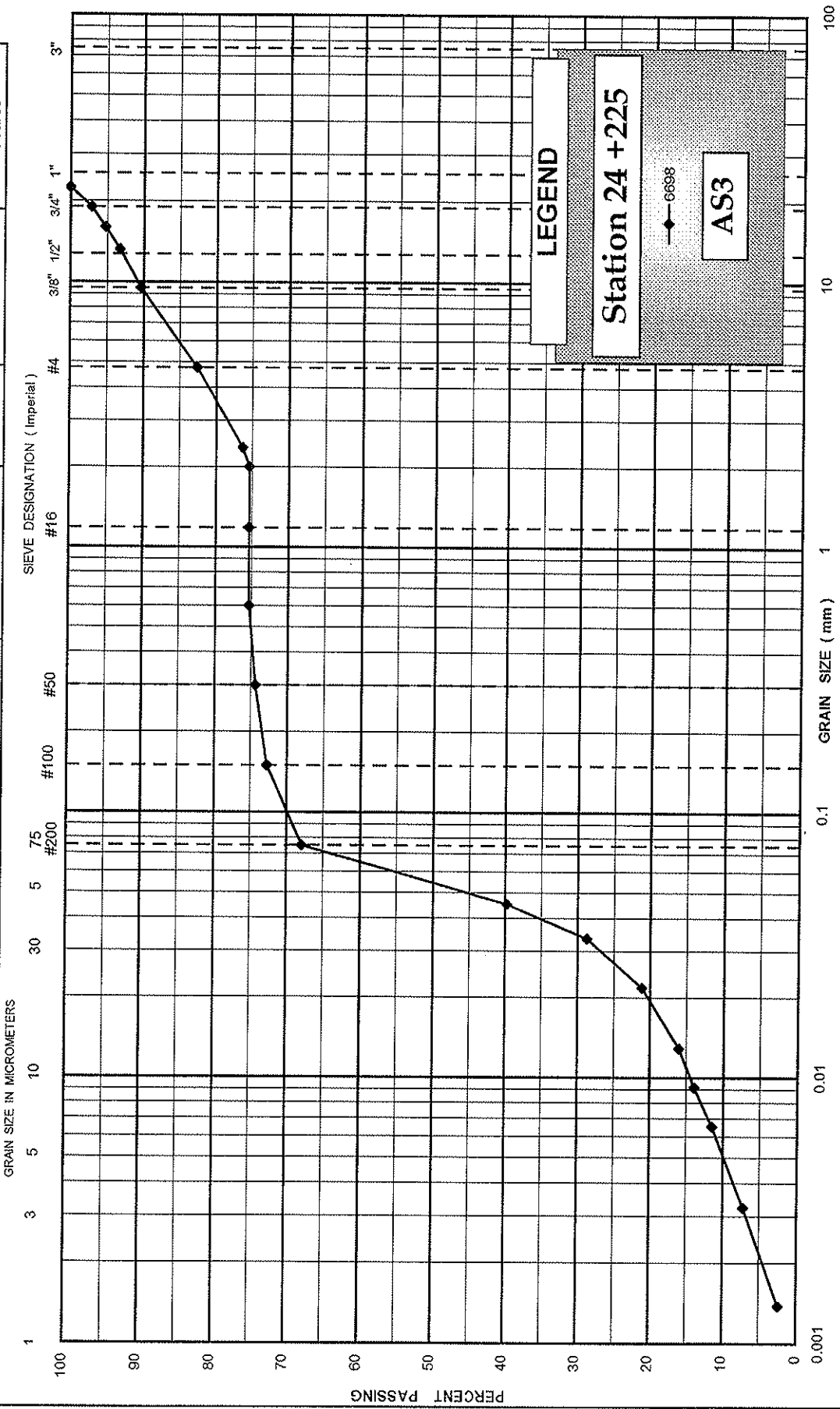
# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



**LEGEND**

Station 24 +225

AS3

SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION

Silt, some sand and gravel

SAMPLE No.: 1  
 PROJECT No: SPT - 1174  
 Date: November 05, 2006

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT

GRAIN SIZE IN MICROMETERS

1 3 5 10 30 50 75 #200

Fine

SAND

Medium

Coarse

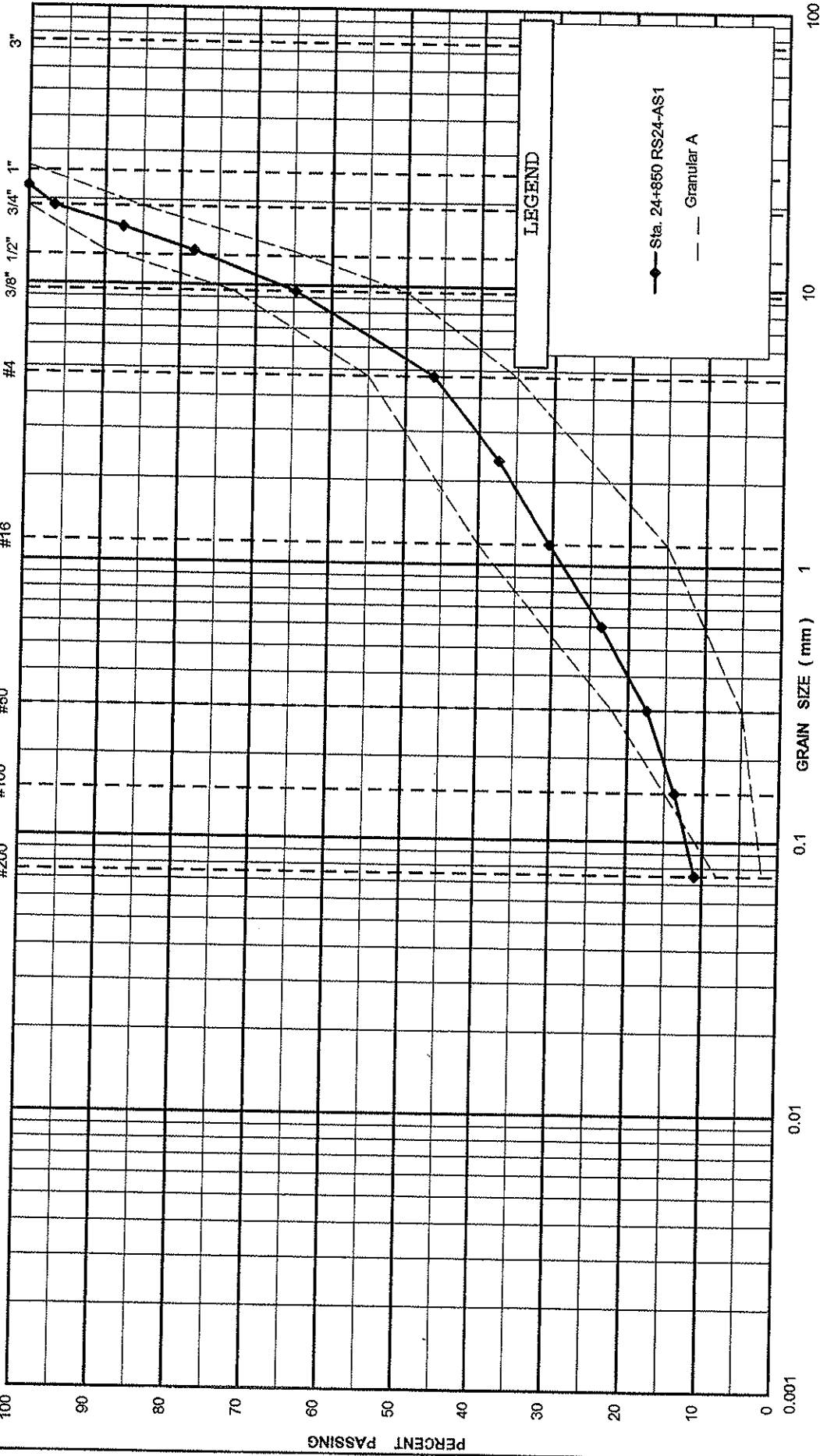
Fine

GRAVEL

Coarse

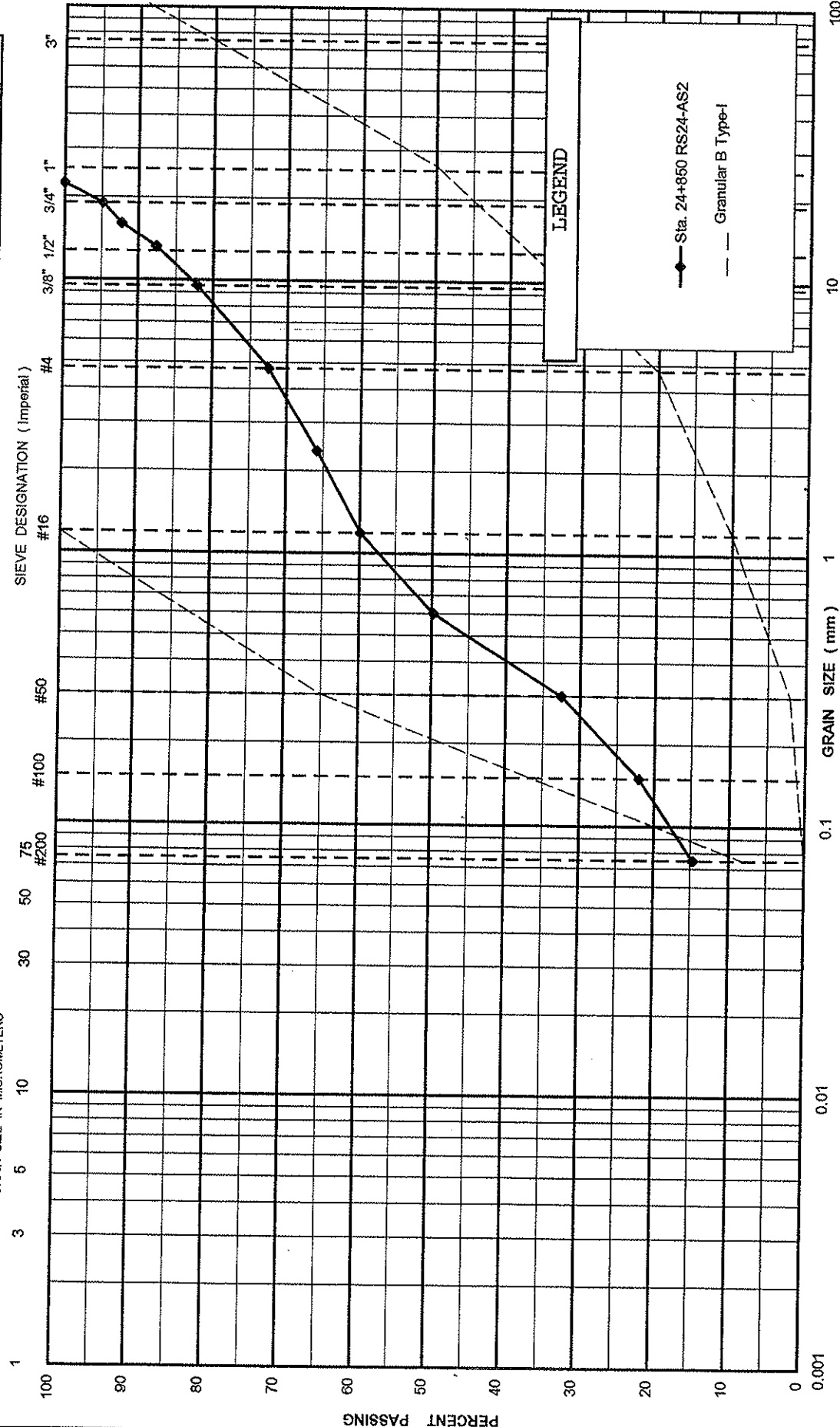
SIEVE DESIGNATION (Imperial)

100 90 80 70 60 50 40 30 20 10 0



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT				SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS				Fine	Medium	Coarse	Fine	Coarse	Coarse



## GRAIN SIZE DISTRIBUTION

Sand with Gravel Some Silt

SHAHEEN & PEAKER LIMITED

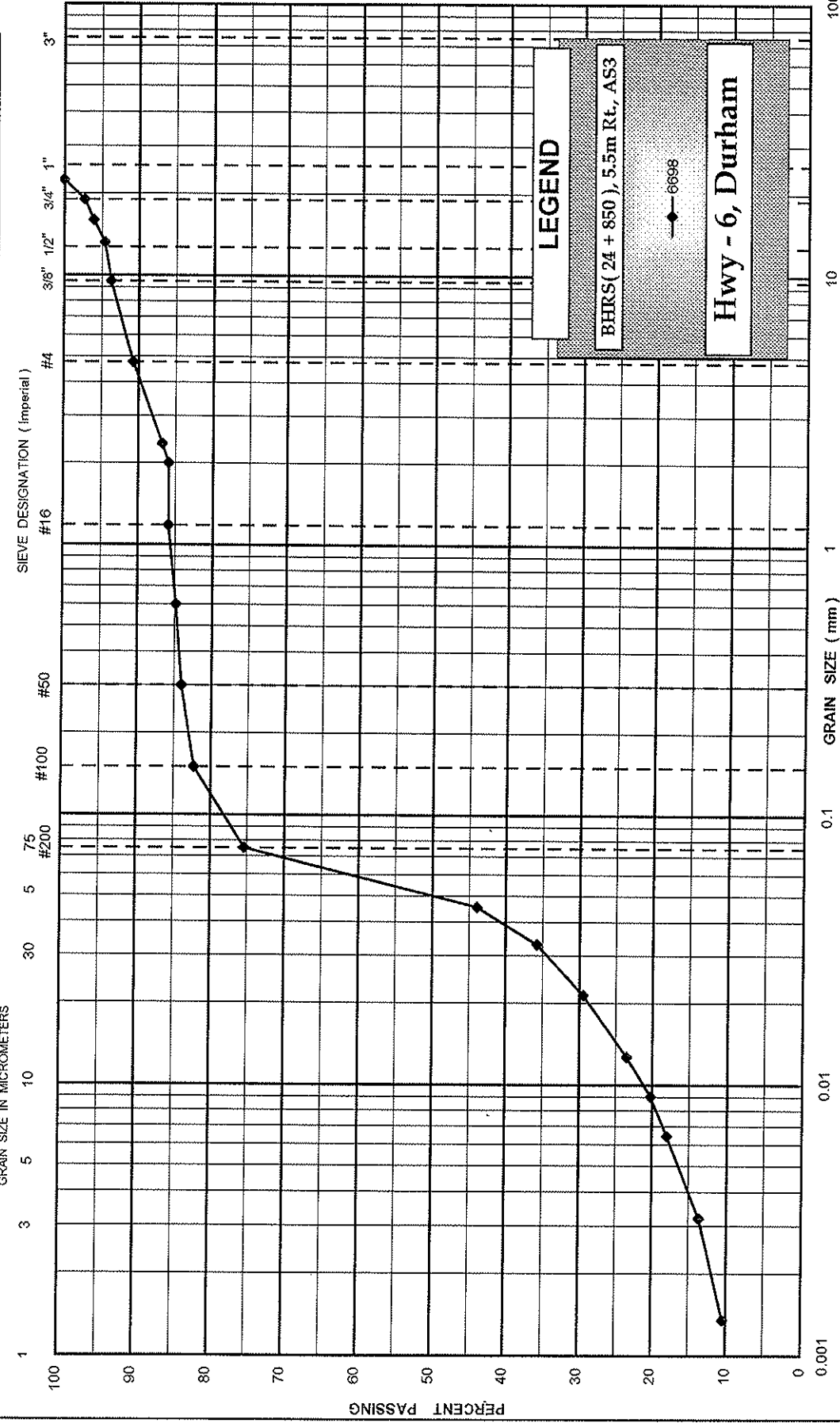
FIGURE No.

REF. No. SPT 1174

DATE January, 2007

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	Coarse



## GRAIN SIZE DISTRIBUTION

Silt, some sand and clay trace gravel

SHAHEEN & PEAKER LIMITED

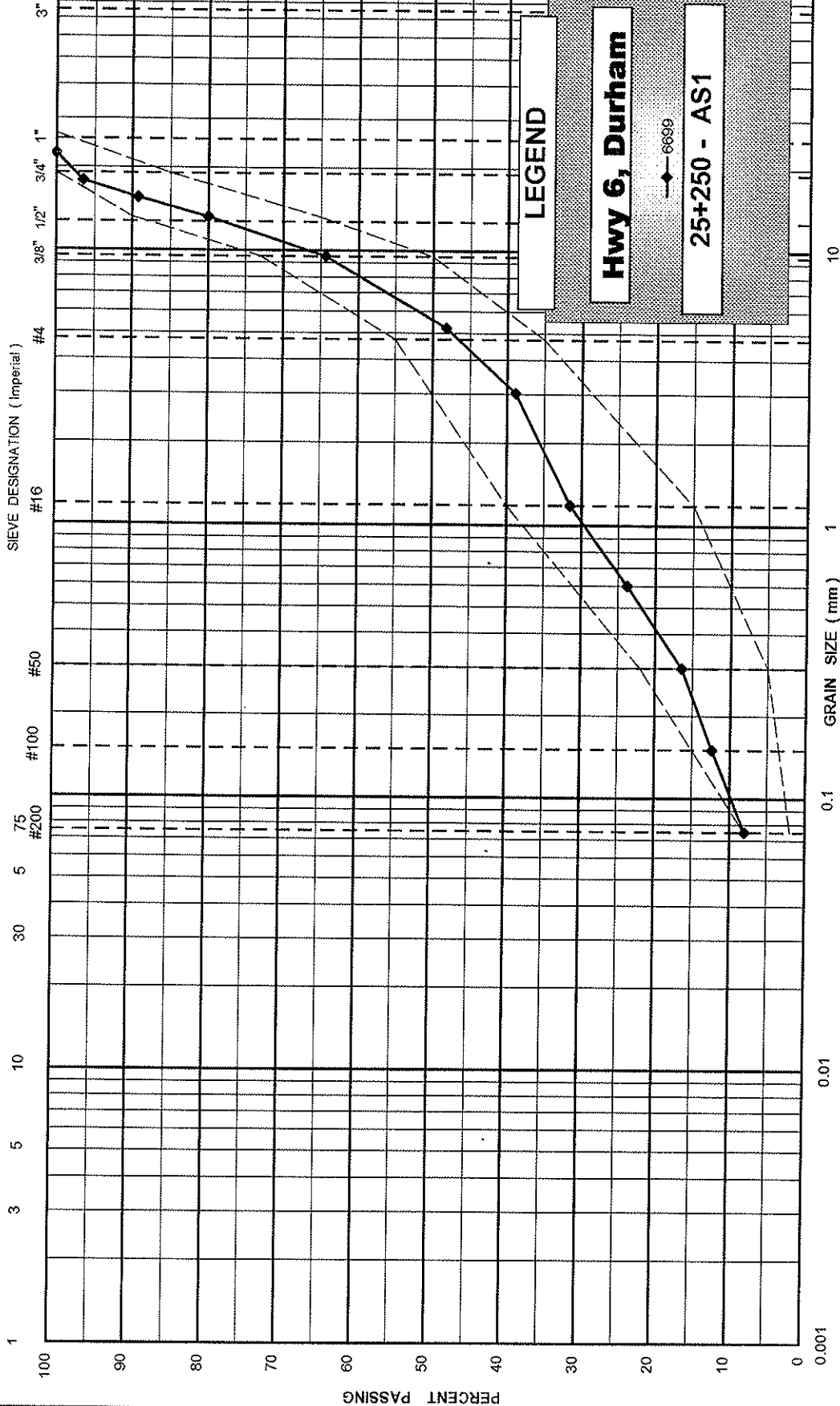
SAMPLE No.: 2  
PROJECT No: SPT - 1174  
Date: November 05, 2006



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS



## GRAIN SIZE DISTRIBUTION

Sand and Gravel trace Silt

SHAHEEN & PEAKER LIMITED

SAMPLE No.: 10

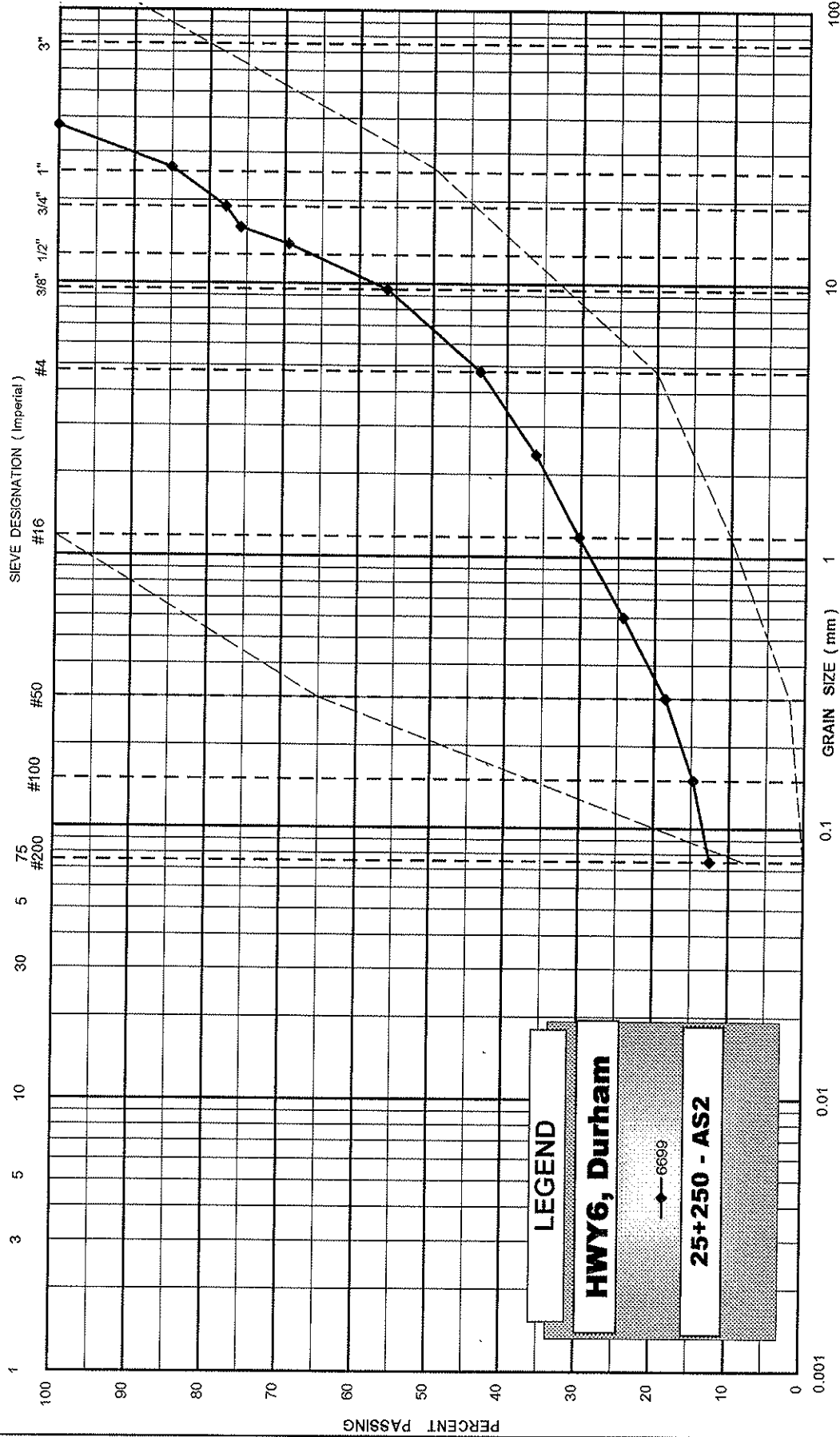
PROJECT No: SPT - 1174

Date: Dec 18, 2007

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS



LEGEND

HWY6, Durham

6699

25+250 - AS2

SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION

Sandy Gravel some Silt

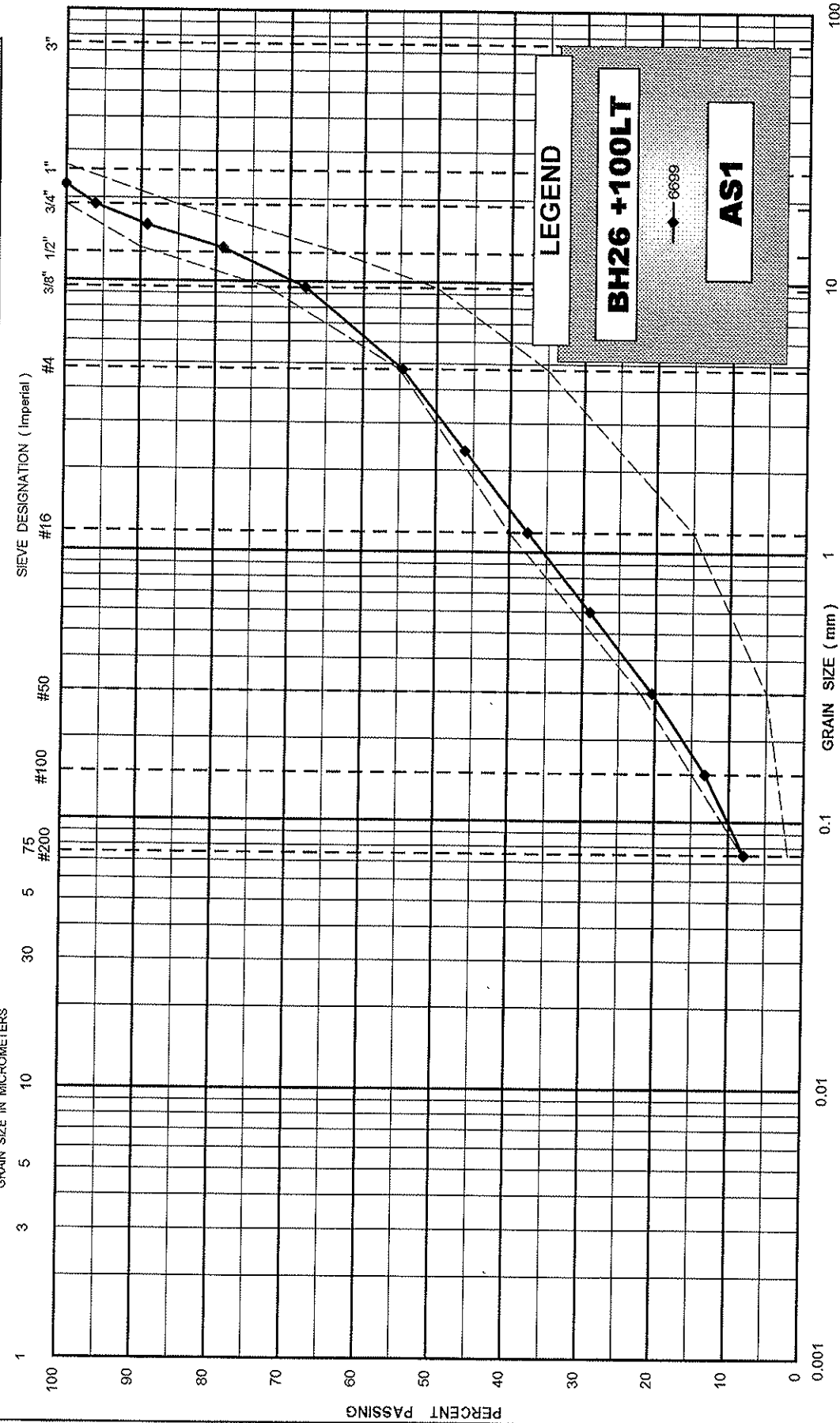
SAMPLE No.: 11

PROJECT No: SPT-1174

Date: Dec 18, 2007

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	



SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION  
Sand and Gravel Trace Silt

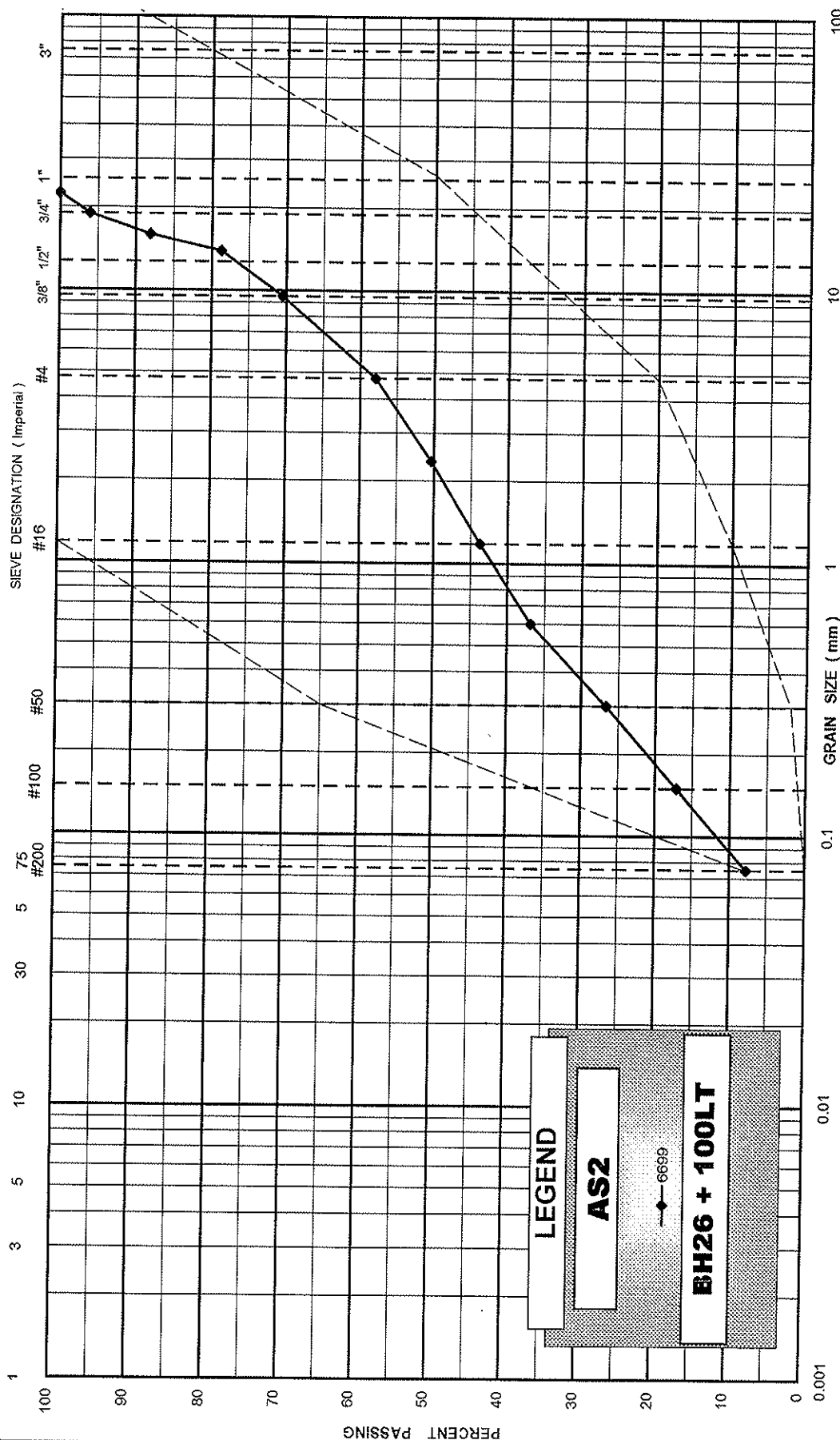
SAMPLE No.: 15

PROJECT No: SPT - 1174

Date: October 16, 2006

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	Coarse



SHAHEEN & PEAKER LIMITED

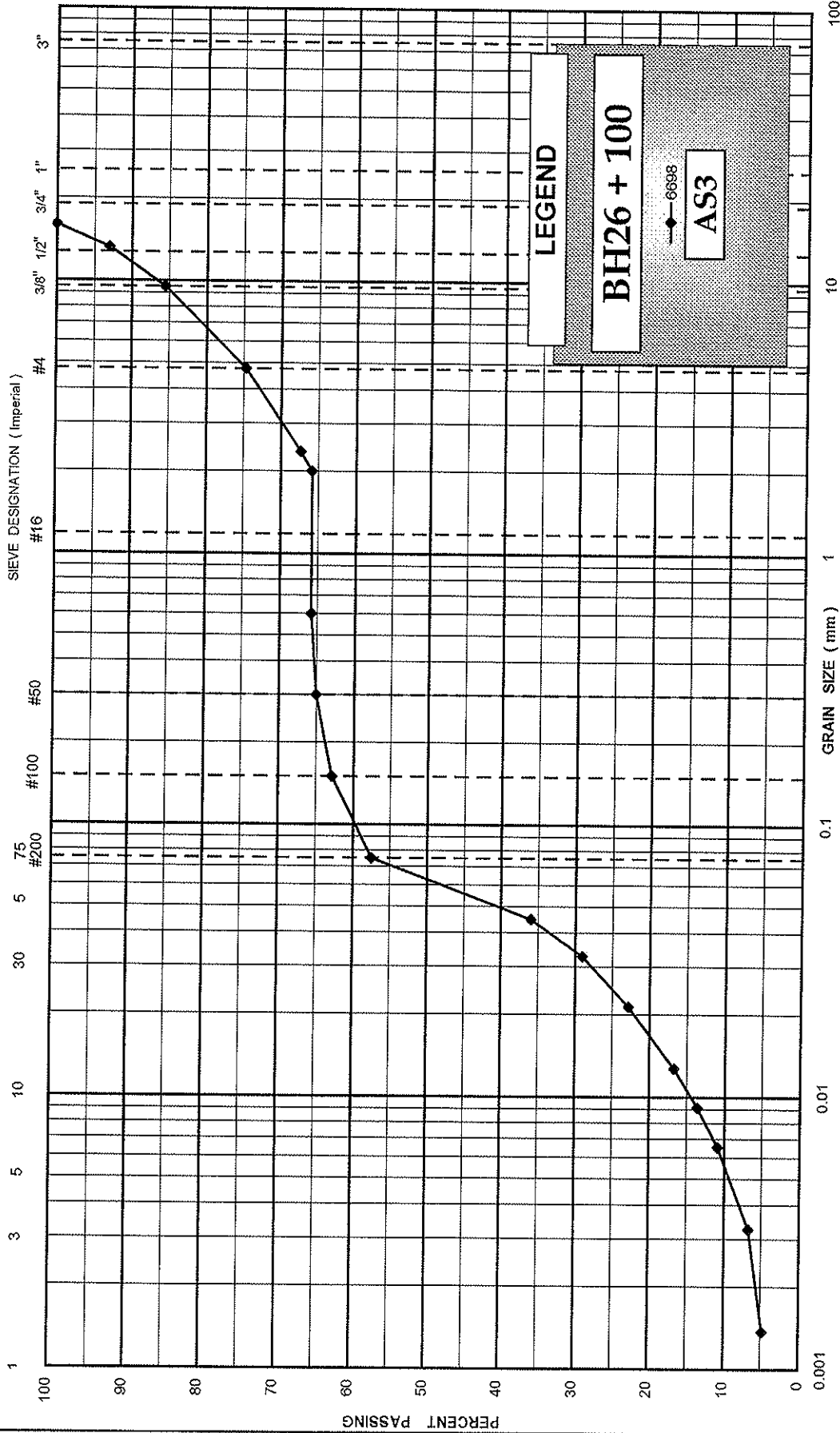
GRAIN SIZE DISTRIBUTION  
Sand and Gravel trace Silt

SAMPLE No.: 16  
PROJECT No: SPT - 1174  
Date: Dec 18, 2007

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS



SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION

Sandy Silt, Some Gravel

SAMPLE No.: 1

PROJECT No: SPT - 1174

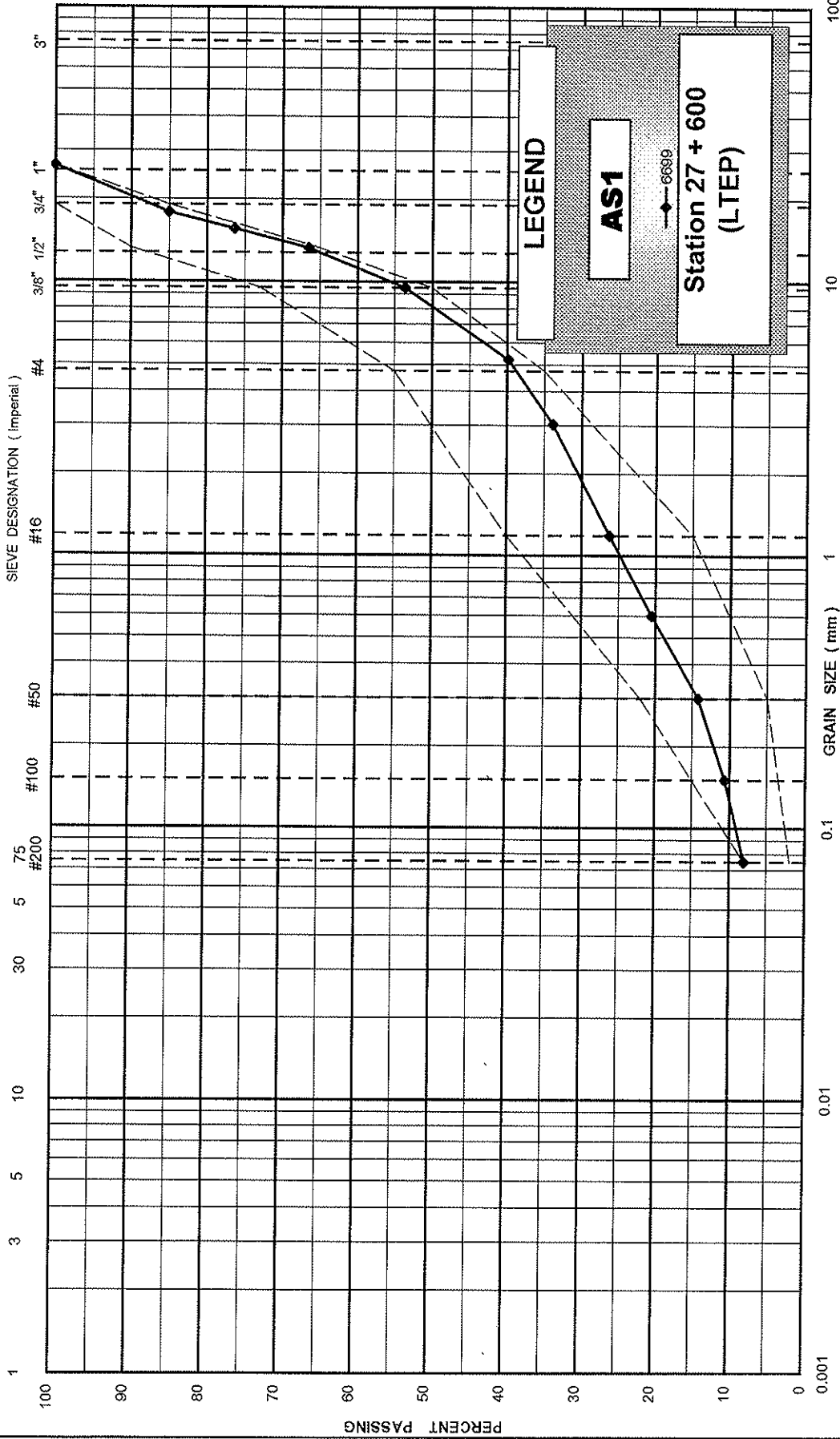
Date: November 05, 2006



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS



SHAHEEN & PEAKER LIMITED

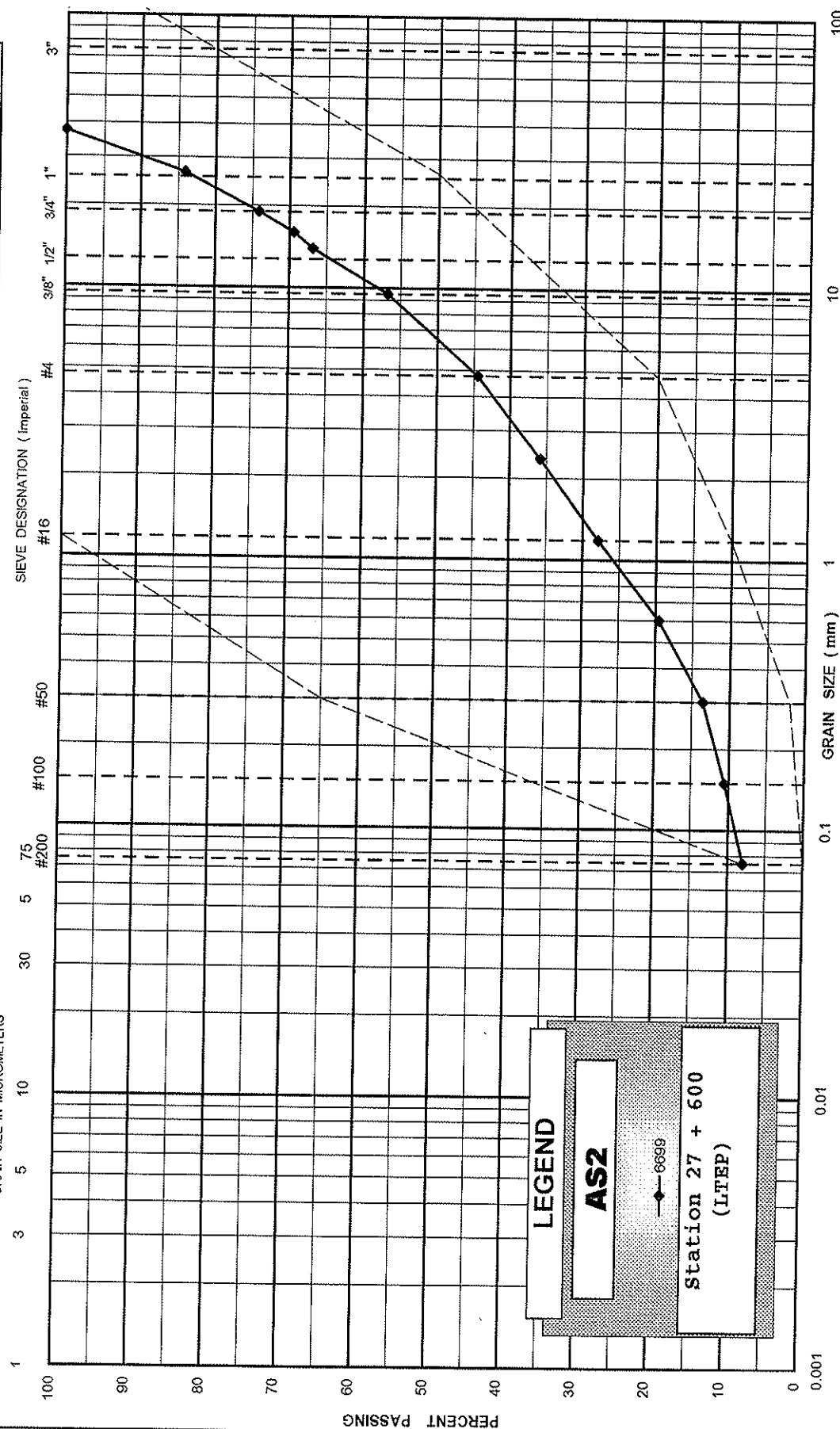
GRAIN SIZE DISTRIBUTION  
Sandy Gravel Trace Silt

SAMPLE No.: 03

PROJECT No: SPT-1174

Date: October 05, 2006

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse
	GRAIN SIZE IN MICROMETERS				



SHAHEEN & PEAKER LIMITED

## GRAIN SIZE DISTRIBUTION

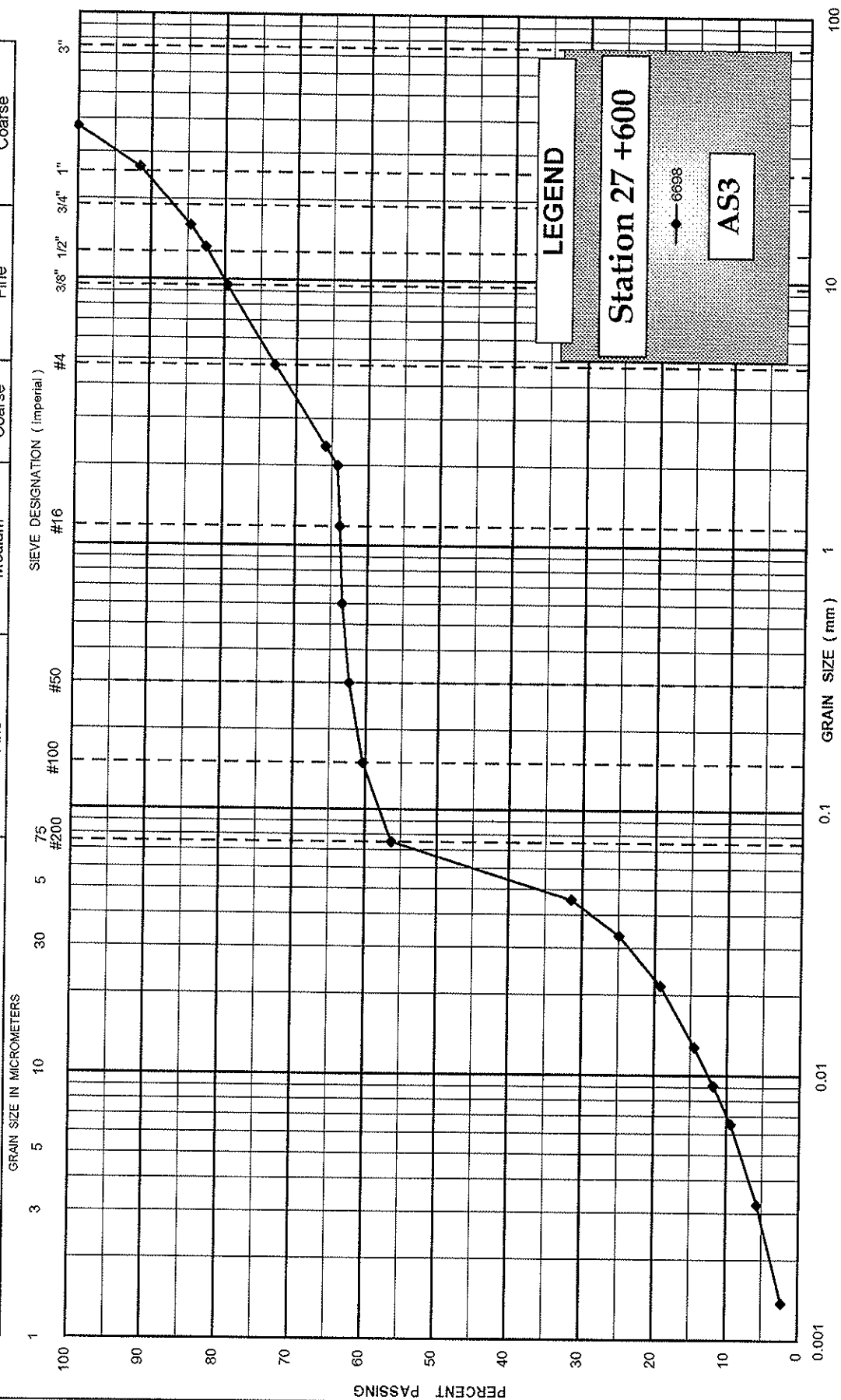
Sandy Gravel Trace Silt

SAMPLE No.: 04

PROJECT No: SPT - 1174

Date: January 09, 2007

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



SHAHEEN & PEAKER LIMITED

## GRAIN SIZE DISTRIBUTION

Sandy Silt, Some Gravel

SAMPLE No.: 2

PROJECT No: SPT - 1174

Date: November 05, 2006

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	GRAVEL	
				Fine	Coarse



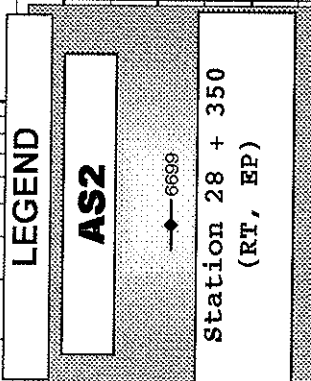
SHAHEEN & PEAKER LIMITED

SAMPLE No.: 05

PROJECT No: SPT-1174

Date: Dec 18. 2007

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse		
				Fine	Coarse



SHAHEEN & PEAKER LIMITED

### GRAIN SIZE DISTRIBUTION

SAMPLE No.: 06

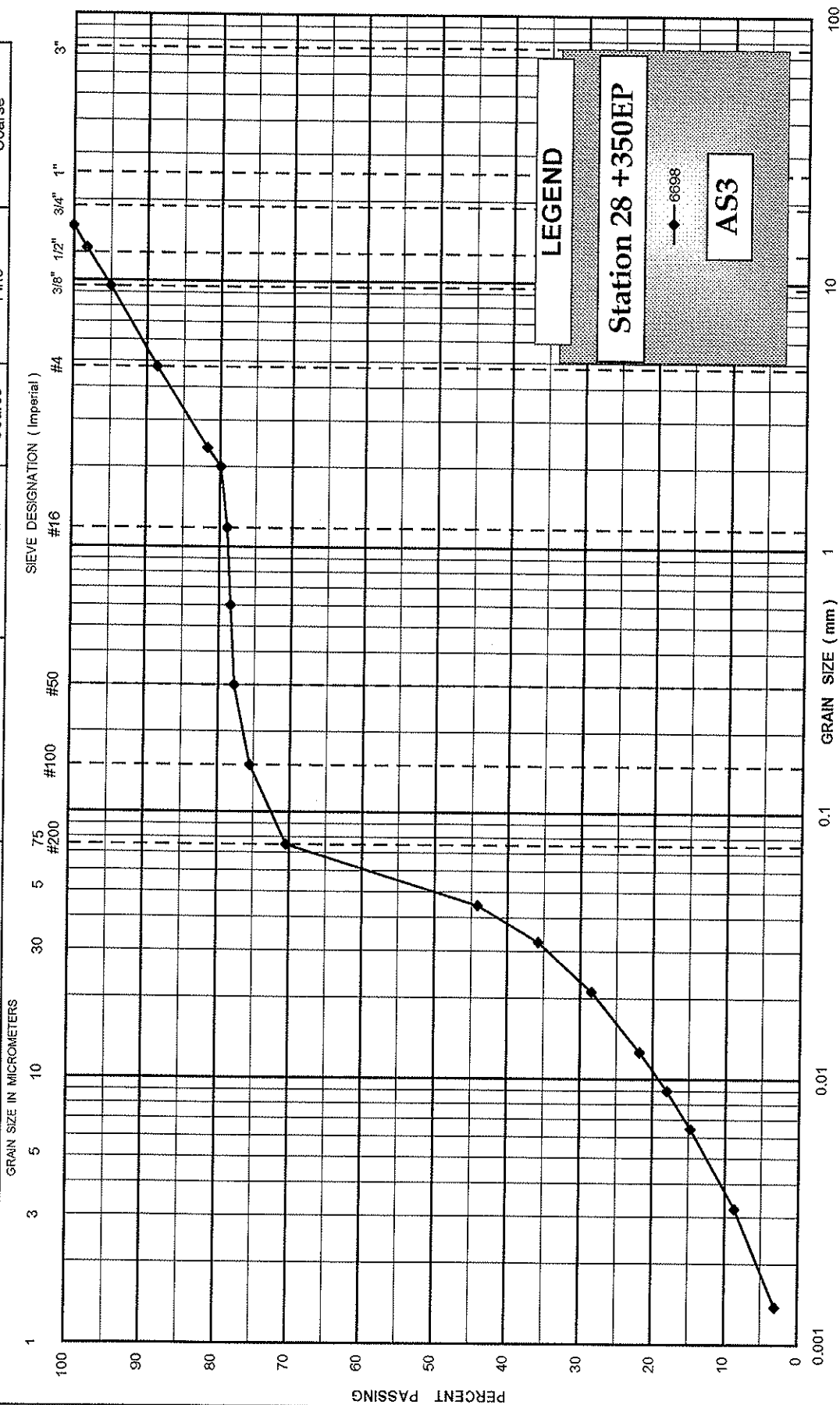
PROJECT No: SPT - 1174

Date: Dec 18, 2007



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	



## GRAIN SIZE DISTRIBUTION

Sandy Silt, some gravel

SHAHEEN & PEAKER LIMITED

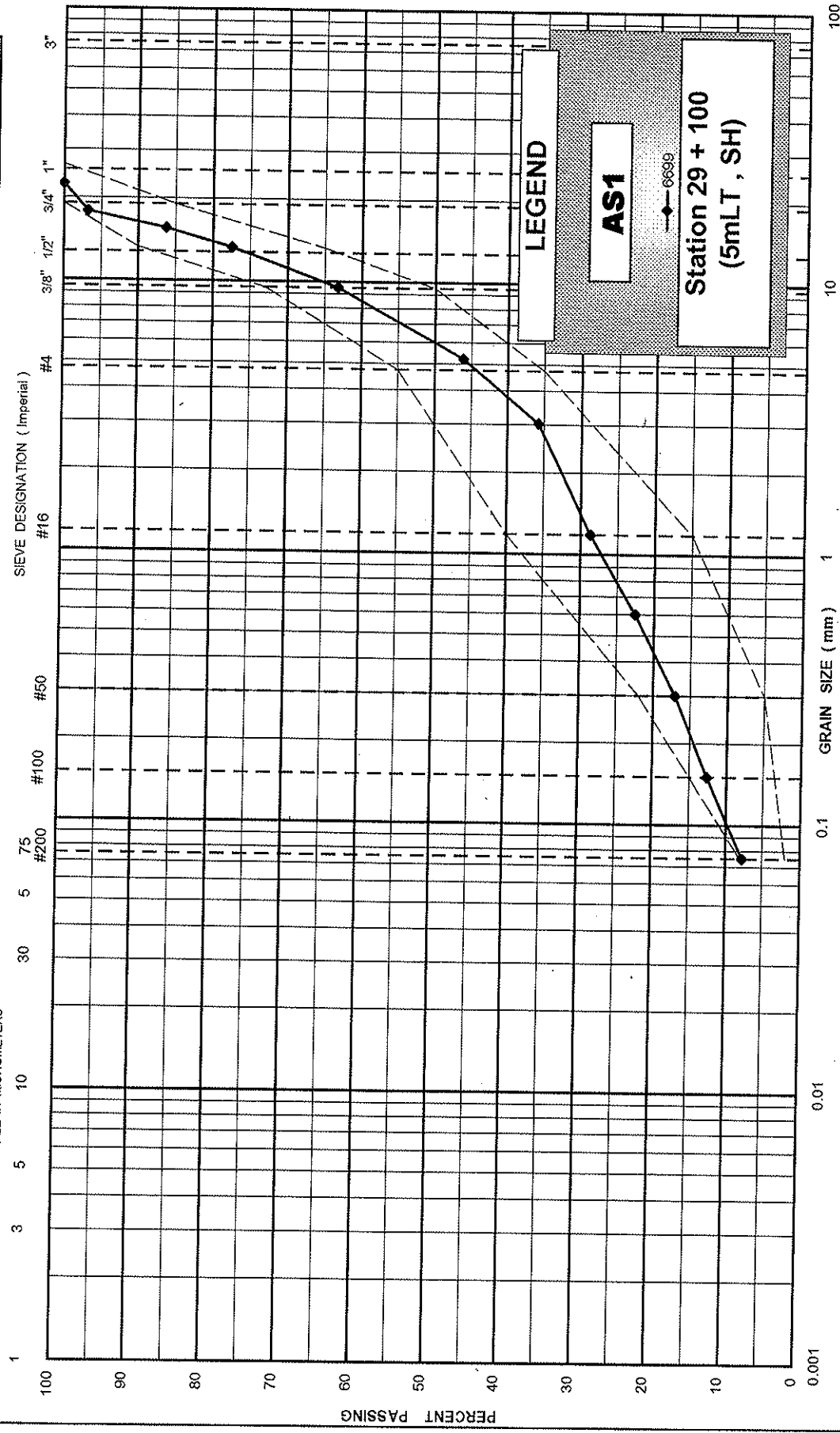
SAMPLE No.: 3

PROJECT No: SPT - 1174

Date: November 05, 2006

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	



## GRAIN SIZE DISTRIBUTION

Sandy Gravel Trace Silt

SHAHEEN & PEAKER LIMITED

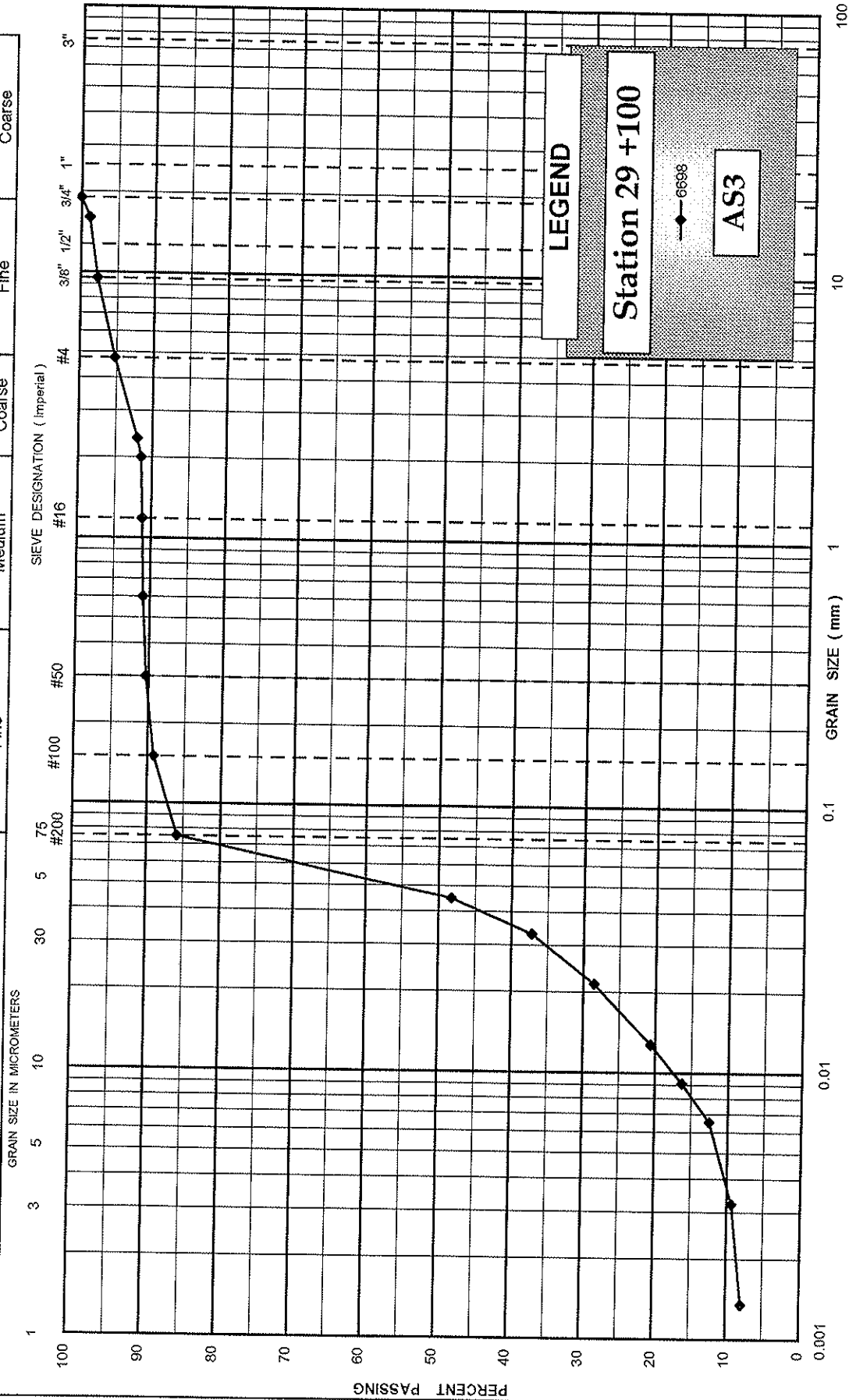
SAMPLE No.: 07

PROJECT No: SPT - f174

Date: October 05, 2006

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	



SHAHEEN & PEAKER LIMITED

GRAIN SIZE DISTRIBUTION

Silt, Trace Sand and Clay

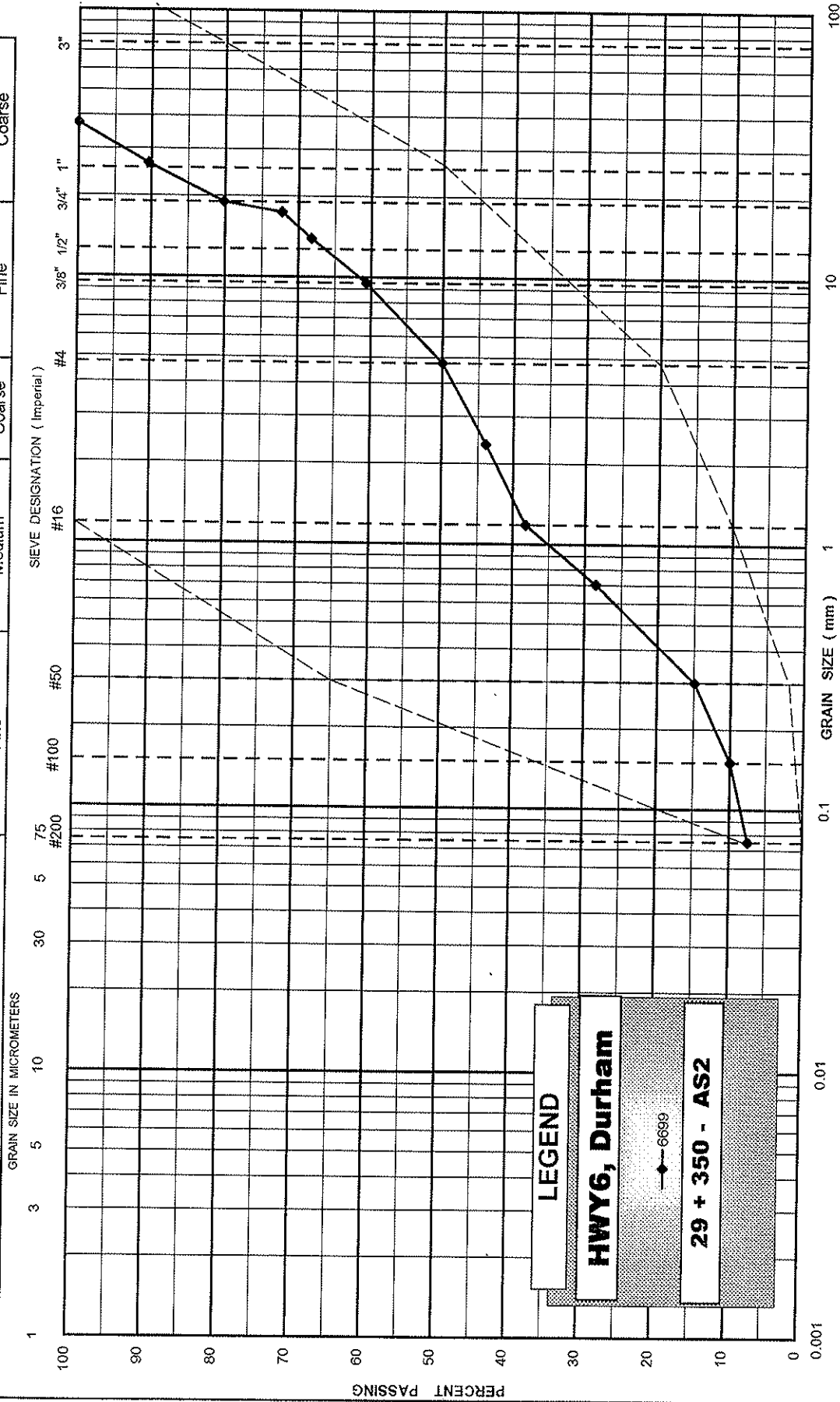
SAMPLE No.: 4

PROJECT No: SPT - 1174

Date: November 05, 2006

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT			SAND			GRAVEL		
			Fine	Medium	Coarse	Fine	Coarse	



SHAHEEN & PEAKER LIMITED

**GRAIN SIZE DISTRIBUTION**  
Sand and Gravel trace Silt

SAMPLE No.: 14  
PROJECT No: SPT-1174  
Date: October 10, 2006

# Appendix 6

## Pavement Selection and Life Cycle Cost Analysis (LCCA)



**PAVEMENT DESIGN SELECTION MEETING  
ON DECEMBER 20, 2006**

**HIGHWAY 6  
FROM 1.1 KM SOUTH OF GREY COUNTY ROAD 9  
(NORTH JUNCTION) NORTHERLY 10.5 KM  
TO DURHAM SOUTH LIMIT  
G.W.P. 338-97-00**

**Ministry of Transportation, Ontario  
Southwestern Region Geotechnical Section**

## Highway 6 - PAVEMENT DESIGN SELECTION

Table I: Existing Conditions

Township	Existing Pavement Structure	Materials	Thickness (mm)		Comments
			Range	Average	
<p>The project is located within the Municipality of West Grey, the Townships of Southgate and Normanby in the County of Grey, Ontario. The south limit of the project is Station 21+100 (1.1 km south of Grey County Road 9, while the north limit of the project is Station 11+887, south limit of Town of Durham.</p>	Asphalt	HL4	90 - 235	150	<p>70% meet Gran A specs 60% meet Gran B Type I specs Existing Average GBE = 638 mm</p>
	Base (Granular A)	Sand and gravel	120 - 740	200	
	Subbase (Granular B)	Sand some to trace gravel	150 - 1150	600	
	Total granular material		270 - 1400	800	
	Existing Granular Base Equivalency (GBE)				
	Subgrade (predominant soils type)	Sandy silt to fine sand			
	Maintenance History	<p>Highway 6, within the project limits, was originally constructed under Contract 61-010 and 62-46 and reconstructed under Contract 84-08 (Resurfacing) and 99-123 (Mill and Pave with new SB lane). A 1990 Preservation Management contract routed and sealed all transverse, mid lane, pavement edge, and centerline cracks. Cold mix patching was also done at partially paved shoulder (PPS) break-up areas and to the inside of curves to hold pavement edge alligatored sections. In addition, a 600 m strip along the west edge of pavement was repaired in 2000. Lastly, a 2004 Minor Capital Contract 2004-3250 routed and sealed the passing lanes that were constructed under Contract 99-123, 2.5km south of Durham to south limit of Durham.</p> <p>Very severe, throughout transverse cracking with cupping, severe cracking in the partially paved shoulder with break-up and edge breaking, moderate, throughout distortion due mostly to cupped transverse cracking, moderate, frequent centreline cracking with slight and few alligators, moderate, intermittent longitudinal meander and mid lane cracks.</p> <p>The 2005 Pavement Condition Rating is 49 with a Ride Condition Rating (RCR) of 5.0.</p>			
	Predominant Pavement Distress				

**Table II: Pavement Design Alternatives**

Designs	Alternatives	Reasons for no further Review
Composite	Not warranted	Composite pavement is specified for highways with heavier traffic, not economical, user delays
Full Depth asphalt	Not warranted	Enough granular available, not economical, waste of energy, waste of existing material
Deep Strength asphalt	Not warranted	Granular Base and subbase currently existing in the pavement, not economical
Concrete	Not warranted	Concrete pavement is specified for highways with heavier traffic, not economical, user delays
White Topping	Not warranted	Not feasible due to extensive distresses, not economical
Full reconstruction of pavement	Not warranted	Enough granular available, not economical, waste of energy, waste of material
Conventional Resurfacing (simple Overlay)	Not warranted	Pavement in poor condition, cracks will immediately propagate, extensive future maintenance effort, future user delays
Mill/Pave	Consider	Good constructability, traffic staging, good construction experience, economical, no waste of energy (though will not treat deep cracks of the pavement, extensive future maintenance, future user delays)
In-place and Process (Pulverize/Pave)	Consider	Addresses pavement distress, provides required GBE, extends pavement life, minimal maintenance effort
Pad/Pave	Not warranted	Cracks will immediately propagate, extensive future maintenance effort, future user delays
Excavate asphalt /Pave	Consider	Addresses pavement distress, provides required GBE, extends pavement life, minimal maintenance effort
Hot In-place Recycling (HIR)	Not warranted	Will not treat deep pavement distress, extensive future maintenance effort.
Cold In-place Recycling	Consider	Addresses pavement distress, provides required GBE, re-use of material, energy saving, low LCC.

Table III: Design Parameters

Feature	Parameter
Estimated Structural Number (SN) of Existing Pavement	82.5 (GBE = 638 mm)
Required Structural Number (SN)	138
Estimated Cumulative ESALs for 18 Years	4,381,000
AADT	Base Year 2006 = 6233 Year 2021 = 7909 Year 2026 = 8563
% Heavy Trucks	10.8

Table IV: Alternative Design Options for Main lane Highway 6, Durham

ALTERNATIVE DESIGNS	Pavement Structure			Initial Life Years	Initial Construction Cost (\$/2 Lane.km)	Life Cycle Cost (\$/2 Lane.km)	Advantages	Disadvantages
	Materials	Thickness (mm)	SN					
<b>OPTION #1</b> <b>Pulverization and Pave</b> Mill existing pavement at select locations where applicable, pulverize the asphalt and upper portion of base course to a depth of 300 mm, and pave with 140 mm hot mix asphalt (40 mm SP 12.5 FC1 surface course over two lifts of 50 mm SP 19.0 binder course).	<ul style="list-style-type: none"> <li>• Surface</li> <li>• Binder</li> <li>• Pulverize mat</li> <li>• Granular</li> </ul>	40 100 300 650	138 (GBE 918)	16	271,755	336,737	<ul style="list-style-type: none"> <li>• Exceeds required SN</li> <li>• Highest GBE value</li> <li>• Eliminates pavement distress</li> <li>• Re-use of pavement material (environmental benefit)</li> <li>• Reduced material off-site hauling</li> <li>• More resistance to frost action</li> <li>• Minimal future maintenance effort</li> <li>• Higher initial life (16 years)</li> <li>• Grade adjustments are possible</li> </ul>	<ul style="list-style-type: none"> <li>• Considerable grade raise (140 mm)</li> <li>• Longer construction period</li> <li>• Extra delay to road users and travelling on gravel road during construction</li> <li>• Higher initial cost</li> </ul>
<b>OPTION #2</b> <b>Full Depth Asphalt Removal and Pave</b> Excavate existing asphalt full depth and pave 190 mm hot mix asphalt (40 mm SP 12.5 FC1 surface course over three lifts of 50 mm SP 19.0 binder course).	<ul style="list-style-type: none"> <li>• Surface</li> <li>• Binder</li> <li>• Granular</li> </ul>	40 150 800	139 (GBE 830)	15	308,775	418,568	<ul style="list-style-type: none"> <li>• Provides required SN</li> <li>• Eliminates pavement distress</li> <li>• Minimum grade raise (only 40 mm)</li> <li>• Minimal shoulder grade raise</li> <li>• Relatively high initial life (15 years)</li> </ul>	<ul style="list-style-type: none"> <li>• Waste of pavement material</li> <li>• Highest initial and life cycle cost</li> </ul>
<b>OPTION #3</b> <b>Cold In-place Recycling and Pave</b> Mill existing pavement at select locations where applicable, cold in-place recycle the existing asphalt to a depth of 120 mm, and pave with 90 mm hot mix asphalt (40 mm SP 12.5 FC1 surface course over 50 mm SP 19.0 binder course).	<ul style="list-style-type: none"> <li>• Surface</li> <li>• Binder</li> <li>• CIR</li> <li>• Ex Asph</li> <li>• Granular</li> </ul>	40 50 120 30 800	145 (GBE 878)	15	216,555	299,347	<ul style="list-style-type: none"> <li>• Exceeds required SN</li> <li>• Lowest initial and life cycle costs</li> <li>• Conservation of non-renewable material (environmental benefit)</li> <li>• Energy conservation</li> <li>• Less delay to road users during construction and more safety</li> <li>• Reflective cracking is minimized by selective milling and deep processing depth.</li> <li>• Relatively high initial life (15 years)</li> <li>• Road users not travelling on gravel surface</li> <li>• Reduced material off-site hauling</li> </ul>	<ul style="list-style-type: none"> <li>• Limited construction season</li> <li>• Extensive on site QC</li> <li>• Parking space for equipment</li> </ul>



<p><b>OPTION #4 Mill and Pave</b></p> <p>Mill existing asphalt to an average depth of 100 mm, and pave with 160 mm of HMA (40 mm SP 12.5 FC1 surface course over two lifts of 60 mm SP 19.0 binder course).</p>	<ul style="list-style-type: none"> <li>• Surface</li> <li>• Binder</li> <li>• Granular</li> </ul>	<p>40 120 800</p>	<p>140 (GBE 833)</p>	<p>12</p>	<p>266,925</p>	<p>416,227</p>	<ul style="list-style-type: none"> <li>• Provides required SN</li> <li>• Relatively low grade raise (60 mm)</li> <li>• Relatively low initial and life cycle costs</li> <li>• Good construction and traffic staging</li> <li>• Well established construction experience</li> <li>• Less delay to road users during construction</li> </ul>	<ul style="list-style-type: none"> <li>• Will not treat deep cracks on pavement</li> <li>• Extensive future maintenance due to reflective cracking</li> <li>• Future user delay</li> <li>• Waste of pavement material</li> <li>• Lowest initial life (12 years)</li> <li>• Prior to paving, treatment of severe cracks (crack repairs) are needed.</li> </ul>
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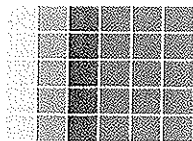
Note: GBE was calculated using the equivalency factors: HMA = 2, Existing Asphalt = 1.25; CIR = 1.75, Existing Base = 0.75; Existing Subbase = 0.5; Pulverised granular = 0.9.

### Preferred Option:

The Summary of LCCA indicates that Option 1 (Pulverization) and Option 3 (Cold in-place Recycling) shows the most economical options. Table IV above provides advantages and disadvantages of each pavement alternative. Option 3 (Cold in-place recycling and pave) has the lowest initial and life cycle costs as compared to Option 1 (Pulverization). CIR, however, has shorter construction season, compared to Pulverization. Pulverization option eliminates pavement distresses by full depth asphalt treatment and thus eliminate reflective cracking. On the other hand, CIR can mitigate reflective cracking by selective milling of thick asphalt and deeper (120 mm) processing depth, which could practically eliminate reflective cracking. In addition, the existing granular base is considered "clear", which is favourable for CIR.

Based on these and for the following reasons below, we recommend adopting **Option 3 (Cold In-place Recycling and Pave)** as a preferred alternative for the rehabilitation of Hwy 6:

- Lowest initial and life cycle costs.
- Exceeds required SN resulting in a longer pavement life.
- Practically eliminates pavement distress and reflective cracking.
- Re-use of pavement material (environmental benefit).
- Reduced material off-site hauling.
- Public not travelling on gravel road during construction.



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info@shaheenpeaker.ca

## PRESENT WORTH LIFE CYCLE COST ANALYSIS

G.W.P. 338-97-00 Highway 6, 1.1 km South of Grey County Road 9 to Durham South Limit

Average Existing Pavement Structure: 150 mm HMA, 200 mm Base, and 600 mm Subbase

### Option 1 - Pulverization and Pave - Initial Life = 16 yrs.

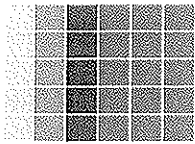
This analysis is for one km of a 7.5 m wide pavement.

Discount rate = 5 %

Year	Treatment	SN	Quantity	Unit Cost	Total Cost	PW Cost	Total PWC
0	<b>INITIAL CONSTRUCTION</b>	138					
	Selective Milling (assume 20% of total area )		1500 m <sup>2</sup>	2.50	3750	3750	
	Pulverize to 300 mm (Asph + Gran)		7500 m <sup>2</sup>	2.00	15,000	15,000	
	Granular A on shoulders		2280 t	16.00	36,480	36,480	
	Tack Coat x 2		15000 m <sup>2</sup>	0.30	4,500	4,500	
	40 mm Superpave 12.5 FC1		765 t	85.00	65,025	65,025	
	100 mm Superpave 19.0		1838 t	80.00	147,000	147,000	
							271,755
8	Rout and Seal Cracks @ 10 m spacing		750 m	2.00	1,500	1,015	1,015
12	Routine Maintenance 5% of total area		375 m <sup>2</sup>	15.00	5,625	3,132	3,132
16	<b>FIRST REHABILITATION</b>	127					
	Mill Existing asphalt 40 mm		7500 m <sup>2</sup>	2.50	18,750	8,590	
	Tack Coat		7500 m <sup>2</sup>	0.30	2,250	1,031	
	50 mm Superpave 12.5 FC1		956 t	85.00	81,281	37,236	46,856
20	Rout and Seal Cracks @ 8 m spacing		938 m	2.00	1,876	707	707
24	Routine Maintenance 7% of total area		525 m <sup>2</sup>	15.00	7,875	2,442	2,442
27	<b>SECOND REHABILITATION</b>	127					
	Mill Existing asphalt 50 mm		7500 m <sup>2</sup>	2.50	18,750	5,022	
	Tack Coat		7500 m <sup>2</sup>	0.30	2,250	603	
	50 mm Superpave 12.5 FC1		956 t	85.00	81,281	21,771	27,396
30	Residual Value				71597	16,566	-16,566
	<b>Total Life Cycle Cost</b>						<b>\$336,737</b>

#### Notes:

- 1 Assumed density for Superpave 12.5 FC1 is 2.55 t/m<sup>3</sup>, for Superpave 19.0 is 2.45 t/m<sup>3</sup>, and for Granular A is 2.4 t/m<sup>3</sup>.
- 2 Analysis Period = 30 years
- 3 User costs are not considered
- 4 Unit prices provided by UMA are used for above calculations.
- 5 Required SN = 138



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# PRESENT WORTH LIFE CYCLE COST ANALYSIS

G.W.P. 338-97-00 Highway 6, 1.1 km South of Grey County Road 9 to Durham South Limit

Average Existing Pavement Structure: 150 mm HMA, 200 mm Base, and 600 mm Subbase

## Option 2 - Full Depth Asphalt Removal - Initial Life = 15 yrs.

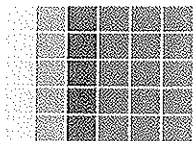
This analysis is for one km of a 7.5 m wide pavement.

Discount rate = 5.00 %

Year	Treatment	SN	Quantity	Unit Cost	Total Cost	PW Cost	Total PWC
0	<b>INITIAL CONSTRUCTION</b>	139					
	Remove existing asphalt 150 mm		7500 m <sup>2</sup>	2.50	18,750	18,750	
	Tack Coat x 2		15000 m <sup>2</sup>	0.30	4,500	4,500	
	40 mm Superpave 12.5 FC1		765 t	85.00	65,025	65,025	
	150 mm Superpave 19.0		2756 t	80.00	220,500	220,500	308,775
8	Rout and Seal Cracks @ 10 m spacing		750 m	2.00	1,500	1,015	1,015
12	Routine Maintenance 5% of total area		375 m <sup>2</sup>	15.00	5,625	3,132	3,132
15	<b>FIRST REHABILITATION</b>	131					
	Mill Existing asphalt 70 mm		7500 m <sup>2</sup>	2.50	18,750	9,019	
	Tack Coat		7500 m <sup>2</sup>	0.30	2,250	1,082	
	40 mm Superpave 12.5 FC1		765 t	85.00	65,025	31,278	
	50 mm Superpave 19		919 t	80.00	73,500	35,355	76,734
19	Rout and Seal Cracks @ 8 m spacing		938 m	2.00	1,876	742	742
23	Routine Maintenance 7% of total area		525 m <sup>2</sup>	15.00	7,875	2,564	2,564
26	<b>SECOND REHABILITATION</b>	131					
	Mill Existing asphalt 90 mm		7500 m <sup>2</sup>	2.50	18,750	5,273	
	Tack Coat		7500 m <sup>2</sup>	0.30	2,250	633	
	40 mm Superpave 12.5 FC1		956 t	85.00	81,260	22,854	
	50 mm Superpave 19		919 t	80.00	73,500	20,671	49,431
27	Rout and Seal Cracks @7 m spacing		1071 m	2.00	2,143	574	574
30	Residual Value				105456	24,400	-24,400
	<b>Total Life Cycle Cost</b>						<b>\$418,568</b>

### Notes:

- 1 Assumed density for Superpave 12.5 FC1 is 2.55 t/m<sup>3</sup>, for Superpave 19.0 is 2.45 t/m<sup>2</sup>, and for Granular A is 2.4 t/m<sup>3</sup>.
- 2 Analysis Period = 30 years
- 3 User costs are not considered
- 4 Unit prices provided by UMA are used for above calculations.
- 5 Required SN = 138



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# PRESENT WORTH LIFE CYCLE COST ANALYSIS

G.W.P. 338-97-00 Highway 6, 1.1 km South of Grey County Road 9 to Durham South Limit

Average Existing Pavement Structure: 150 mm HMA, 200 mm Base, and 600 mm Subbase

## Option 3 - Cold In-Place Recycling - Initial Life = 15 yrs.

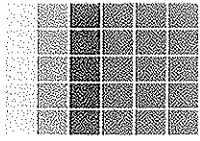
This analysis is for one km of a 7.5 m wide pavement.

Discount rate = 5.00 %

Year	Treatment	SN	Quantity	Unit Cost	Total Cost	PW Cost	Total PWC
0	<b>INITIAL CONSTRUCTION</b>	145					
	Selective Milling (Assume 20% of total area)		1500 m <sup>2</sup>	2.50	3,750	3,750	
	CIR Process 120 mm		7500 m <sup>2</sup>	7.00	52,500	52,500	
	Tack Coat (2 times)		15000 m <sup>2</sup>	0.30	4,500	4,500	
	40 mm Superpave 12.5 FC1		765 t	85.00	65,025	65,025	
	50 mm Superpave 19.0		919 t	80.00	73,500	73,500	
	Granular A on shoulders		1080 t	16.00	17,280	17,280	216,555
6	Rout and Seal Cracks @ 10 m spacing		750 m	2.00	1,500	1,119	1,119
10	Routine Maintenance 7% of total area		525 m <sup>2</sup>	15.00	7,875	4,835	4,835
15	<b>FIRST REHABILITATION</b>	134					
	Mill Existing asphalt 50 mm		7500 m <sup>2</sup>	2.50	18,750	9,019	
	Tack Coat		7500 m <sup>2</sup>	0.30	2,250	1,082	
	50 mm Superpave 12.5 FC1		956 t	85.00	81,281	39,098	49,199
18	Rout and Seal Cracks @ 8 m spacing		938 m	2.00	1,875	779	779
21	Routine Maintenance 10% of total area		750 m <sup>2</sup>	15.00	11,250	4,038	4,038
24	<b>SECOND REHABILITATION</b>	134					
	Mill Existing asphalt 50 mm		7500 m <sup>2</sup>	2.50	18,750	5,814	
	Tack Coat		7500 m <sup>2</sup>	0.30	2,250	698	
	50 mm Superpave 12.5 FC1		956 t	85.00	81,281	25,203	31,714
27	Rout and Seal Cracks @ 7 m spacing		1071 m	2.00	2,143	574	574
30	Residual Value				40913	9,466	-9,466
	<b>Total Life Cycle Cost</b>						<b>\$299,347</b>

### Notes:

- 1 Assumed density for Superpave 12.5 FC1 is 2.55 t/m<sup>3</sup>, for Superpave 19.0 is 2.45 t/m<sup>3</sup>, and for Granular A is 2.4 t/m<sup>3</sup>.
- 2 Analysis Period = 30 years
- 3 User costs are not considered
- 4 Unit prices provided by UMA are used for above calculations.
- 5 Required SN = 138



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# PRESENT WORTH LIFE CYCLE COST ANALYSIS

G.W.P. 338-97-00 Highway 6, 1.1 km South of Grey County Road 9 to Durham South Limit

Average Existing Pavement Structure: 150 mm HMA, 200 mm Base, and 600 mm Subbase

**Option 4 - Mill 100 mm and Pave 160 mm - Initial Life = 12 yrs.**

This analysis is for one km of a 7.5 m wide pavement.

Discount rate = 5.00 %

Year	Treatment	SN	Quantity	Unit Cost	Total Cost	PW Cost	Total PWC
0	<b>INITIAL CONSTRUCTION</b>	141					
	Mill Existing asphalt 100 mm		7500 m <sup>2</sup>	2.50	18,750	18,750	
	40 mm Superpave 12.5 FC1		765 t	85.00	65,025	65,025	
	120 mm Superpave 19.0		2205 t	80.00	176,400	176,400	
	Tack Coat x 3		22500 m <sup>2</sup>	0.30	6,750	6,750	266,925
3	Rout and Seal Cracks @ 5 m spacing		1500 m	2.00	3,000	2,592	
7	Rout and Seal Cracks @ 5 m spacing		1500 m	2.00	3,000	2,132	
10	Routine Maintenance 7% of total area		525 m <sup>2</sup>	18.00	9,450	5,801	
12	<b>FIRST REHABILITATION</b>	131					10,525
	Mill Existing asphalt 90 mm		7500 m <sup>2</sup>	2.50	18,750	10,441	
	Tack Coat		7500 m <sup>2</sup>	0.30	2,250	1,253	
	40 mm Superpave 12.5 FC1		765 t	85.00	65,025	36,208	
	50 mm Superpave 19		919 t	80.00	73,500	40,928	88,829
15	Rout and Seal Cracks @ 5 m spacing		1500 m	2.00	3,000	1,443	
18	Routine Maintenance 10% of total area		750 m <sup>2</sup>	18.00	13,500	5,610	
19	Rout and Seal Cracks @ 5 m spacing		1500 m	2.00	3,000	1,187	
							8,240
23	<b>SECOND REHABILITATION</b>	131					
	Mill Existing asphalt 90 mm		7500 m <sup>2</sup>	2.50	18,750	6,104	
	Tack Coat		7500 m <sup>2</sup>	0.30	2,250	733	
	40 mm Superpave 12.5 FC1		765 t	85.00	65,025	21,170	
	50 mm Superpave 19		919 t	80.00	73,500	23,929	51,937
26	Rout and Seal Cracks @ 5 m spacing		1500 m	2.00	3,000	844	844
30	Residual Value				47858	11,073	-11,073
	<b>Total Life Cycle Cost</b>						<b>\$416,227</b>

## Notes:

- 1 Assumed density for Superpave 12.5 FC1 is 2.55 t/m<sup>3</sup>, and for Superpave 19.0 is 2.45 t/m<sup>3</sup>
- 2 Analysis Period = 30 years
- 3 User costs are not considered
- 4 Unit prices provided by UMA are used for above calculations.
- 5 Required SN = 138



# Appendix 7

## Pavement Design Outputs

# WinPAS

Pavement Thickness Design According to  
**1993 AASHTO Guide for Design of Pavements Structures**  
American Concrete Pavement Association

## Flexible Design Inputs

Agency:

Company: Shaheen & Peaker Limited

Contractor:

Project Description: Highway 6 Durham - New Construction

Location: Highway 6, from Grey County Road 9 to Durham South Limits

## Flexible Pavement Design/Evaluation

Structural Number	134.99	Soil Resilient Modulus	25.00 MPa
Design ESALs	4,381,000.00	Initial Serviceability	4.50
Reliability	90.00 percent	Terminal Serviceability	2.50
Overall Deviation	0.44		

## Layer Thickness Determination

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
New HMA	0.42	1.00	140.00	58.80
New Base	0.14	1.00	150.00	21.00
sub-base	0.09	1.00	650.00	58.50
			$\Sigma$ SN	138.30

# WinPAS

Pavement Thickness Design According to  
**1993 AASHTO Guide for Design of Pavements Structures**  
American Concrete Pavement Association

## Flexible Design Inputs

Agency:

Company: Shaheen & Peaker Limited

Contractor:

Project Description: Highway 6 Durham - Option 1 (Pulverization and Overlay)

Location: Highway 6, from Grey County Road 9 to Durham South Limits

## Flexible Pavement Design/Evaluation

Structural Number	134.99	Soil Resilient Modulus	25.00 MPa
Design ESALs	4,381,000.00	Initial Serviceability	4.50
Reliability	90.00 percent	Terminal Serviceability	2.50
Overall Deviation	0.44		

## Layer Thickness Determination

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
New HMA	0.42	1.00	140.00	58.80
Pulverize Mat	0.12	1.00	300.00	36.00
Ex Base	0.12	0.90	50.00	5.40
Ex Subbase	0.07	0.90	600.00	37.80
			Σ SN	138.00

# WinPAS

Pavement Thickness Design According to  
**1993 AASHTO Guide for Design of Pavements Structures**  
American Concrete Pavement Association

## Flexible Design Inputs

Agency:

Company: Shaheen & Peaker Limited

Contractor:

Project Description: Highway 6 Durham - Option 2 (Full Depth Asphalt Removal)

Location: Highway 6, from Grey County Road 9 to Durham South Limits

## Flexible Pavement Design/Evaluation

Structural Number	134.99	Soil Resilient Modulus	25.00 MPa
Design ESALs	4,381,000.00	Initial Serviceability	4.50
Reliability	90.00 percent	Terminal Serviceability	2.50
Overall Deviation	0.44		

## Layer Thickness Determination

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
New HMA	0.42	1.00	190.00	79.80
Ex Base	0.12	0.90	200.00	21.60
Ex Subbase	0.07	0.90	600.00	37.80
			Σ SN	139.20

# WinPAS

Pavement Thickness Design According to  
**1993 AASHTO Guide for Design of Pavements Structures**  
American Concrete Pavement Association

## Flexible Design Inputs

Agency: Transportation Division

Company: Shaheen & Peaker Limited

Contractor:

Project Description: Highway 6 Durham - Option 3 (CIR and Pave)

Location: Highway 6, from Grey County Road 9 to Durham South Limits

## Flexible Pavement Design/Evaluation

Structural Number	134.99	Soil Resilient Modulus	25.00 MPa
Design ESALs	4,381,000.00	Initial Serviceability	4.50
Reliability	90.00 percent	Terminal Serviceability	2.50
Overall Deviation	0.44		

## Layer Thickness Determination

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
New HMA	0.42	1.00	90.00	37.80
CIR	0.33	1.00	120.00	39.60
Old Asphalt	0.28	1.00	30.00	8.40
Ex Base	0.12	0.90	200.00	21.60
Ex Subbase	0.07	0.90	600.00	37.80
			Σ SN	145.20

# WinPAS

Pavement Thickness Design According to  
**1993 AASHTO Guide for Design of Pavements Structures**  
American Concrete Pavement Association

## Flexible Design Inputs

Agency:

Company: Shaheen & Peaker Limited

Contractor:

Project Description: Highway 6 Durham - Option 4 (Mill and Pave)

Location: Highway 6, from Grey County Road 9 to Durham South Limits

## Flexible Pavement Design/Evaluation

Structural Number	134.99	Soil Resilient Modulus	25.00 MPa
Design ESALs	4,381,000.00	Initial Serviceability	4.50
Reliability	90.00 percent	Terminal Serviceability	2.50
Overall Deviation	0.44		

## Layer Thickness Determination

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
New HMA	0.42	1.00	160.00	67.20
Ex. Asphalt	0.28	1.00	50.00	14.00
Base	0.12	0.90	200.00	21.60
Subbase	0.07	0.90	600.00	37.80
			Σ SN	140.60



# WinPAS

Pavement Thickness Design According to  
**1993 AASHTO Guide for Design of Pavements Structures**  
American Concrete Pavement Association

## Flexible Design Inputs

Agency:

Company: Shaheen & Peaker Ltd

Contractor:

Project Description: SPT1174, Hwy 6 Durham-Varney (Option 1-Deep Strength)

Location: Sta. 28+040-28+380, Hwy 6

## Flexible Pavement Design/Evaluation

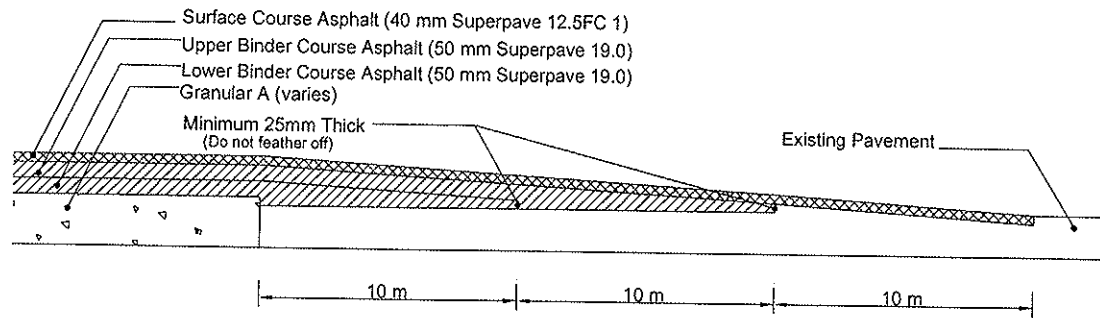
Structural Number	134.99	Soil Resilient Modulus	25.00 MPa
Design ESALs	4,381,000.00	Initial Serviceability	4.50
Reliability	90.00 percent	Terminal Serviceability	2.50
Overall Deviation	0.44		

## Layer Thickness Determination

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
New Asphalt	0.42	1.00	210.00	88.20
Base	0.12	0.90	225.00	24.30
Subbase	0.07	0.90	350.00	22.05
			Σ SN	134.55

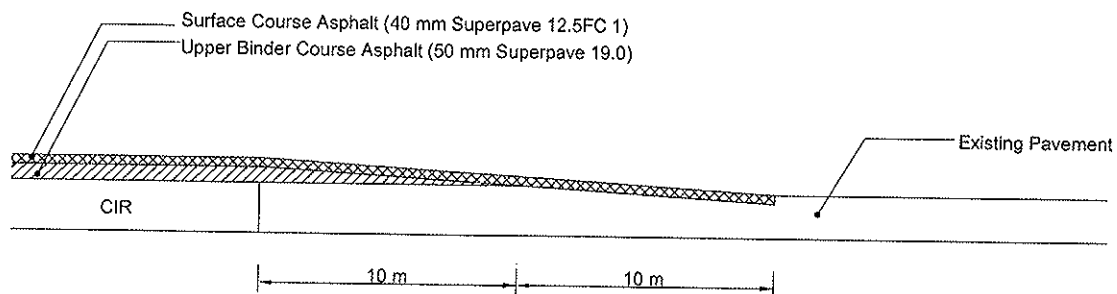
# Appendix 8

## Sketches for Transitions



**TRANSITION AT PROJECT NORTH LIMIT**

(N. T. S.)

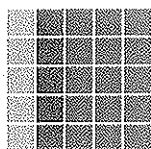


**TRANSITION AT PROJECT SOUTH LIMIT**

(N. T. S.)

# Appendix 9

## Minutes



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## Minutes of Pavement Selection Meeting

**Project:** Highway 6, From 1.1 km South of Grey County Road 9 Northerly to Durham South Limits

WP 338-97-00, Agreement No. 3004-E-0042

**Client:** UMA Engineering Ltd

**Location:** Boardroom 4B, MTO SW Region, London

**Date:** December 20, 2006

**Time:** 2:30 – 4:00 PM

**Meeting Attendees:**

Mr. Dave Harris, MTO  
Mr. Riaz Ahmed, MTO  
Ms. Jaime Vanderburg, MTO  
Mr. Aaron Janke, MTO  
Mr. Christopher Dry, UMA Engineering Ltd  
Mr. Ramon Miranda, Shaheen & Peaker Ltd (S&P)  
Mr. Joshua Li, Shaheen & Peaker Ltd (S&P)

The following are the minutes of the pavement selection meeting on December 20, 2006 held at the Ministry of Transportation's London Office.

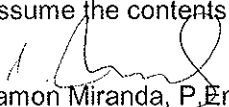
Item	Discussion	Action By
1.	S&P introduced the project with a brief overview of the existing highway conditions and proposed works. With the aid of a pavement selection meeting handout, various pavement rehabilitation alternatives were presented and consequently four rehabilitation options were considered for Life Cycle Cost Analysis (LCCA). Based on the LCCA and advantages/disadvantages presented, pulverization (Option 1) and Cold In-place recycling (Option 3) were considered the most economical options.	
2.	MTO asked S&P to revisit the AADT traffic growth rate that is used in the pavement design.	S&P
3.	MTO suggested S & P to check Design Traffic Category based on 20-year ESAL and change recommended asphalt type from FC2 to FC 1.	S&P
4.	MTO suggested that MTO Routine Pavement Design Method should be performed as an overall comparative check of the pavement designs developed using the AASHTO 93 procedure.	S&P

5.	MTO indicated that, due to good quality granular materials which are favorable for CIR, CIR could be a very good alternative. S & P was asked to review LCCA for CIR (e.g. increasing the initial year for CIR from 13 years to 15 years). MTO also indicated to use selective pre-milling prior to the CIR to maintain a uniform pavement thickness.	S&P
6.	Regarding LCCA, MTO pointed out that discount rate of 5.0% should be used according to MTO latest data. MTO also believed that the unit rate for sealing thermal cracks (Routing and Sealing Cracks), provided by UMA, \$4/m is too high.	UMA/S&P
7.	For Option 3- Cold In-Place Recycling, MTO suggested to consider more appropriate treatment schedule for Superpave. For instance, first rout and seal should be done at year 6 and second rout and seal at year 18. Also for second rehabilitation, 7-8 m transverse crack spacing instead of 5 m for rout and seal should be considered. After considering all the above revision on the parameters, LCCA would be recalculated and a decision on the most economically feasible rehabilitation option will be made.	S&P
8.	MTO asked S&P to consider application of CIR, if chosen, in Varney section (Sta.28+000 – 28+400) where grade raise is restricted. MTO also asked UMA/S&P to check the culvert that is involved within this section to make sure pavements and foundations match in elevations.	UMA/S&P
9.	MTO indicated that two lifts of asphalt should be used for paved shoulders. Different mix type for the surface course for the fully paved shoulders may be considered depending on the quantity of the surface course for fully paved shoulders.	S&P
10.	MTO instructed S&P to consider resurfacing only (possible mill and pave) for main lanes and southbound passing lane which was built/resurfaced in 1999 for the section from Sta.29+100 to 29+691.722 and from 10+000 to 11+705 <sup>1</sup> . With this treatment, S&P indicated that this section will deteriorate much sooner than the rest of the project, but was told by MTO that this section will be rehabilitated/maintained under MTO capital works program. MTO noted that new pavement design for reconstruction was provided for the vertical cut section (Sta. 29+350 to 29+691.722, and 10+000 to 10+070) within this section. However, for the section south of the vertical cut (considering relatively short section of only about 250 m), CIR (if chosen) instead of resurfacing should be considered. For the section north of this vertical cut, we understand that grade raise is required and this can be achieved by granular lift using Granular A ( after removing the existing asphalt hot mix) and then paving three lifts of new hot mix.	S & P

Note:

1. There is a chainage equation at the centerline of Southgate-Glenleg Townline / Normanby-Bentick Townline: Station 29+691.722 = Station 10+000.

If this minute does not agree with your records of the meeting, or if there are any omissions, please advise, otherwise we will assume the contents to be correct.

Submitted by:  Ramon Miranda, P.Eng.

Cc: All present



shaheen peaker  
INC.