ROAD ASSESSMENT
PROPOSED CLASS "A" GRAVEL PIT
584015 – SIDEROAD 60, BERKELEY
Part Lot 27, Concession 7
(FORMER TOWNSHIP OF HOLLAND)
TOWNSHIP OF CHATSWORTH
COUNTY OF GREY

GAMSBY AND MANNEROW LIMITED
CONSULTING PROFESSIONAL ENGINEERS
GUELPH, OWEN SOUND, LISTOWEL, KITCHENER, EXETER

May 2013
OUR FILE: 210099

Gamsby and Mannerow
ENGINEERS

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Gamsby and Mannerow
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1.0 INTRODUCTION

The owners of 584015 Sideroad 60 in the (former Township of Holland) Township of Chatsworth have retained Gamsby and Mannerow Limited to conduct a road assessment between Veterans Road South, easterly to Highway #10. The road assessment was requested to support a zoning amendment for the subject development lands, which will be filed in conjunction with an application to the Ministry of Natural Resources (MNR) for the development of a proposed Category 1, Class "A" Pit Licence. The proposed licence would permit the extraction of up to 150,000 tonnes of aggregate per year from a licensed area of 39.6 ha, with an extraction area of approximately 19 ha.

The subject property fronts onto both Veterans Road South and 60 Sideroad as shown on Figure No. 1 – Borehole Location Plan. At this time, there is only one proposed pit entrance/exit, which is located at the south easterly corner of the existing ±95 acre parcel. It is proposed that 60 Sideroad will be the only designated haul route for the development and, therefore, all of the site generated truck traffic will travel along 60 Sideroad easterly to Highway #10 at the hamlet of Berkeley. Since Highway #10 is a Class 1 road, there are no further concerns beyond 60 Sideroad. Therefore, 60 Sideroad between the site and Highway #10 is the main focus of this assessment.

This road assessment documents the findings of our review of existing surface and sub-surface conditions along the proposed haul route. Potential impacts of the proposed development are considered and assessed. Road geometry is not included in the scope of work for this assessment.

2.0 BACKGROUND

Prior to applying for re-zoning, the development planner (Cuesta Planning) requested that a road assessment be conducted to ensure a proper haul route was established. Upon acknowledgement of this requirement by the owner, G&M contacted the Township to determine information related to 60 Sideroad. In response to some initial questions, the Township indicated the following applicable information:

- Current Township practice is to require any haul routes for new gravel pits to be constructed (if required) and to be hard surfaced.
- The road classification is a Class 4 (see Appendix "A" for additional information related to the classification of highway systems)
- The traffic count for 60 Sideroad, between Veterans Road South and West Back Line is 289 (counted in 2012 and assumed to represent the average annual daily traffic (*AADT*)). The traffic counts for 60 Sideroad between West Back Line and Highway #10 are unavailable at this time.
- No load restrictions are posted along 60 Sideroad, between Highway #10 westerly to Veterans Road South.
- The speed limits are 50 km/hr in the hamlet of Berkeley and 80 km/hr west of the hamlet (Berkeley) limits (through to the site).
- There are no reports of flooding along the proposed haul route (60 Sideroad).
- There are no road design drawings available.
- The Township has no projected improvements to this section of roadway in the immediate future.

As outlined above, the 2012 average annual daily traffic along 60 Sideroad, between Veterans Sideroad and West Back Line was 289 vehicles. Since the data for the easterly concession of 60 Sideroad is unavailable, it can be assumed that traffic volumes would be similar to the westerly concession of 60 Sideroad. As indicated by both the appended table (Classification for Highways) and the Township's response, the current classification for 60 Sideroad is a Class 4.

3.0 EXISTING CONDITIONS

The distance between the proposed entrance/exit to the site and Highway #10 is approximately 4.7 kilometers. This section of 60 Sideroad is divided into two concessions by the West Back Line. For discussion purposes, the current features and conditions for these two concessions of 60 Sideroad and Highway #10 are addressed independently as follows:

Highway #10 – In the Hamlet of Berkeley *(Providing North/South Access)*

- Posted speed limit - 50 km/hr posted speed limit within the Hamlet of Berkeley.
  - 80 km/hr is posted speed limit north and south of the Hamlet of Berkeley.
- 60 Sideroad intersecting Highway #10 is the only intersection within the Hamlet of Berkeley.
- The intersection of 60 Sideroad and Highway #10 is located in the center of the ± 900 meter long posted 50 km/hr zone in the Hamlet of Berkeley.
- Highway #10 is constructed to MTO standards.

60 Sideroad – Highway #10 to West Back Line *(Providing East/West Access)*

- Posted speed limit - 50 km/hr from Highway #10 to the western limits of the Hamlet of Berkeley (approx. 750 m west of Highway #10).
- No posted speed limit, so assumed 80 km/hr from the westerly limits of the Hamlet of Berkeley to the West Back Line (approximately 1.3 km).
- Road constructed using two lifts of Hot Mix Asphalt (HMA), approximately 80 - 100 mm in overall thickness. The current condition of the HMA is relatively good with no obvious longitudinal or transverse cracking. It appears this asphalt was installed within the past 5 years.
- Average lane widths of 3.25 m, with an average 1.25 m wide gravel shoulders, which are overgrown with grass and weeds.
- Drainage culverts installed under roadway, just west of the Hamlet of Berkeley limits (Sargents Lake).
- Open ditches (overgrown) on both sides of road.

60 Sideroad – West Back Line to Veterans Road South *(Providing East/West Access)*

- Posted speed limit - No posted speed limit, so assumed 80km/hr from the West Back Line to the Veterans Road South (± 2.65 km).

- Road surface is Surface Treatment, approximately 30 - 35 mm in thickness. The current condition is assessed as fair to poor with areas of aggregate "pop outs" and unraveling.

- Average lane widths of 3.0 m, with an average 0.6 m wide gravel shoulders which are partially overgrown with grass and weeds. Beyond the exposed gravel shoulders an additional ± 0.4 m of overgrown surface is evident prior to encountering the shoulder rounding.

- Drainage culverts installed under roadway, at southwestern most curve of 'S' bend.

- Open ditches (overgrown) on both sides of road.

4.0 SITE GENERATED TRAFFIC

The final stages of the operational plan have not yet been finalized, however, we have assumed that the extraction operations would be conducted between 7:00 a.m. and 6:00 p.m. from Monday to Saturday inclusive. A typical operating season would start in early May and end in late December. This is about thirty-four (34) weeks, so there would be 34 x 6 = 204 working days available for hauling aggregate materials.

If a five (5) day work week were to be used (Monday to Friday inclusive), there would be 34 x 5 = 170 working days available in a typical year.

It is expected that the number of actual working days would be between 170 and 200 days in any year. There would be days when no aggregate is removed (weather days, no demand) and days when only a few truck loads would be hauled.

The number of truck loads removed from the pit per day would vary with the demand for aggregate materials which would change from time to time and year to year. More specifically, the number of truck loads per day leaving the proposed pit would vary with:

1. The load capacity of the truck.

2. The turnaround time (time to load, travel to the dump site, unload and return to the pit).

3. The quantity of materials required for projects.

It is expected that most of the aggregate materials removed from the pit would be via triaxle single unit trucks. These trucks typically haul ± 22 tonnes per load.
To extract aggregate materials to the full licensed capacity of 150,000 tonnes per year, the average number of truck trips per day would be as follows:

- Number of truck loads per year = 150,000 t ÷ 22 t/load = 6,818 trucks per year.

- Average number of truck loads per day:

  i) 200 working day season = 6,818 ÷ 200 ≈ 34 loads per day.
  ii) 170 working day season = 6,818 ÷ 170 ≈ 40 loads per day.

Each truck load would generate two truck trips (one loaded, one empty return). Therefore, the average number of truck trips per day would be:

i) 200 working day season = 34 x 2 = 68 trips per day (6.2 trips/hour).
ii) 170 working day season = 40 x 2 = 80 trips per day (7.3 trips/hour).

In summary, to extract the proposed 150,000 tonnes per year licensed quantity, based on a proposed peak annual scenario of 170 working days, there would be about 80 trips per day generated by the development of the proposed aggregate pit. Therefore, an additional 80 vehicles per day would increase the 2012 average annual daily traffic counts for 60 Sideroad from 289 vehicles per day to 369 vehicles per day. The annual average of 369 vehicles per day remains well below the maximum allowable 999 vehicles per day for a Class 4 roadway (see Appendix "A"). This would provide an increase in traffic during the seasonal pit operation of 28%, thus resulting in an average annual increase in traffic of 12.9%.

The life expectancy for the proposed gravel pit is expected to remain active for approximately 25 years. Over this 25 year period a projected increase of 2% in background traffic will increase the background AADT to: [1.02^{25} (2% compounding over 25 years) = 1.64 (factor)]. Therefore [1.64 (factor) x 289 (2012 AADT background)] 474 background AADT. With the maximum site generated traffic of 80 trucks per day added to the forecasted 25 year AADT of 474, the AADT along the proposed haul route would be 554 after a 25 year pit operation lifecycle. This 25 year forecasted AADT of 554 remains within the limits for a Class 4 road system.

Due to the geographic location of the proposed pit, and the absence of major urban centers surrounding the site, it is not expected that there would be sufficient demand to require the removal of the entire 150,000 tonnes from the proposed pit each year. However, at times during the operational life of the proposed pit there would be projects that require more trucks to be used. These projects would typically consist of road reconstruction or new subdivision construction where large quantities of aggregate materials are placed in a relatively short time period ranging from several days to several weeks. Given the usual scale of these types of projects in this area, aggregate materials would be adequately supplied using 5 or 6 trucks at the peak haulage periods.

During these peak periods, an assumed 1 hour turnaround time (which includes loading, hauling, dumping and return trip), would generate [6 (trucks) x 11 (hr/day) x 2 (round trip)] 132 trips per day or 12 trips per hour. This would be the expected maximum number of trips generated by the proposed pit on a peak day. This scenario of an additional 132 vehicles per day would increase the 2012 average annual daily traffic counts from 289 vehicles per day to 421 vehicles per day. Even with this scenario, the Class 4 parameters of 999 vehicles per day remains satisfied. It is not possible to estimate the number of days in a year that this situation would occur as this is dependent upon demand. However, hauling from the proposed pit at this rate could only be conducted for (150,000 t ÷ [66 loads/day x 22 t/loads]) ≈ 103 days before the proposed licence capacity would be exceeded. In addition, if the full licensed tonnage was removed every year the life expectancy of the proposed pit would be approximately 11 years.

5.0 FIELD REVIEW / INVESTIGATION – 60 SIDEROAD

With the known and projected traffic generated by the site, the assessment to determine the suitability for using 60 Sideroad as the proposed haul route was satisfied by determining the subgrade construction of the existing road. A total of seven (7) boreholes were drilled within the existing right of way (ROW). These boreholes extended to depths of 3.5 meters (11.5 ft) to determine the existing stratigraphy of the road base and underlain subgrade. The boreholes were located relatively evenly throughout the ± 4.7 km proposed haul route and were drilled within the existing hot mix asphalt or surface treatment limits. The actual locations have been illustrated on the appended Borehole Location Plan (Figure 1).

Using a solid stem auger to drill the boreholes and a 0.05 m (2 inch) Ø split spoon to recover samples at varying depths, the soil stratigraphy and consistency of the encountered soils throughout each borehole was recorded and summarized in the appended Borehole Logs (Appendix 'B'). Some of the granular samples (recovered using the split spoon sampling) from the upper 0.75 meters were processed to determine their grain size distribution (Appendix "C"). In addition, some of the samples obtained from deeper elevations were also processed for grain size distributions. The field observations along with the tested samples generally indicate that underlain to the existing surficial asphalt or surface treatment, imported processed granular materials were installed as a granular base for the existing road. As found throughout the drilling of the boreholes, the thickness of the installed granular road base is approximately 0.75 m and is fairly representative throughout both concessions of 60 Sideroad.

Underlain to the encountered ± 0.75 m of granular road base, the native subgrade generally consists of sand and gravel with varying amounts of silt and cobbles. These encountered subgrade soils are generally moist and become wetter with depth and are generally dense, which provides a suitable and stable subgrade for the road above. However, Borehole #5 contacted a layer of black fibrous peat below the layer of imported granular base. The limits of the peat are unknown at this time. The thickness of the peat is 0.77 m and is underlain by a silty sand and gravel with cobble subgrade, as determined by Borehole #5.

The Structural Design Guidelines for Flexible Pavements – Secondary Highways (copy included in Appendix "D") indicate the recommended pavement design with various levels of traffic and sub-grade material conditions. For a 200 – 500 Average Annual Daily Traffic (AADT), the total road base structure (pavement plus base material (Granular "A") plus sub-base material (Granular "B")) should have a Granular Base Equivalency (GBE) of 250 mm in thickness. This is assuming a subgrade consisting of sand with silts less than 40%, which coincides with the borehole findings of the subgrade. One (1) GBE is equivalent to 0.5mm of HMA. Whereas one (1) mm of Granular "A" is equivalent to 1 GBE and the underlain Granular Base material has a GBE value of 0.67. This design recommendation assumes 10% commercial vehicles (i.e. trucks), new construction and a non-saturated sub-grade.

A typical rural low volume road design (such as 60 Sideroad) would consist of a 150 mm layer of Granular "A" over 300 mm of Granular "B". This would provide a GBE of 150 x 1.0 + 300 x 0.67 = 351 which satisfies the design requirement for the confirmed sub-grade soils consisting of silty sand and gravel with cobbles. Note that surface treatment has no structural strength; however, it is noted to clarify it as the intended surface for the proposed road. In turn, the minimum granular thickness observed throughout the boreholes exceeds the minimum GBE required for these roadways.

6.0 CONLUSIONS AND RECOMMENDATIONS

The theoretical peak increases in traffic volume generated by the proposed pit was found to be less than half of the requirement as indicated in the Minimum Maintenance Standards (Appendix "A"). Therefore, the Class 4 road classification would remain applicable despite the minor increase in traffic on the proposed haul route generated by the proposed development.

As previously noted, 60 Sideroad has two different types of existing road surfaces. West of the West Back Line, the road surface is surface treatment, and east of the West Back Line the road surface is HMA. The surface treatment for the westerly section of Sideroad 60 is reaching the end of its serviceability life. Currently there is evidence of unraveling and surficial aggregate "pop outs". Since the existing road base is generally performing and evidence of a suitable granular base and the subgrade mainly consists of silty sand and gravel the replacement of the surface of the roadway is expected to be necessary within the next five (5) years, regardless of the traffic generated by the proposed development.

The easterly section of 60 Sideroad (east of the West Back Line) has a relatively new surface of Hot Mix Asphalt (HMA). Boreholes Nos. 5, 6, and 7, were located along this section of roadway, which identified the road base consisting mainly of granular materials, and a sand and gravel with cobble subgrade which satisfies the GBE minimum design requirements. However, Borehole #5 contacted a $\pm$0.77 m thick layer of black fibrous peat underlain to 1.42 meters of granular road base and 0.1 meters of HMA. This road base and subgrade stratigraphy provides a GBE ranging from 1,150 to 1,200 above the layer of the contacted peat. This amount of installed granular material exceeds the required GBE for a Class 4 roadway. In addition, this thickness of granular base provides adequate dissipation of surficial loading into the granular subgrade, transferring little to no load into the contacted layer of peat. Since there are no visible signs of

settlements reflecting through the surficial asphalt, it appears the granular road base is performing throughout this section of roadway. Therefore, the peat is not affecting the overall performance of the existing road base or subgrade.

It is expected that the granular materials used in the original construction of 60 Sideroad would generally provide a structurally acceptable road base for the proposed use. Since the expected site generated traffic remains relatively low, the stability of the existing road base and subgrade should not be affected. Therefore, a major reconstruction of 60 Sideroad would not be required to support the additional truck traffic generated by the proposed development. However, due to the proposed increase in traffic consisting mainly of trucks, it is recommended that consideration be taken by the Township to implement a seasonal load restriction along 60 Sideroad, if the development progresses. This should provide a greater longevity for the flexible roadway surfaces, by reducing the loading on the flexible pavements and subgrade under high moisture conditions and frost cycles (spring and late fall).

7.0 SUMMARY

1. The proposed gravel pit would generate an average of 68 to 80 truck trips per day, based on a 170 to 200 working day operating season, if the extraction limit of 150,000 tonnes per year was reached.

2. The truck trips would increase the daily traffic volume on 60 Sideroad by 28% during the operating season. The increase over the full year would be approximately 13%.

3. In general, the subgrade findings provide enough certainty that the majority of the existing road subgrade is suitable to provide the required loading for the intended use and the projected site generated traffic.

4. Upon approvals for both the re-zoning and pit licence, the proposed haul route may require some improvements. The sequence of construction of these improvements should be discussed and/or negotiated with the Township of Chatsworth along with any additional governing parties.

The conclusions and recommendations in this report are based on information gathered at the borehole locations and field observations pertaining to the available geological data of general nature which is pertinent to the area investigated. Sub-surface and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations and conditions may become apparent at a later date, which would not be detected or anticipated at the time of the investigation. The information contained within this report in no way reflects the environmental aspect of the site, the entire municipal roadway or the soils contained between the investigative boreholes. However, the uses of approximations pertaining to site generated traffic volumes are general. If additional or specific information beyond this scope of work is required, than a subsequent investigation by a qualified transportation engineer would be required.

Prepared and respectfully submitted by,

GAMSBY AND MANNEROW LIMITED
Per:

Derek Brewster, C.Tech.
DB/dv

Reviewed by:

John B. Slocombe, P. Eng
JBS/dv

Encl.

cc: Brian and Pearl Bumstead
Don Scott – Cuesta Planning
Mike Davis – Cuesta Planning
File - 210099

210099
Proposed Aggregate Pit
Township of Chatsworth

LEGEND

BH-1 BOREHOLE LOCATION

SCALE 1:15,000

APRIL 2013

BOREHOLE LOCATION PLAN

Part Lot 27, Conc. 7
(Former Township of Holland)
County of Grey

Figure No. 1

Gamsby and Mannerow
ENGINEERS

Plotted on: APRIL 23, 2013 210099 BH-B.dwg

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APPENDIX "A"

TABLE #1 – MTO – Classification of Highway Minimum Maintenance Standards

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ONTARIO REGULATION 239/02

MINIMUM MAINTENANCE STANDARDS FOR MUNICIPAL HIGHWAYS

CLASSIFICATION OF HIGHWAYS

Average Annual Daily Traffic (number of motor vehicles)	Posted or Statutory Speed Limit (kilometres per hour)						
	91 - 100	81 - 90	71 - 80	61 - 70	51 - 60	41 - 50	1 - 40
15,000 or more	1	1	1	2	2	2	2
12,000 - 14,999	1	1	1	2	2	3	3
10,000 - 11,999	1	1	2	2	3	3	3
8,000 - 9,999	1	1	2	3	3	3	3
6,000 - 7,999	1	2	2	3	3	3	3
5,000 - 5,999	1	2	2	3	3	3	3
4,000 - 4,999	1	2	3	3	3	3	4
3,000 - 3,999	1	2	3	3	3	4	4
2,000 - 2,999	1	2	3	3	4	4	4
1,000 - 1,999	1	3	3	3	4	4	5
500 - 999	1	3	4	4	4	4	5
200 - 499	1	3	4	4	5	5	5
50 - 199	1	3	4	5	5	5	5
0 - 49	1	3	6	6	6	6	6

O. Reg. 613/06, s. 1.

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COUNTY OF GREY

APPENDIX "B"

Borehole Logs

Log of Borehole: 1

Project No: 210099

Project: Aggregate Investigation

Client: Pearl and Brian Bumstead

Location: 584015 - Sideroad 60, Berkeley

Drill Date: March 7, 2013

Field Eng/Tech: D. Brewster

Drilling Company: London Soil Test

SUBSURFACE PROFILE				SAMPLE				Soil Properties: N-Value (20 40 60 80) / % Moisture (5 10 15 20)	Ground Water Monitoring Details
Depth (ft / m)	Symbol	Description	Elevation (m)	Number	Type	Recovery (%)	Unit Weight (KN/m3)		
0 / 0		Ground Surface	398.13						
0		Surface Treatment (30mm Thick)		1	SS		n/a	100	Gradation of Collected Sample (0.3m bgs)
1		Brown crushed sand and gravel **fill**. Cobbles encountered with depth. Moist and very dense.	397.37						
2				2	SS		n/a	100	
3 / 1		Brown sand and gravel with cobbles and trace silt. Moist and very dense.	396.61						
4									
5		Brown sand and gravel with trace silt. Moist and compact.		3	SS		n/a	23	
6 / 2			395.84						
7									
8		Brown sand and gravel with cobbles. Moist and very dense.		4	SS		n/a	63	
9									
10 / 3				5	SS		n/a	100	
11			394.62						
12		Borehole Terminated							
13 / 4									
14									
15									

Drill Method: Solid Stem Auger

Notes:

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people engineering environments
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519-376-1805 Fax 519-376-8977 www.gamsby.com

Log of Borehole: 2

Project No: 210099

Project: Aggregate Investigation

Client: Pearl and Brian Bumstead

Location: 584015 - Sideroad 60, Berkeley

Drill Date: March 7, 2013

Field Eng/Tech: D. Brewster

Drilling Company: London Soil Test

SUBSURFACE PROFILE				SAMPLE				Soil Properties	Ground Water Monitoring Details
Depth (ft / m)	Symbol	Description	Elevation (m)	Number	Type	Recovery (%)	Unit Weight (KN/m3)	N-Value 20 40 60 80 / % Moisture 5 10 15 20	
0 / 0		Ground Surface	396.54						
1		Surface Treatment (35mm Thick)		1	SS			100	
2		Brown crushed sand and gravel **fill**. Cobbles encountered with depth. Moist and very dense.	395.78						
3 / 1		Dark brown sand and gravel with cobbles and trace silt. Moist and compact.		2	SS			19	
4			395.02						
5		Brown sand and gravel with trace silt. Moist and very dense.		3	SS			10	Gradation of Collected Sample (1.5m bgs)
6 / 2									
7			394.25						
8		Brown sand and gravel with cobbles. Moist and dense to very dense.		4	SS			100	
9									
10 / 3			393.49						
11		Brown sand and gravel with cobbles. Moist and compact.		5	SS			25	
12			393.03						
13 / 4		Borehole Terminated							
14									
15									

Drill Method: Solid Stem Auger

Notes:

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Log of Borehole: 3

Project No: 210099

Project: Aggregate Investigation

Client: Pearl and Brian Bumstead

Location: 584015 - Sideroad 60, Berkeley

Drill Date: March 7, 2013

Field Eng/Tech: D. Brewster

Drilling Company: London Soil Test

SUBSURFACE PROFILE				SAMPLE				Soil Properties	Ground Water Monitoring Details
Depth (ft / m)	Symbol	Description	Elevation (m)	Number	Type	Recovery (%)	Unit Weight (KN/m3)	N-Value 20 40 60 80 / % Moisture 5 10 15 20	
0 / 0		Ground Surface	396.71						
0		Surface Treatment (35mm Thick)		1	SS			100	
1		Brown crushed sand and gravel **fill**. Cobbles encountered with depth. Moist and very dense.	395.95						
2				2	SS			61	Gradation of Collected Sample (0.75m bgs)
3 / 1		Dark brown sand and gravel with cobbles and trace silt. Moist and very dense.							
4									
5				3	SS			60	
6									
7 / 2			394.42						
8		Brown sand and gravel with cobbles. Moist and very dense.		4	SS			59	
9									
10 / 3			393.66						
10		Brown sand and gravel with cobbles. Moist and dense.		5	SS			49	
11			393.20						
12		Borehole Terminated							
13 / 4									
14									
15									

Drill Method: Solid Stem Auger

Notes:

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Log of Borehole: 4

Project No: 210099

Project: Aggregate Investigation

Client: Pearl and Brian Bumstead

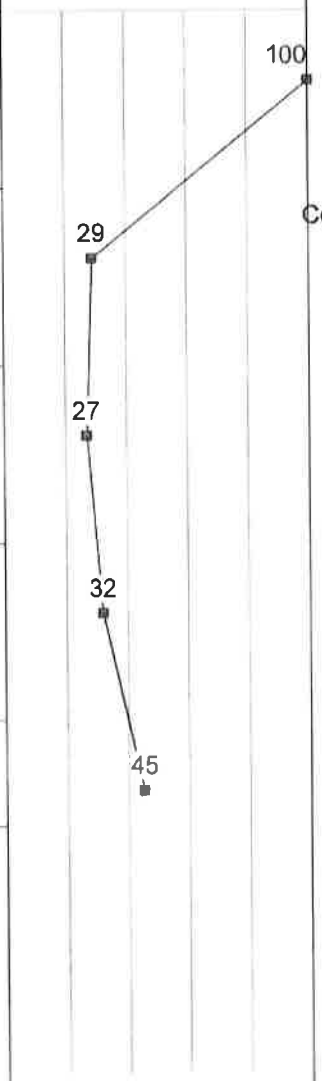
Location: 584015 - Sideroad 60, Berkeley

Drill Date: March 7, 2013

Field Eng/Tech: D. Brewster

Drilling Company: London Soil Test

SUBSURFACE PROFILE				SAMPLE				Soil Properties	Ground Water Monitoring Details
Depth (ft / m)	Symbol	Description	Elevation (m)	Number	Type	Recovery (%)	Unit Weight (KN/m3)	N-Value 20 40 60 80 / % Moisture 5 10 15 20	
0 / 0		Ground Surface	401.33						
0		Surface Treatment (35mm Thick)		1	SS				
1		Brown crushed sand and gravel **fill**. Cobbles encountered with depth. Moist and very dense.	400.57						
2				2	SS				
3 / 1		Brown sand and gravel with cobbles and some silt. Moist and compact.							
4									
5				3	SS				
6 / 2									
7			399.04						
8		Brown sand and gravel with cobbles and some silt. Moist and dense.		4	SS				
9									
10 / 3				5	SS				
11			397.82						
12		Borehole Terminated							
13 / 4									
14									
15									



Gradation of Collected Sample (0.75m bgs)

Drill Method: Solid Stem Auger

Notes:

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Log of Borehole: 5

Project No: 210099

Project: Aggregate Investigation

Client: Pearl and Brian Bumstead

Location: 584015 - Sideroad 60, Berkeley

Drill Date: March 7, 2013

Field Eng/Tech: D. Brewster

Drilling Company: London Soil Test

SUBSURFACE PROFILE				SAMPLE				Soil Properties	Ground Water Monitoring Details
Depth (ft / m)	Symbol	Description	Elevation (m)	Number	Type	Recovery (%)	Unit Weight (KN/m3)	N-Value 20 40 60 80 / % Moisture 5 10 15 20	
0 / 0		Ground Surface	396.30						
1		Hot Mix Asphalt (100mm Thick)		1	SS				Gradation of Collected Sample (0.15m bgs)
2		Brown crushed sand and gravel **fill**. Cobbles encountered with depth. Moist and very dense.	395.54	2	SS				Gradation of Collected Sample (0.75m bgs)
3 / 1		Brown sand and gravel **fill** with cobbles. Moist and very dense.	394.78						
5		Black organics and fibrous peat, changing to grey silty sand at tip of spoon. Wet and soft.		3	SS			6	
6 / 2			394.01						
8		Grey silty sand with gravel and cobbles. Moist to wet and compact.		4	SS			16	
9 / 3			393.25						
10		Grey sand and gravel with cobbles and trace silt. Moist to wet and dense.		5	SS			35	
11			392.79						
12		Borehole Terminated							
13 / 4									
14									
15									

Drill Method: Solid Stem Auger

Notes:

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Guelph, Kitchener, Listowel, Owen Sound
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519-376-1805 Fax 519-376-8977 www.gamsby.com

Log of Borehole: 6

Project No: 210099

Project: Aggregate Investigation

Client: Pearl and Brian Bumstead

Location: 584015 - Sideroad 60, Berkeley

Drill Date: March 7, 2013

Field Eng/Tech: D. Brewster

Drilling Company: London Soil Test

SUBSURFACE PROFILE				SAMPLE				Soil Properties	Ground Water Monitoring Details
Depth (ft / m)	Symbol	Description	Elevation (m)	Number	Type	Recovery (%)	Unit Weight (KN/m3)	N-Value (20 40 60 80) / % Moisture (5 10 15 20)	
0 / 0		Ground Surface	395.47						
		Hot Mix Asphalt (100mm Thick)		1	SS			46	
1		Brown crushed sand and gravel **fill**. Cobbles encountered with depth. Moist and dense.	394.71						
2				2	SS			27	Gradation of Collected Sample (0.75m bgs)
3 / 1		Brown sand and gravel with cobbles and trace silt. Wet and compact.	393.95						
4				3	SS			10	
5		Grey sand and gravel with cobbles. Wet and compact.							
6 / 2									
7			393.18						
8		Brown coarse gravel and trace sand. Wet to saturated and compact.		4	SS			14	
9									
10 / 3			392.42						
11		Brown coarse gravel and trace sand. Wet to saturated and loose.		5	SS			9	
12			391.96						
13 / 4		Borehole Terminated							
14									
15									

Drill Method: Solid Stem Auger

Notes:

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Log of Borehole: 7

Project No: 210099

Project: Aggregate Investigation

Client: Pearl and Brian Bumstead

Location: 584015 - Sideroad 60, Berkeley

Drill Date: March 7, 2013

Field Eng/Tech: D. Brewster

Drilling Company: London Soil Test

SUBSURFACE PROFILE				SAMPLE				Soil Properties	Ground Water Monitoring Details
Depth (ft / m)	Symbol	Description	Elevation (m)	Number	Type	Recovery (%)	Unit Weight (KN/m3)	N-Value 20 40 60 80 / % Moisture 5 10 15 20	
0 / 0		Ground Surface	403.31						
0		Hot Mix Asphalt (80mm Thick)		1	SS			51	
1		Brown crushed sand and gravel **fill**. Cobbles encountered with depth. Moist and very dense.	402.55						
2				2	SS			100	
3 / 1		Brown sand and gravel with cobbles. Moist and very dense.	401.79						
4									
5		Brown sand and gravel with cobbles. Moist and dense.		3	SS			39	Gradation of Collected Sample (1.5m bgs)
6 / 2									
7				4	SS			42	
8									
9									
10 / 3			400.26						
10		Brown sand and gravel with cobbles. Moist and very dense.		5	SS			100	
11			399.80						
12		Borehole Terminated							
13 / 4									
14									
15									

Drill Method: Solid Stem Auger

Notes:

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ROAD ASSESSMENT
PROPOSED CLASS "A" GRAVEL PIT
584015 – SIDEROAD 60, BERKELEY
Part Lot 27, Concession 7
(FORMER TOWNSHIP OF HOLLAND)
TOWNSHIP OF CHATSWORTH
COUNTY OF GREY

APPENDIX "C"

Grain-Size Analysis

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GRAIN SIZE ANALYSIS

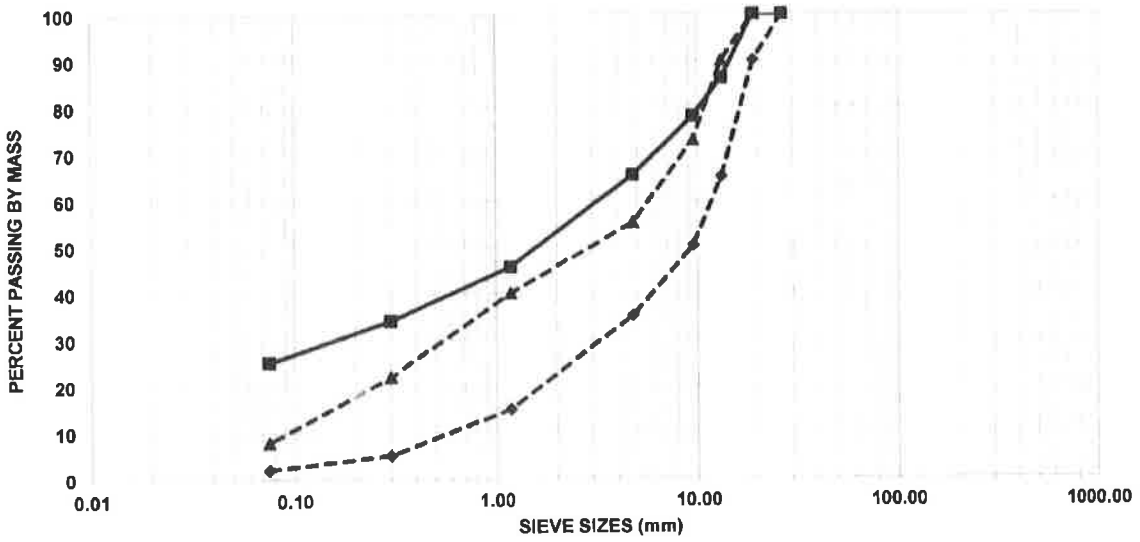
PROJECT: Aggregate Investigation
LOCATION: 584015 - 60 Sideroad
CLIENT: Pearl and Brian Bumstead

PROJECT NO: 210099
LAB SAMPLE NO: S-1252

SAMPLE DATE: March 7, 2013
SAMPLED BY: D.B.

SAMPLE MATERIAL: Brown Crushed Sand & Gravel (Roadbase Fill)
SAMPLE SUPPLIER: Harvested from Borehole Split Spoon
SAMPLE LOCATION: BH#1, Sampled from 0.3m bgs

GRAIN SIZE DISTRIBUTION



SIEVE SIZE mm	PERCENT PASSING			GRANULAR 'A' OPSS FORM 1010	
	SPECIFIED MIN.	SPECIFIED MAX.	SAMPLE		
26.5	100	100	100.0		**NOTES:**
19.0	90	100	100.0		Smaller than specified sample size processed Results are for illustration purposes only
13.2	65	90	86.2		
9.5	50	73	78.0	#	
4.75	35	55	65.4	#	
1.18	15	40	45.6	#	
0.300	5	22	34.1	#	
0.075	2	8	25.2	#	

Remarks: Sample is outside the grading requirements for OPSS Granular A

Asphalt Coated Particles (%) _____ Crushed Particles (%) _____

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GRAIN - SIZE ANALYSIS

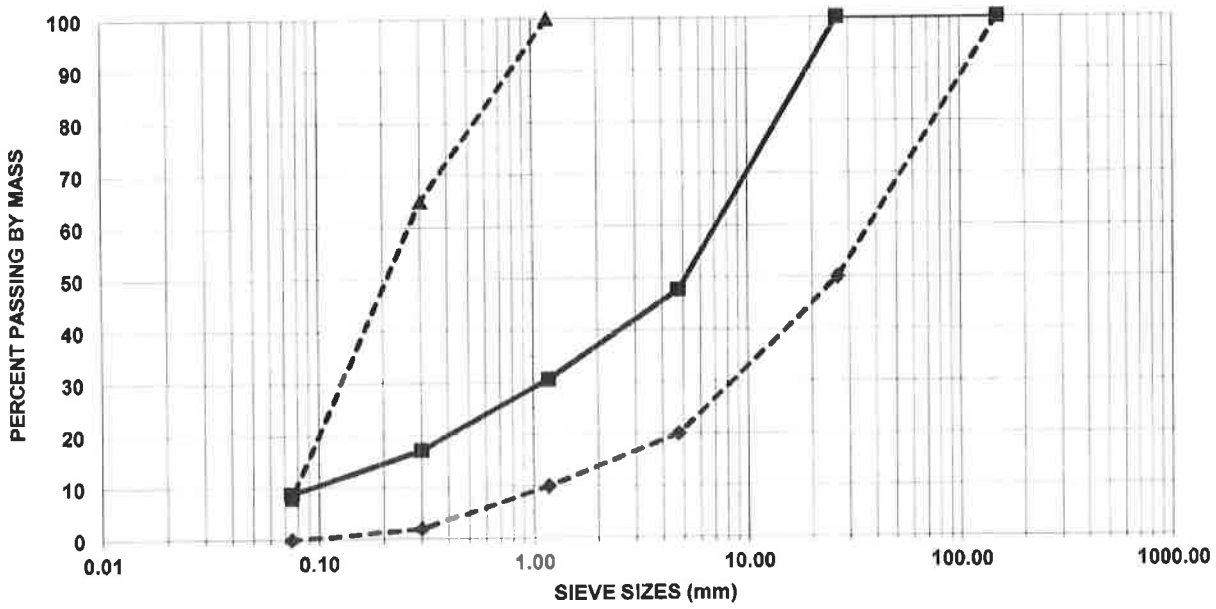
PROJECT: Aggregate Investigation
LOCATION: 584015 - 60 Sideroad
CLIENT: Pearl and Brian Bumstead

PROJECT NO: 210099
LAB SAMPLE NO: S-1253

SAMPLE DATE: March 7, 2013
SAMPLED BY: D.B.

SAMPLE MATERIAL: Brown Sand & Gravel with trace Silt (Subgrade)
SAMPLE SUPPLIER: Harvested from Borehole Split Spoon
SAMPLE LOCATION: BH#2, Sampled from 1.5m bgs

GRAIN SIZE DISTRIBUTION



SIEVE SIZE mm	PERCENT PASSING SPECIFIED MIN.	PERCENT PASSING SPECIFIED MAX.	SAMPLE	GRANULAR 'B Type I' OPSS FORM 1010	
150.0	100	100	**100.0**		**NOTES:** Smaller than specified sample size processed. Results are for illustration purposes only. Tested sample also meets OPSS 1010 as Select Subgrade Matrerial (SSM).
26.5	50	100	**100.0**		
4.75	20	100	**47.7**		
1.18	10	100	**30.6**		
0.300	2	65	**17.1**		
0.075	0	8	**8.8**	#	

Remarks Sample is marginally outside the requirements for OPSS Granular B Type I

Asphalt Coated Particles (%) _____
OPSS Spec. = 30% Max

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GRAIN - SIZE ANALYSIS

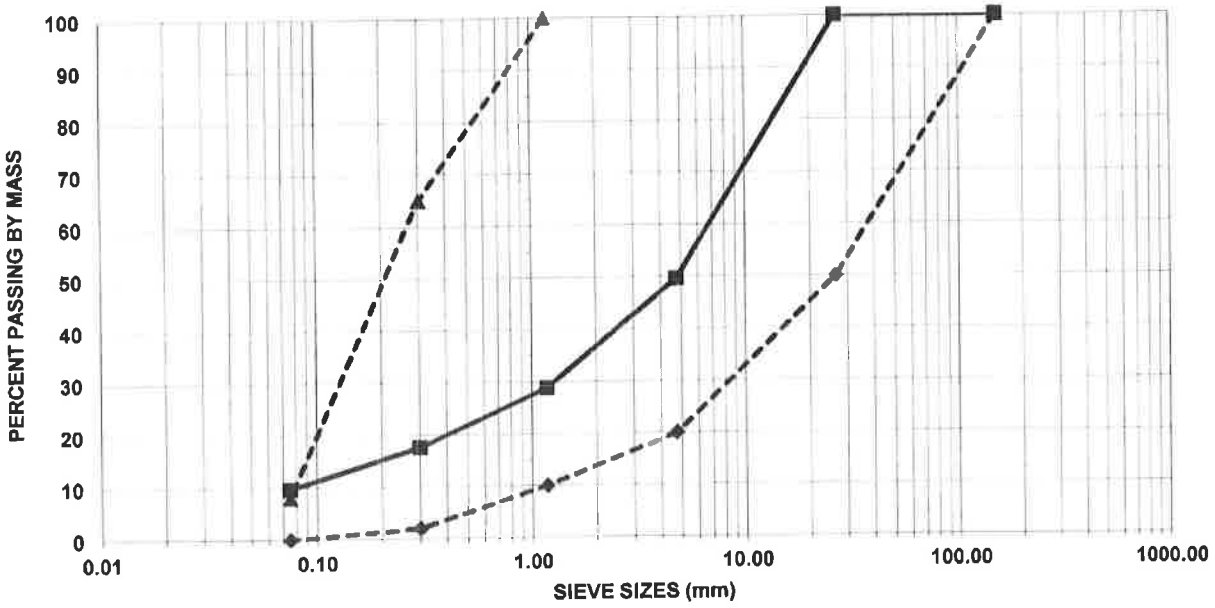
PROJECT: Aggregate Investigation
LOCATION: 584015 - 60 Sideroad
CLIENT: Pearl and Brian Bumstead

PROJECT NO: 210099
LAB SAMPLE NO: S-1254

SAMPLE DATE: March 7, 2013
SAMPLED BY: D.B.

SAMPLE MATERIAL: Dark Brown Sand & Gravel with Cobbles and trace Silt
SAMPLE SUPPLIER: Harvested from Borehole Split Spoon
SAMPLE LOCATION: BH#3, Sampled from 0.75m bgs

GRAIN SIZE DISTRIBUTION



SIEVE SIZE mm	PERCENT PASSING SPECIFIED MIN.	PERCENT PASSING SPECIFIED MAX.	PERCENT PASSING SAMPLE	GRANULAR 'B Type I' OPSS FORM 1010	
150.0	100	100	100.0		**NOTES:** Smaller than specified sample size processed. Results are for illustration purposes only. Tested sample also meets OPSS 1010 as Select Subgrade Matrerial (SSM).
26.5	50	100	100.0		
4.75	20	100	49.6		
1.18	10	100	28.8		
0.300	2	65	17.6		
0.075	0	8	9.7	#	

Remarks Sample is marginally outside the requirements for OPSS Granular B Type I

Asphalt Coated Particles (%) _____
OPSS Spec. = 30% Max.

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GRAIN - SIZE ANALYSIS

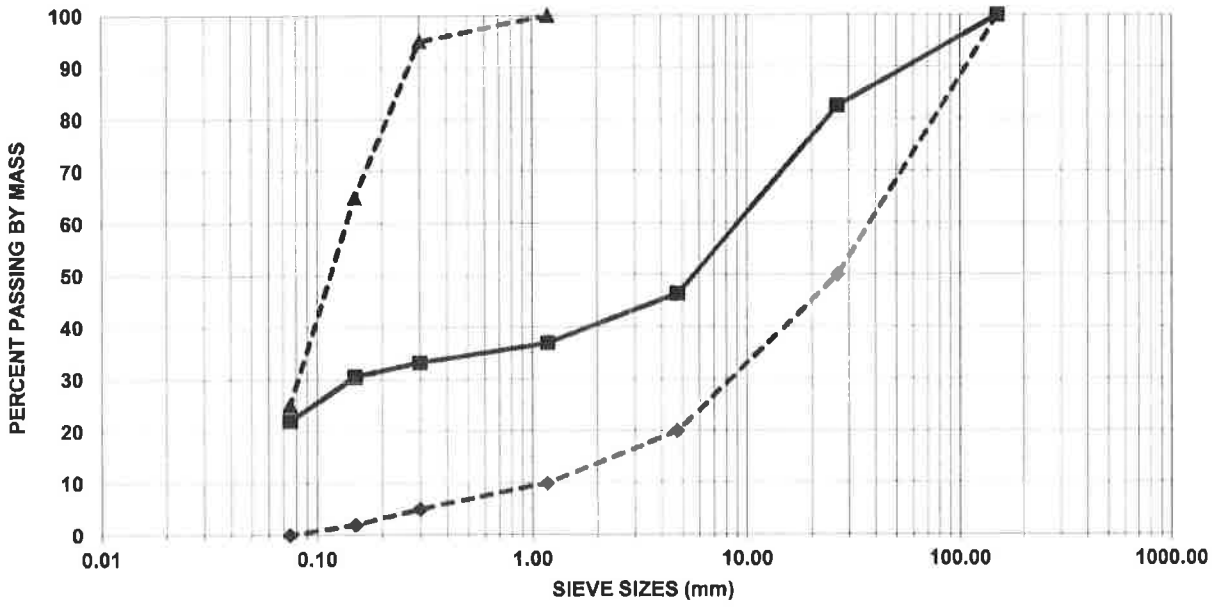
PROJECT: Aggregate Investigation
LOCATION: 584015 - 60 Sideroad
CLIENT: Pearl and Brian Bumstead

PROJECT NO: 210099
LAB SAMPLE NO: S-1255

SAMPLE DATE: March 7, 2013
SAMPLED BY: D.B.

SAMPLE MATERIAL: Brown Sand and Gravel with cobbles and some Silt
SAMPLE SUPPLIER: Harvested from Borehole Split Spoon
SAMPLE LOCATION: BH#4, Sampled from 0.75m bgs

GRAIN SIZE DISTRIBUTION



SIEVE SIZE mm	PERCENT PASSING SPECIFIED MIN.	PERCENT PASSING SPECIFIED MAX.	PERCENT PASSING SAMPLE
150.0	100	100	**100.0**
26.5	50	100	**82.5**
4.75	20	100	**46.4**
1.18	10	100	**36.9**
0.300	5	95	**33.2**
0.150	2	65	**30.6**
0.075	0	25	**22.0**

Select Subgrade Material OPSS FORM 1010

NOTES:
Smaller than specified sample size processed. Results are for illustration purposes only.

Remarks Sample meets the requirements for Select Subgrade Material

Asphalt Coated Particles (%) _____
OPSS Spec. = 30% Max.

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GRAIN SIZE ANALYSIS

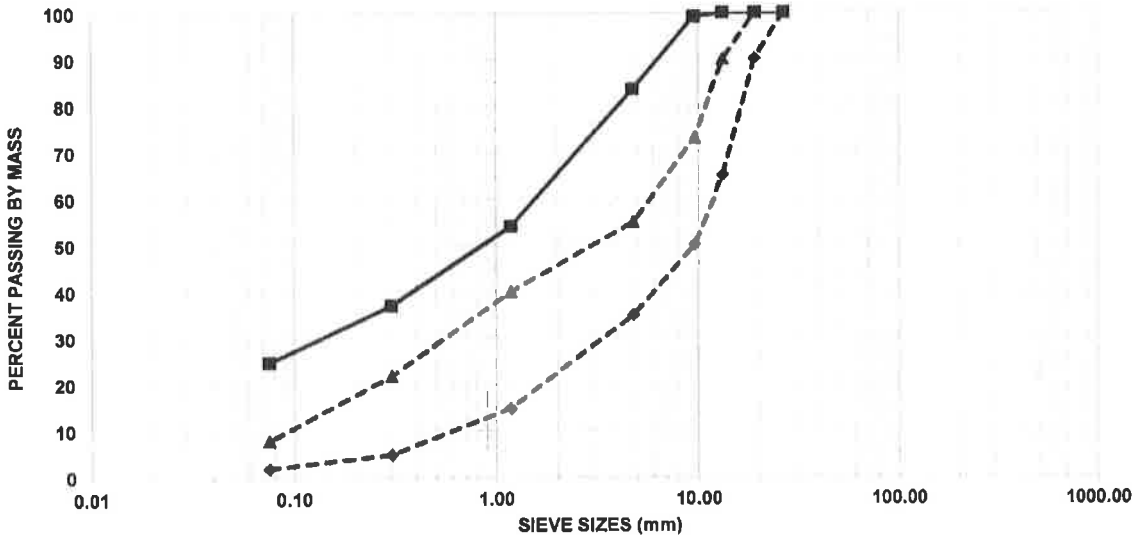
PROJECT: Aggregate Investigation
LOCATION: 584015 - 60 Sideroad
CLIENT: Pearl and Brian Bumstead

PROJECT NO: 210099
LAB SAMPLE NO: S-1256

SAMPLE DATE: March 7, 2013
SAMPLED BY: D.B.

SAMPLE MATERIAL: Brown Crushed Sand & Gravel with traces of Asphalt
SAMPLE SUPPLIER: Harvested from Borehole Split Spoon
SAMPLE LOCATION: BH#5, Sampled from 0.15m bgs

GRAIN SIZE DISTRIBUTION



SIEVE SIZE mm	PERCENT PASSING			GRANULAR 'A' OPSS FORM 1010	
	SPECIFIED MIN.	SPECIFIED MAX.	SAMPLE		
26.5	100	100	**100.0**		**NOTES:**
19.0	90	100	**100.0**		Smaller than specified sample size processed. Results are for illustration purposes only
13.2	65	90	**100.0**	#	
9.5	50	73	**99.2**	#	
4.75	35	55	**83.6**	#	
1.18	15	40	**54.1**	#	
0.300	5	22	**37.1**	#	
0.075	2	8	**24.8**	#	

Remarks: Sample is outside the grading requirements for OPSS Granular A

Asphalt Coated Particles (%) _____ Crushed Particles (%) _____

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GRAIN - SIZE ANALYSIS

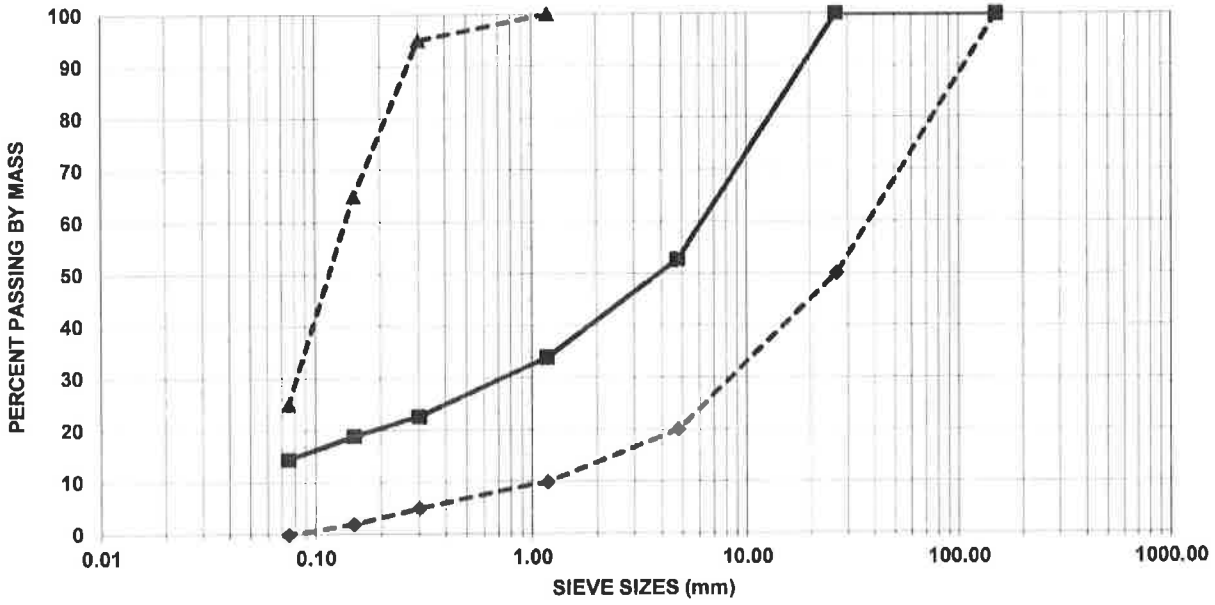
PROJECT: Aggregate Investigation
LOCATION: 584015 - 60 Sideroad
CLIENT: Pearl and Brian Bumstead

PROJECT NO: 210099
LAB SAMPLE NO: S-1257

SAMPLE DATE: March 7, 2013
SAMPLED BY: D.B.

SAMPLE MATERIAL: Brown Sand and Gravel with Cobbles
SAMPLE SUPPLIER: Harvested from Borehole Split Spoon
SAMPLE LOCATION: BH#5, Sampled from 0.75m bgs

GRAIN SIZE DISTRIBUTION



SIEVE SIZE mm	PERCENT PASSING SPECIFIED MIN.	PERCENT PASSING SPECIFIED MAX.	PERCENT PASSING SAMPLE
150.0	100	100	**100.0**
26.5	50	100	**100.0**
4.75	20	100	**52.7**
1.18	10	100	**33.9**
0.300	5	95	**22.6**
0.150	2	65	**18.9**
0.075	0	25	**14.4**

Select Subgrade Material OPSS FORM 1010

NOTES:
Smaller than specified sample size processed. Results are for illustration purposes only.

Remarks Sample meets the requirements for Select Subgrade Material

Asphalt Coated Particles (%) _____
OPSS Spec = 30% Max

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GRAIN - SIZE ANALYSIS

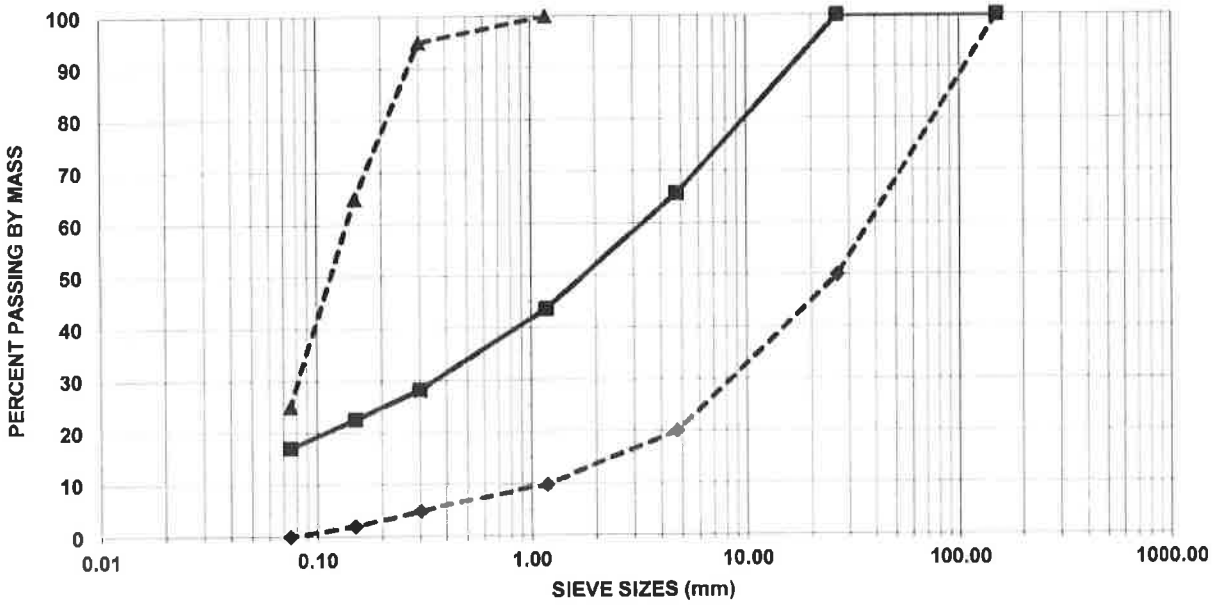
PROJECT: Aggregate Investigation
LOCATION: 584015 - 60 Sideroad
CLIENT: Pearl and Brian Bumstead

PROJECT NO: 210099
LAB SAMPLE NO: S-1258

SAMPLE DATE: March 7, 2013
SAMPLED BY: D.B.

SAMPLE MATERIAL: Brown Sand and Gravel with Cobbles and trace Silt
SAMPLE SUPPLIER: Harvested from Borehole Split Spoon
SAMPLE LOCATION: BH#6, Sampled from 0.75m bgs

GRAIN SIZE DISTRIBUTION



SIEVE SIZE mm	PERCENT PASSING SPECIFIED MIN.	PERCENT PASSING SPECIFIED MAX.	PERCENT PASSING SAMPLE	Select Subgrade Material OPSS FORM 1010
150.0	100	100	**100.0**	
26.5	50	100	**100.0**	
4.75	20	100	**65.8**	
1.18	10	100	**43.7**	
0.300	5	95	**28.2**	
0.150	2	65	**22.6**	
0.075	0	25	**17.1**	

NOTES:
Smaller than specified sample size processed. Results are for illustration purposes only.

Remarks Sample meets the requirements for Select Subgrade Material

Asphalt Coated Particles (%) _____
OPSS Spec = 30% Max.

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GRAIN - SIZE ANALYSIS

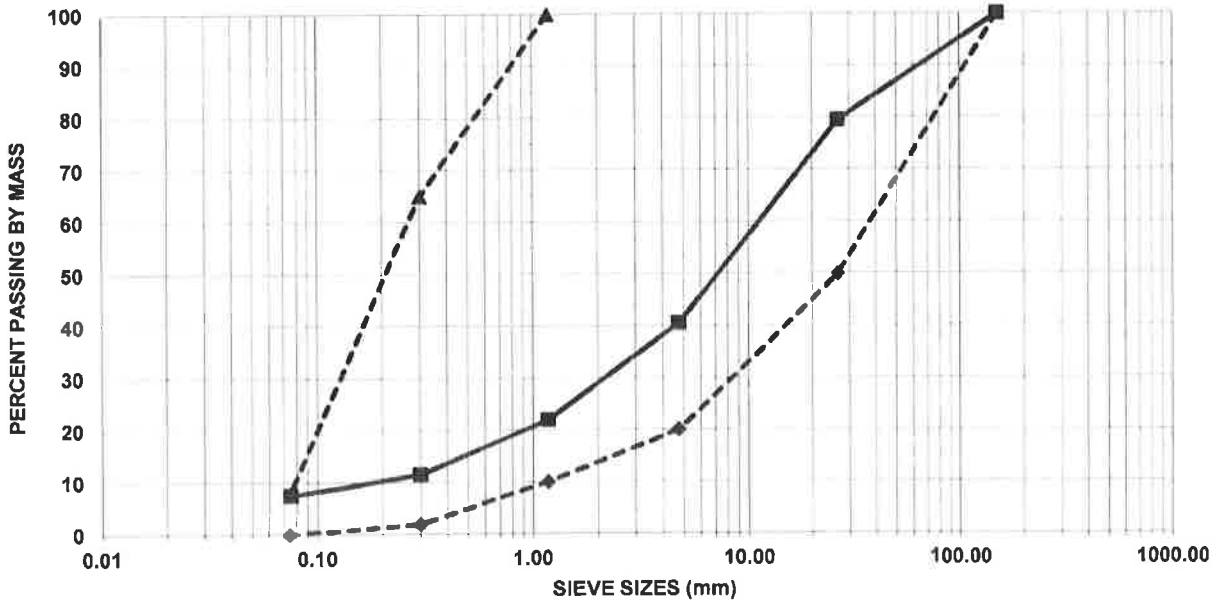
PROJECT: Aggregate Investigation
LOCATION: 584015 - 60 Sideroad
CLIENT: Pearl and Brian Bumstead

PROJECT NO: 210099
LAB SAMPLE NO: S-1259

SAMPLE DATE: March 7, 2013
SAMPLED BY: D.B.

SAMPLE MATERIAL: Brown Sand & Gravel with Cobbles
SAMPLE SUPPLIER: Harvested from Borehole Split Spoon
SAMPLE LOCATION: BH#7, Sampled from 1.5m bgs

GRAIN SIZE DISTRIBUTION



SIEVE SIZE mm	PERCENT PASSING SPECIFIED MIN.	PERCENT PASSING SPECIFIED MAX.	PERCENT PASSING SAMPLE	GRANULAR 'B Type I' OPSS FORM 1010
150.0	100	100	**100.0**	
26.5	50	100	**79.5**	
4.75	20	100	**40.5**	
1.18	10	100	**21.9**	
0.300	2	65	**11.5**	
0.075	0	8	**7.4**	

NOTES:
Smaller than specified sample size processed. Results are for illustration purposes only. Tested sample also meets OPSS 1010 as Select Subgrade Matrerial (SSM).

Remarks Sample meets the requirements of OPSS Granular B Type I

Asphalt Coated Particles (%) _____
OPSS Spec = 30% Max.

ROAD ASSESSMENT
PROPOSED CLASS "A" GRAVEL PIT
584015 – SIDEROAD 60, BERKELEY
Part Lot 27, Concession 7
(FORMER TOWNSHIP OF HOLLAND)
TOWNSHIP OF CHATSWORTH
COUNTY OF GREY

APPENDIX "D"

Structural Design Guidelines for Flexible Pavements – Secondary Highways

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Table 3.4 Structural Design Guidelines for Flexible Pavements — Secondary Highways

		Subgrade Material					
AADT	Pavement Structure Elements	Gravels and Sands Suitable as Gran-Borrow	SANDS AND SILTS 5-75µm <40%	SANDS AND SILTS 5-75µm 40-55%	SANDS AND SILTS 5-75µm >55%	Lacustrine Clays	Varved & Leda Clays
2000-3000 AADT	HM	90	90	90	90	90	90
	B	150	150	150	150	150	150
	SB**	—	300	450	600	450	800
	GBE	330	530	630	730	630	865
1500-2000 AADT	HM	50	50	50	50	50	50
	B	150	150	150	150	150	150
	SB**	—	250	300	450	300	450 (300-600)
	GBE	250	415	450	550	450	550 (450-650)
1000-1500 AADT	CL	50	50	50	50	50	50
	B	150	150	150	150	150	150
	SB**	—	250	300	450	300	450 (300-600)
	GBE	240	405	440	540	450	540 (450-640)
500-1000 AADT	ST*	—	—	—	—	—	—
	B	150	150	150	150	150	150
	SB*	—	150	250	300	250	350 (250-450)
	GBE	150	250	315	350	315	385 (315-450)
200-500 AADT	ST*	—	—	—	—	—	—
	B	150	150	150	150	150	150
	SB**	—	150	250	300	250	300
	GBE	150	250	315	350	315	350
Less than 200 AADT	Gravel	—	—	—	—	—	—
	B	100	100	100	100	100	100
	SB**	—	150	250	300	250	300
	GBE	100	200	265	300	265	300

Notes: All AADT Volumes refer to Present Traffic.

HM — Hot Mix Asphalt & Thickness
B — Base Thickness
SB — Subbase Thickness
GBE — Granular Base Equivalency Thickness
(1 mm HM = 2 mm B = 3 mm SB = 1.11)
CL — Cold Mixed, Cold Laid or Road Mixed Mulch
ST — Double Surface Treatment or Single Surface Treatment with Prime.
* — Apply surface treatments 0.25 m wider than lane width.
** — Proposed subbase thicknesses may be decreased or increased respectively, for harder or softer subgrade conditions in each category, except for varved and leda clay subgrade where exceptionally large ranges are shown.