BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix C

Monitoring Well and Soil Logs

Appendix C1
Summary of Landfill Monitoring Wells & Boreholes
St. Marys Landfill

Monitoring Well	Date of Installation	Screened Stratigraphy	Top of Casing (m ags)	Depth Below Ground Surface							Well Status
				Borehole Depth	Well Screen		Sand Pack		Bentonite Seal		
					Bottom	Top	Bottom	Top	Bottom	Top	
OW1-80	27-May-80	Clayey Silt Till	0.93	7.60	6.90	6.30	7.60	6.00	6.00	5.80	Decom
OW2-80	27-May-80	Clayey Silt Till		6.40	5.80	5.20	6.40	4.80	4.80	4.60	Decom
OW3-80	27-May-80	Clayey Silt Till	1.13	4.60	4.20	3.60	4.60	3.00	3.00	2.80	Decom
OW4-80	27-May-80	Clayey Silt Till	1.03	10.50	9.80	9.20	10.50	9.00	9.00	8.80	Decom
OW1-84	25-Sep-84	Sandy Clayey Silt Till w Gravel	0.61	9.60	8.38	7.62	9.60	6.50	6.50	5.87	Decom
OW2-84	25-Sep-84	Sand and Gravel	0.65	9.60	9.53	8.77	9.60	8.08	8.08	7.10	WL / S
OW3-84	24-Sep-84	Sand with Gravel	0.46	13.87	13.87	13.11	13.87	11.05	11.05	10.36	WL
OW4-84	24-Sep-84	Silty Sand / Clayey Silt	0.84	13.87	3.05	2.29	3.05	1.83	1.83	1.45	WL / S
OW5-84	25-Sep-84	Sand with Gravel	0.49	14.78	14.78	14.02	14.78	11.73	11.73	11.28	WL / S
OW6-84	25-Sep-84	Silt / Clayey Silt Till	0.86	14.78	3.20	2.44	3.20	2.18	2.18	1.98	WL
OW7-91	4-Oct-91	Limestone	0.77	39.22	39.01	37.49	39.22	33.83	33.83	0.50	WL / S
OW8A-91	3-Oct-91	Limestone	0.86	32.36	32.11	30.58	32.11	26.36	26.36	0.60	WL / S
OW8B-10	25-Oct-10	Clay	0.96	6.40	6.40	5.49	6.40	4.57	4.57	0.00	WL / S
OW9A-91	1-Oct-91	Limestone	0.74	40.39	40.39	38.86	40.39	37.19	37.19	0.55	WL / S
OW9B-91	1-Oct-91	Gravel	0.84	6.55	6.10	5.18	6.55	4.57	4.57	0.60	WL / S
OW15-91	21-Oct-91	Sand and Gravel	0.85	6.20	5.49	4.57	5.49	3.91	3.91	0.60	WL / S
OW17-91	16-Nov-91	Silt Till / Sand / Silt and Sand	1.00	9.45	5.79	2.74	6.05	2.34	2.34	0.60	Decom
OW21-91	9-Dec-91	Silt and Sand Till / Silt and Clay	0.77	7.70	7.70	6.17	7.70	5.33	5.33	0.60	WL / S
OW25-91	11-Dec-91	Silt some Sand / Gravel	0.56	10.36	9.75	8.84	10.36	7.01	7.01	0.61	WL / S
OW32-96	7-Aug-96	Silt Till	0.89	11.58	11.43	9.91	11.58	6.10	6.10	1.22	WL / S
OW32A-02	17-Sep-02	Limestone	0.45	43.28	43.28	40.24	43.28	36.58	36.58	0.00	WL / S
OW33-96	8-Aug-96	Till	0.91	13.56	13.41	11.89	13.56	9.85	9.85	1.20	WL / S
OW34-96	9-Aug-96	Silt Till	0.82	9.14	8.99	5.94	9.14	4.42	4.42	1.25	WL / S
OW35			0.57		42.08						Inactive
MW04-01			0.65		15.07						Inactive
MW04-02			0.71		11.97						Inactive
MW04-03			0.74		15.82						Inactive
MW04-04			0.77		31.57						Inactive
DP1	24-Nov-15	-	1.12	0.71	0.71	0.41	-	-	-	-	WL
DP2	24-Nov-15	-	1.16	0.67	0.67	0.37	-	-	-	-	WL
DP3	24-Nov-15	-	1.15	0.68	0.68	0.38	-	-	-	-	WL

Monitoring Well	Well Location	Screened Flow System	Elevation (above mean sea level)								
			Ground Elevation	Top of Casing	Bottom of Borehole	Well Screen		Sand Pack		Bentonite Seal	
						Bottom	Top	Bottom	Top	Bottom	Top
OW1-80	Phase II/III	Shallow Overburden	316.02	316.95	308.42	309.12	309.72	308.42	310.02	310.02	310.22
OW2-80	Phase II/III	Shallow Overburden	NA	315.39	NA	NA	NA	NA	NA	NA	NA
OW3-80	Phase I	Shallow Overburden	315.07	316.20	310.47	310.87	311.47	310.47	312.07	312.07	312.27
OW4-80	Phase I	Deep Overburden	315.10	316.13	304.60	305.30	305.90	304.60	306.10	306.10	306.30
OW1-84	Phase I	Shallow Overburden	321.87	322.48	312.27	313.49	314.25	312.27	315.37	315.37	316.00
OW2-84	Phase I	Shallow Overburden	322.19	322.84	312.59	312.66	313.42	312.59	314.11	314.11	315.09
OW3-84	Phase I	Deep Overburden	314.58	315.04	300.71	300.71	301.47	300.71	303.53	303.53	304.22
OW4-84	Phase I	Shallow Overburden	314.52	315.36	300.65	311.47	312.23	311.47	312.69	312.69	313.07
OW5-84	Phase I	Deep Overburden	313.93	314.42	299.15	299.15	299.91	299.15	302.20	302.20	302.65
OW6-84	Phase I	Shallow Overburden	313.93	314.79	299.15	310.73	311.49	310.73	311.75	311.75	311.95
OW7-91	Phase I	Bedrock	314.50	315.27	275.28	275.49	277.01	275.28	280.67	280.67	314.00
OW8A-91	Phase II/III	Bedrock	314.00	314.86	281.64	281.89	283.42	281.89	287.64	287.64	313.40
OW8B-10	Phase II/III	Shallow Overburden	314.39	315.35	307.99	307.99	308.90	307.99	309.82	309.82	314.39
OW9A-91	Phase II/III	Bedrock	317.75	318.49	277.36	277.36	278.89	277.36	280.56	280.56	317.20
OW9B-91	Phase II/III	Shallow Overburden	317.74	318.58	311.19	311.64	312.56	311.19	313.17	313.17	317.14
OW15-91	Phase II/III	Shallow Overburden	317.82	318.67	311.62	312.33	313.25	312.33	313.91	313.91	317.22
OW17-91	Phase II/III	Shallow Overburden	317.39	318.39	307.94	311.60	314.65	311.34	315.05	315.05	316.79
OW21-91	Phase I	Shallow Overburden	319.99	320.76	312.29	312.29	313.82	312.29	314.66	314.66	319.39
OW25-91	Phase II/III	Shallow Overburden	322.86	323.42	312.50	313.11	314.02	312.50	315.85	315.85	322.25
OW32-96	Phase I	Shallow Overburden	322.54	323.43	310.96	311.11	312.63	310.96	316.44	316.44	321.32
OW32A-02	Phase I	Bedrock	322.09	322.54	278.81	278.81	281.85	278.81	285.51	285.51	322.09
OW33-96	Phase I	Shallow Overburden	320.66	321.57	307.10	307.25	308.77	307.10	310.81	310.81	319.46
OW34-96	Phase I	Shallow Overburden	320.77	321.59	311.63	311.78	314.83	311.63	316.35	316.35	319.52
OW35			312.95	313.52		270.87					
MW04-01	CKD Pile		332.90	333.55		317.83					
MW04-02	CKD Pile		329.41	330.12		317.44					
MW04-03	CKD Pile		329.33	330.07		313.51					
MW04-04	Phase II/III	Bedrock	314.21	314.98		282.64					
DP1	Phase II/III		310.06	311.18	309.35	309.35	309.65	-	-	-	-
DP2	Phase I		309.57	310.73	308.90	308.90	309.20	-	-	-	-
DP3	Phase I		308.86	310.01	308.18	308.18	308.48	-	-	-	-

Notes:

All measurmetns are in metres
ags - above ground surface
MW - monitoring well - 51 mm diameter PVC
OW - observation well - 51 mm diameter PVC; except OW7-91, OW8A-91 and OW9A-91 - 102 mm diameter PVC
DP - drive point - 19 mm diameter stainless-steel screen and galvanized steel standpipe
All measurements are based on conditions at time of construction

WL - water levels measured as part of monitoring program
S - water samples collected as part of monitoring program
NA - not available

Decom - decommissioned
CKD - cement kiln dust
Inactive - not currently monitored

Appendix C1
Summary of Landfill Monitoring Wells & Boreholes
St. Marys Landfill

Borehole	*Date*	*Ground Elevation (amsl)*	*Borehole Depth (bgs)*	*Borehole Depth (amsl)*	*Location*
BH10-91	15-Oct-91	317.37	20.12	297.25	Phase II/III
BH11-91	10-Oct-91	316.25	17.68	298.57	Phase II/III
BH12-91	16-Oct-91	317.07	19.96	297.11	Phase II/III
BH13-91	18-Oct-91	313.79	15.54	298.25	Phase II/III
BH14-91	21-Oct-91	317.60	7.57	310.03	Phase II/III
BH16-91	21-Oct-91	317.24	7.32	309.92	Phase II/III
BH18-91	16-Nov-91	317.00	7.47	309.53	Phase II/III
BH19-91	16-Nov-91	317.39	6.71	310.68	Phase II/III
BH20-91	9-Dec-91	315.62	6.71	308.91	Phase II/III
BH22-91	10-Dec-91	314.22	4.27	309.95	Phase II/III
BH23-91	11-Dec-91	313.97	5.18	308.79	Phase II/III
BH24-91	11-Dec-91	313.97	4.57	309.40	Phase II/III
BH26-91	12-Dec-91	316.96	8.23	308.73	Phase II/III
BH27-91	12-Dec-91	316.01	8.23	307.78	Phase II/III
BH28-91	12-Dec-91	313.50	6.55	306.95	Phase II/III
BH29-91	13-Dec-91	314.24	6.71	307.53	Phase II/III
BH30-91	13-Dec-91	317.61	8.23	309.38	Phase II/III
BH31-91	13-Dec-91	316.52	8.08	308.44	Phase II/III

Notes:
All measurements are in metres
amsl - above mean sea level
bgs - below ground surface

Project Name: ST. MARYS LANDFILL SITE
Job No. 979-645
Client: TOWN OF ST. MARYS
Borehole Type: Hollow Stem Auger
Location: On Site

Borehole No. OW1-80
Date Completed May 27, 1980
Geologist/Engineer ESR
Elevation Top of Casing, 316.946m AMS

Profile			Sample			Penetration Test Blows/Foot	Piezometer or Standpipe Installation
Depth (Elev.)	Stratigraphy	Description & Remarks	Number	Type	Blows/Foot	20 40 60 80	
							Threaded Plug
		Grey clayey-silt till					3.3cm Ø PVC Pipe
3m			13	AS			Borehole Cuttings
6.1m			14	AS			Bentonite Seal
							Sand
7.6m			15	SS	100		Well Screen 3.8cm x .6m slotted PVC pipe wrapped with fiberglass cloth

FIGURE 2.1

Conestoga - Rovers & Associates

Project Name: ST. MARYS LANDFILL SITE
Job No. 979-645
Client: TOWN OF ST. MARYS
Borehole Type: Hollow Stem Auger
Location: On Site

Borehole No. OW2-80
Date Completed May 27, 1980
Geologist/Engineer ESR
Elevation Top of Casing, 315.386m

Profile			Sample			Penetration Test Blows/Foot	Piezometer or Standpipe Installation
Depth (Elev.)	Stratigraphy	Description & Remarks	Number	Type	Blows/Foot	20 40 60 80	
							Threaded Plug
		Grey clayey-silt till					3.8cm ø PVC pipe
3m							Borehole Cuttings
							Bentonite Seal
6.1m							Sand
6.4m							Well Screen 3.8cm x .6m slotted PVC pipe wrapped with fiberglass cloth

FIGURE 2.2

Conestoga - Rovers & Associates

Project Name: ST. MARYS LANDFILL SITE
Job No. 979-645
Client: TOWN OF ST. MARYS
Borehole Type: Hollow Stem Auger
Location:

Borehole No. OW3-80
Date Completed May 27, 1980
Geologist/Engineer ESR
Elevation Top of casing, 316.197m

AMS

Profile			Sample			Penetration Test Blows/Foot	Piezometer or Standpipe Installation
Depth (Elev.)	Stratigraphy	Description & Remarks	Number	Type	Blows/Foot	20 40 60 80	
							Threaded Plug
		Grey clayey silt till					3.8cm Ø PVC pipe
1.8m							Borehole Cuttings
2.4m		Grey, clayey silt					
3m		Grey clayey silt till	~~11~~	~~AS~~			Bentonite Seal
							Sand
4.6m			12	SS	40		Well Screen 3.8cm x .6m slotted PVC pipe wrapped with fiberglass cloth

FIGURE 2.3
Conestoga - Rovers & Associates

Project Name: ST. MARYS LANDFILL SITE
Job No. 979-645
Client: TOWN OF ST. MARYS
Borehole Type: Hollow Stem Auger
Location:

Borehole No. OW4-80
Date Completed May 27, 1980
Geologist/Engineer ESR
Elevation Top of Casing, 316.126m

Profile			Sample			Penetration Test Blows/Foot	Piezometer or Standpipe Installation
Depth (Elev.)	Stratigraphy	Description & Remarks	Number	Type	Blows/Foot	20 40 60 80	Threaded Plug
		Grey clayey silt till	1	SS	37		3.8cm ø PVC pipe
1.2m							
1.8m		Grey clayey silt	2	SS	53		
			3	SS	56		Borehole Cuttings
3m		Grey clayey silt till	4	SS			
			5	SS	26		
			6	SS	31		
			7	SS	31		
6.1m			8	SS			
			9	SS	62		
							Bentonite Seal
9.1m			10	SS	100		
							Sand
10.2m		Rock					Well Screen 3.8cm x .6m slotted PVC pipe wrapped with fiberglass cloth

FIGURE 2.4

Conestoga - Rovers & Associates

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : ST. MARYS LANDFILL SITE
JOB Nº : 9-645
CLIENT : TOWN OF ST. MARYS
HOLE TYPE : HOLLOW STEM AUGER
LOCATION :

HOLE Nº: OW1-84
DATE COMPLETED: SEPTEMBER 25, 1984
GEOLOGIST/ENGINEER: PSB
GROUND ELEVATION:* 321.87 m AMSL
TOP OF PIPE ELEVATION:* 322.484 M AMSL

PROFILE		MONITOR INSTALLATION	SAMPLE		
DEPTH (ELEVATION)	STRATIGRAPHY DESCRIPTION & REMARKS		NUMBER	TYPE	BLOWS/FT.
0.0 321.87		Locking Threaded Cap			
		75mm ø x 120 cm Black Iron Casing			
0.91 320.96		Cement grout			
	Sandy clayey silt till with gravel	Borehole cuttings			
		50 mmø PVC Sch. 80 pipe			
5.87 316.00		Peltonite			
6.50 315.37		Silica sand			
8.38 313.49		50 mmø x 760 mm 10 slot PVC well screen			
9.14 312.73	Sandy clayey silt till with wet gravel seams		1	SS	89
9.60 312.27					

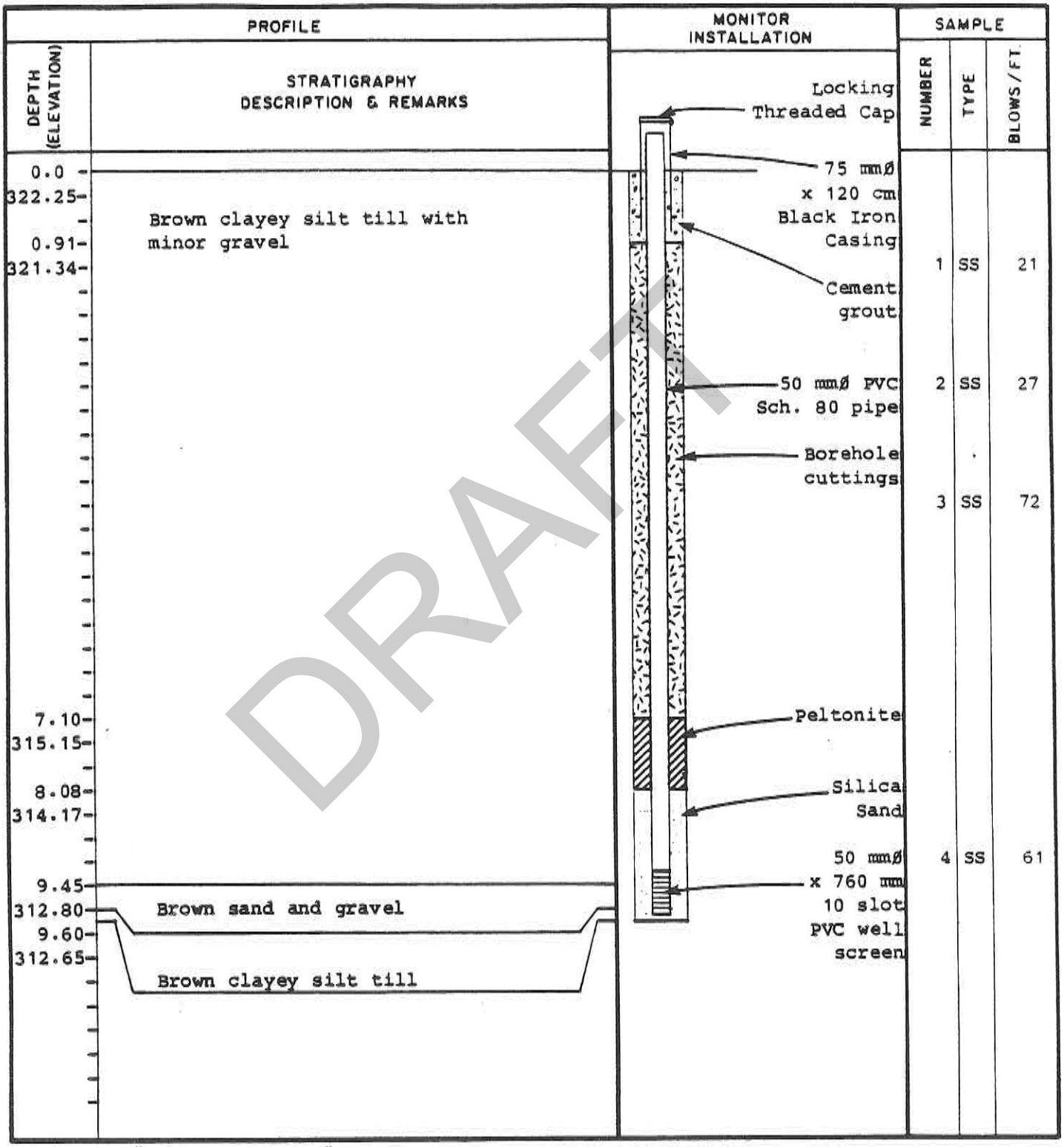
* REFER TO "WATER ELEVATIONS" TABLE FOR CURRENT REFERENCE ELEVATIONS

▼ WATER FOUND ▽ STATIC WATER LEVEL ◯ GRAIN SIZE ANALYSIS SS — SPLIT SPOON SAMPLE

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : ST. MARYS LANDFILL SITE
JOB Nº : 9-645
CLIENT : TOWN OF ST. MARYS
HOLE TYPE : HOLLOW STEM AUGER
LOCATION :

HOLE Nº: OW2-84
DATE COMPLETED: SEPTEMBER 25, 1984
GEOLOGIST/ENGINEER: PSB
GROUND ELEVATION:* 322.25 m AMSL
TOP OF PIPE ELEVATION:* 322.841 m AMSL



* REFER TO "WATER ELEVATIONS" TABLE FOR CURRENT REFERENCE ELEVATIONS

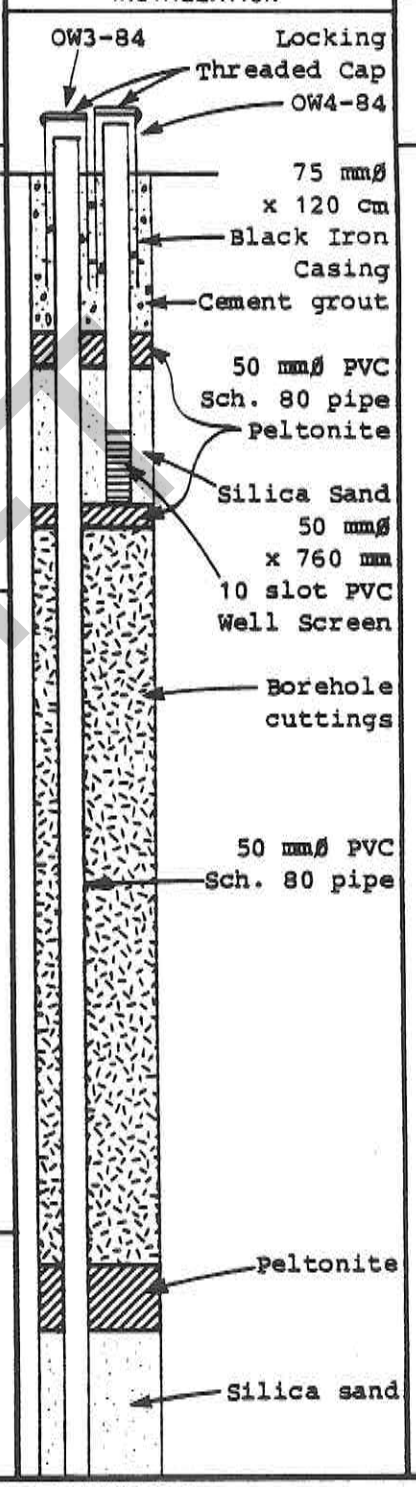
▼ WATER FOUND ▽ STATIC WATER LEVEL ◯ GRAIN SIZE ANALYSIS SS — SPLIT SPOON SAMPLE

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : ST. MARYS LANDFILL SITE
JOB Nº : 9-645
CLIENT : TOWN OF ST. MARYS
HOLE TYPE : HOLLOW STEM AUGER
LOCATION :

HOLE Nº: OW3-84, OW4-84 - page 1 of
DATE COMPLETED: SEPTEMBER 24, 1984
GEOLOGIST/ENGINEER: PSB
GROUND ELEVATION:* 314.52 m AMSL
TOP OF PIPE ELEVATION:* 315.035, 315.364 m AM

DEPTH (ELEVATION)	STRATIGRAPHY DESCRIPTION & REMARKS	NUMBER	TYPE	BLOWS/FT.
0.0 - 314.52	Interbedded moist to wet brown silty sand and clayey silt with minor gravel	1	SS	48
1.45 - 313.07				
1.83 - 312.69				
3.05 - 311.47		2	SS	88
3.66 - 310.86	Dry brown clayey silt till with minor gravel	3	SS	54
		4	SS	64
		5	SS	180
		6	SS	183
10.06 - 304.46	Moist brown clayey silt till with sand and minor gravel	7	SS	150
10.36 - 304.16				
11.05 - 303.47				
12.19 - 302.33		8	SS	102



* REFER TO "WATER ELEVATIONS" TABLE FOR CURRENT REFERENCE ELEVATIONS

▼ WATER FOUND ▽ STATIC WATER LEVEL ◯ GRAIN SIZE ANALYSIS SS — SPLIT SPOON SAMPLE

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : ST. MARYS LANDFILL SITE
JOB Nº : 9-645
CLIENT : TOWN OF ST. MARYS
HOLE TYPE : HOLLOW STEM AUGER
LOCATION :

HOLE Nº: OW3-84, OW4-84 - page 2 of
DATE COMPLETED: SEPTEMBER 24, 1984
GEOLOGIST/ENGINEER : PSB
GROUND ELEVATION:* 314.52 m AMSL
TOP OF PIPE ELEVATION:* 315.035, 315.364 m AM

PROFILE		MONITOR INSTALLATION	SAMPLE		
DEPTH (ELEVATION)	STRATIGRAPHY DESCRIPTION & REMARKS		NUMBER	TYPE	BLOWS/FT.
12.19- 302.33-	Moist brown clayey silt till with sand and minor gravel	50 mmØ PVC Sch. 80 pipe			
13.11- 301.41-	Moist brown medium sand with fine sand and fine gravel		9	SS	60
13.87- 300.65-	Bedrock	Silica sand 50 mmØ x 760 mm 10 slot PVC Well screen			

* REFER TO "WATER ELEVATIONS" TABLE FOR CURRENT REFERENCE ELEVATIONS

▼ WATER FOUND ▽ STATIC WATER LEVEL ◯ GRAIN SIZE ANALYSIS SS — SPLIT SPOON SAMPLE

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : ST. MARYS LANDFILL SITE
JOB Nº : 9-645
CLIENT : TOWN OF ST. MARYS
HOLE TYPE : HOLLOW STEM AUGER
LOCATION :

HOLE Nº: OW5-84, OW6-84 - page 1 o
DATE COMPLETED: SEPTEMBER 25, 1984
GEOLOGIST/ENGINEER: PSB
GROUND ELEVATION:* 313.97 m AMSL
TOP OF PIPE ELEVATION:* 314.423, 314.794

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PROFILE		MONITOR INSTALLATION	SAMPLE		
DEPTH (ELEVATION)	STRATIGRAPHY DESCRIPTION & REMARKS		NUMBER	TYPE	BLOWS/FT.
0.0 - 313.97	Dry gray silt with clay and minor fine sand	OW5-84 Locking Threaded Cap; OW6-84; 75 mmØx120 cm Black Iron Casing; Cement grout; 50 mmØ PVC Sch. 80 pipe	1	SS	98
1.68 - 312.29					
1.98 - 311.99	Interbedded dry gray brown silt and clayey silt till with minor gravel	Peltonite; Silica sand 50 mmØ x 760 mm 10 slot PVC well screen	2	SS	38
3.20 - 310.77					
3.81 - 310.16	Dry brown clayey silt till with cobbles	Borehole Cuttings	3	SS	48
			4	SS	55
		50 mmØ PVC Sch. 80 pipe	5	SS	90
			6	SS	144
			7	SS	260
11.28 - 302.69		Peltonite			
11.73 - 302.24					
12.19 - 301.78		Silica sand			

* REFER TO "WATER ELEVATIONS" TABLE FOR CURRENT REFERENCE ELEVATIONS

▼ WATER FOUND ▽ STATIC WATER LEVEL ◯ GRAIN SIZE ANALYSIS SS — SPLIT SPOON SAMPLE

STRATIGRAPHIC AND INSTRUMENTATION LOG

PROJECT NAME : ST. MARYS LANDFILL SITE
JOB Nº : 9-645
CLIENT : TOWN OF ST. MARYS
HOLE TYPE : HOLLOW STEM AUGER
LOCATION :

HOLE Nº: OW5-84, OW6-84 - page 2 of
DATE COMPLETED: SEPTEMBER 25, 1984
GEOLOGIST/ENGINEER: PSB
GROUND ELEVATION:* 313.97 m AMSL
TOP OF PIPE ELEVATION:* 314.423, 314.794 m AM

PROFILE		MONITOR INSTALLATION	SAMPLE		
DEPTH (ELEVATION)	STRATIGRAPHY DESCRIPTION & REMARKS		NUMBER	TYPE	BLOWS/FT.
12.19-301.78	Dry brown clayey silt till with cobbles	Silica sand	8	SS	165
12.80-301.17		50 mmØ PVC Sch. 80 pipe			
	Wet brown coarse sand with gravel and medium sand	Collapsed Sand & gravel	9	SS	108
14.33-299.64		50 mmØ x 760 mm 10 slot PVC Well screen			
14.78-299.19	Bedrock				

* REFER TO "WATER ELEVATIONS" TABLE FOR CURRENT REFERENCE ELEVATIONS

▼ WATER FOUND ▽ STATIC WATER LEVEL ◯ GRAIN SIZE ANALYSIS SS — SPLIT SPOON SAMPLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-01)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW7-91 (Page 1 of 5)
DATE COMPLETED: OCTOBER 4, 1991
DRILLING METHOD: 159mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	REFERENCE POINT (Top of Riser). GROUND SURFACE	315.270 314.50				
1.0	ML-SILT(GLACIOLACUSTINE), trace to little clay, sandy partings (up to 3mm thick) between varved laminations (3 to 20mm thick), non-cohesive, fractured (0.0 to 0.61m BGS), light brown and moist (0.0 and 0.91m BGS), grey and wet (0.91 to 1.52m BGS) - trace clay, non-cohesive, thin varves (2 to to 5mm thick) with frequent sandy partings, light grey and brown, wet, dilatant		CONCRETE SEAL	1CS		
2.0				2CS		
3.0		311.35				
4.0	ML-SILT(TILL), some clay, little sand, frequent pebbles, very hard, cohesive, light to medium gray-brown, damp, one oblique fracture with silty face		254.0mmø BOREHOLE	3CS		
5.0	- frequent cobbles, occasional horizontal fractures, 4.6 to 5.2m BGS, very hard, and less damp below 5.2M - trace to little sand, no apparent fractures		101.6mmø PVC PIPE	4CS		
6.0				5CS		
7.0	- augering refusal at 6.4m change to 6 1/8" air rotary		BENTONITE GROUT			
8.0	ML-SILT(TILL), some fine sand, some gravel, trace to little clay, extremely dense, non-cohesive light brown, moist	306.77				
9.0						
10.0						
11.0				6SS		>100
12.0						
13.0	SP-SAND, fine to medium grained, poorly graded, brown, damp to moist	301.70				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

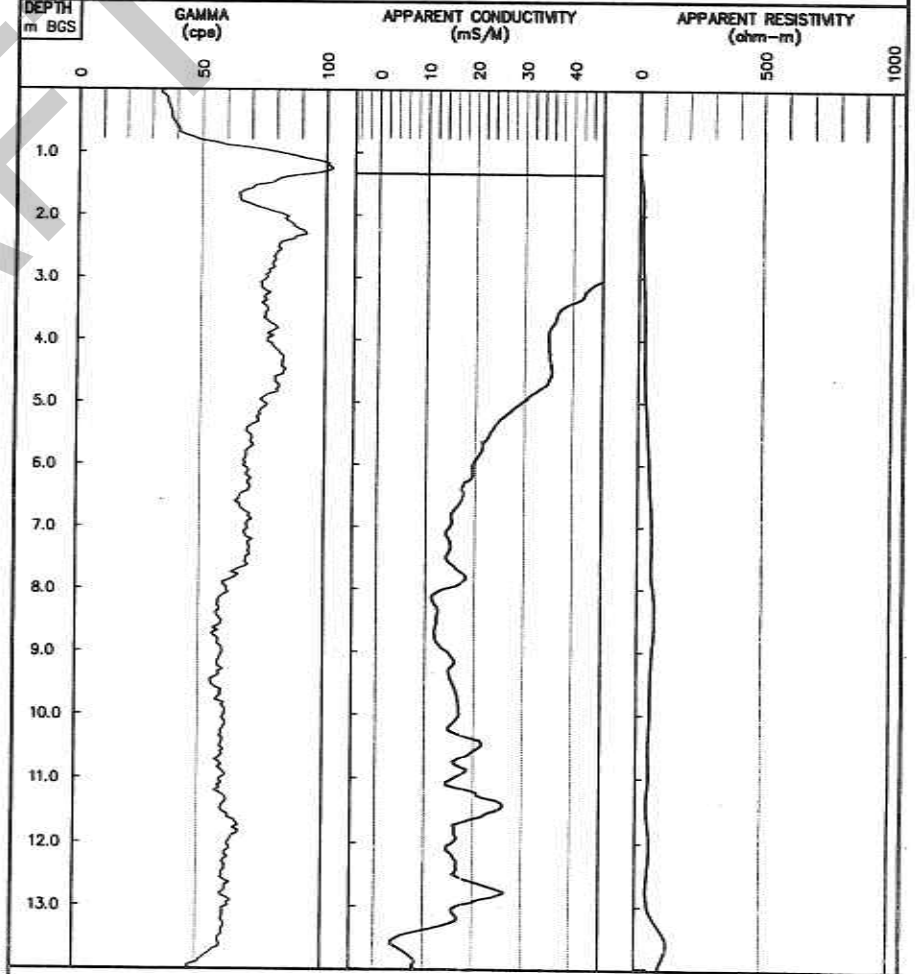
GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-01)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW7-91 (Page 1 of 5)
DATE LOGGED: OCTOBER 11, 1991
DRILLING METHOD: 159mm ID HSA
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-01)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW7-91 (Page 2 of 5)
DATE COMPLETED: OCTOBER 4, 1991
DRILLING METHOD: 159mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
14.0	– fine to medium gravel		254.0mmø BOREHOLE; BENTONITE GROUT; 154.9mmø BOREHOLE; 101.6mmø PVC PIPE			
	END OF OVERBURDEN HOLE @ 14.12 m BGS.	300.40				
15.0						
16.0						
17.0						
18.0						
19.0						
20.0						
21.0						
22.0						
23.0						
24.0						
25.0						
26.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

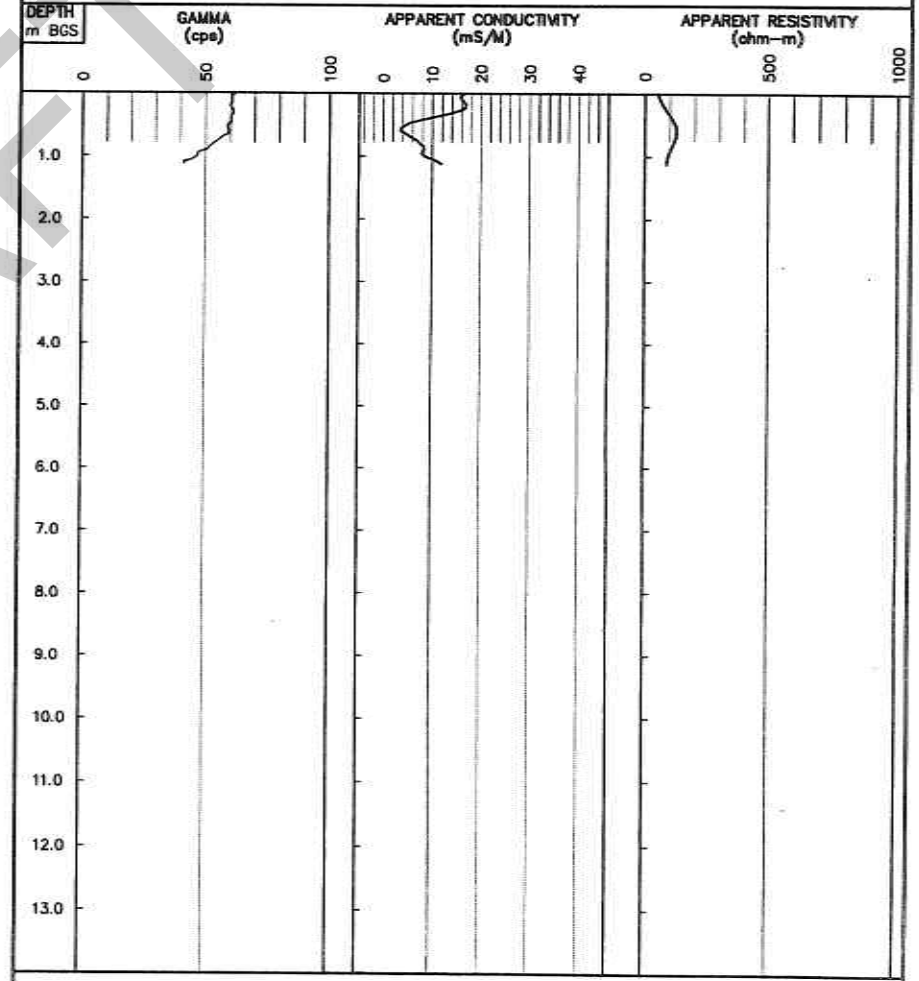
GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-01)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW7-91 (Page 2 of 5)
DATE LOGGED: OCTOBER 11, 1991
DRILLING METHOD: 159mm ID HSA
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

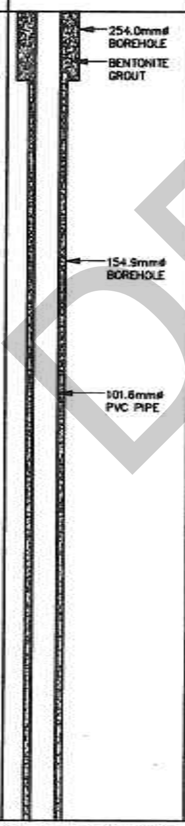
(L-02)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW7-91 (Page 3 of 5)
DATE COMPLETED: OCTOBER 4, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ 6.4cm CORE
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	DESCRIPTION OF STRATA	ELEVATION m AMSL
	See Overburden log	
14.0	LIMESTONE(Dundee Formation): grey, hard, interbeds of brown argillaceous limestone (as described from drilling returns)	300.37
15.0		
16.0		
17.0		
18.0	– argillaceous limestone, soft, brown, interbeds of hard grey limestone	
19.0		
20.0		
21.0		
22.0	LIMESTONE(Lucas Formation):	292.50
23.0		
24.0		
25.0		

Columns: MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY % | RQD % | WATER RETURN %



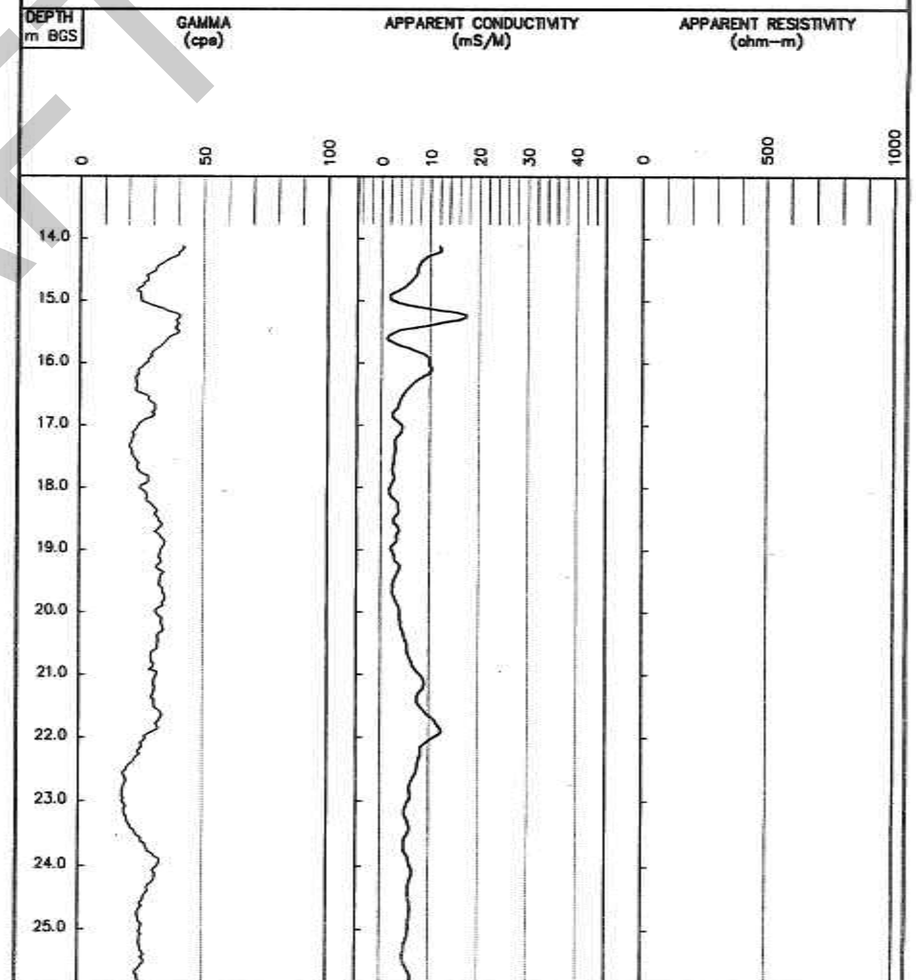
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND   STATIC WATER LEVEL   NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-02)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW7-91 (Page 3 of 5)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ 6.4cm CORE
SURVEY BY HYD-ENG GEOPHYSICS INC.



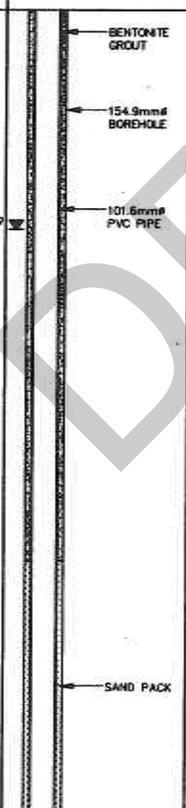
STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-02)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW7-91 (Page 4 of 5)
DATE COMPLETED: OCTOBER 4, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ 6.4cm CORE
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	DESCRIPTION OF STRATA	ELEVATION m AMSL	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY %	RQD %	WATER RETURN %
26.0	– damp							
27.0								
28.0		285.99						
29.0								
30.0	– few thin shale interbeds							
31.0								
32.0								
33.0								
34.0								
35.0	– light to dark brown, sugary to porous/ granular texture, layered							
	– grey (35.66 to 35.81m BGS)							
36.0	– grey with occasional brown layers, brown rock is medium to high porosity, grey rock is low porosity, well fractured, some small vugs and solution cavities, stylolites				1	100	30	
37.0								



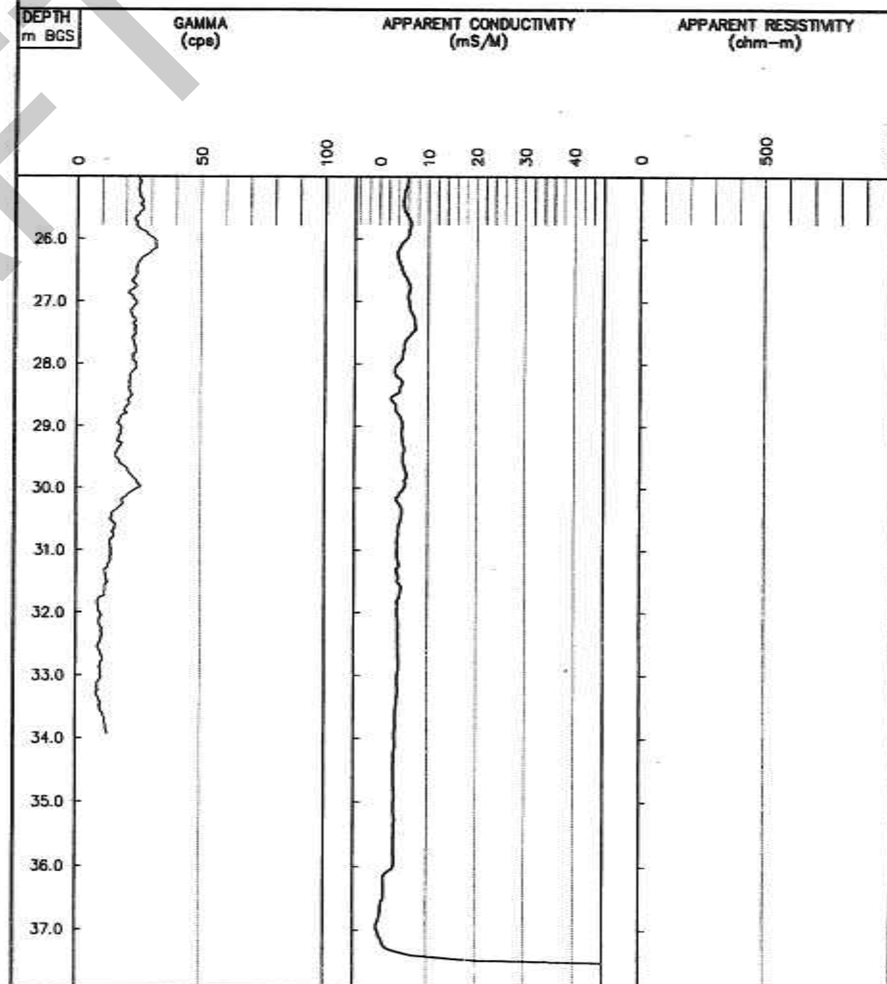
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
▽ WATER FOUND ▼ STATIC WATER LEVEL (OCT 26, 1991) NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-02)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW7-91 (Page 4 of 5)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ 6.4cm CORE
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-02)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW7-91 (Page 5 of 5)
DATE COMPLETED: OCTOBER 4, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ 6.4cm CORE
CRA SUPERVISOR: J.C. MUGFORD

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIT/CORE	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
m BGS		m AMSL				%	%	%
38.0	– fractured (@ 37.95m BGS) – fractured (@ 38.40m BGS) – fractured (@ 38.71m BGS) – (as indicated by drilling rate)		101.6mmø PVC PIPE SAND PACK WELL SCREEN 154.9mmø BOREHOLE					
39.0	END OF HOLE @ 39.22 m BGS.	275.28	SCREEN DETAILS: Screened Interval: 37.49 to 39.01m BGS Length –1.5m Diameter –101.6mm Slot # 10 Material –Stainless Steel Sand pack interval: 33.83 to 39.22m BGS Material –# 3 Silica Sand					
40.0								
41.0								
42.0								
43.0								
44.0								
45.0								
46.0								
47.0								
48.0								
49.0								

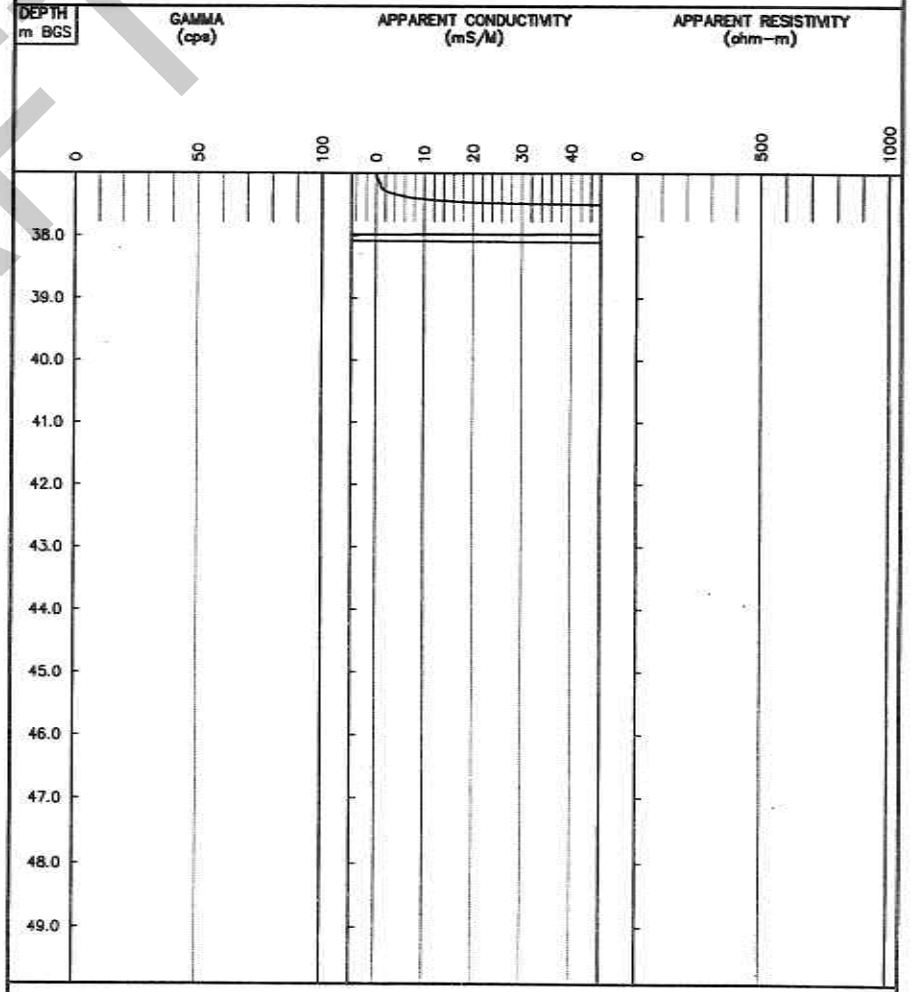
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-02)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW7-91 (Page 5 of 5)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ 6.4cm CORE
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-03)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OWBA-91 (Page 1 of 4)
DATE COMPLETED: OCTOBER 3, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	314.860				
	GROUND SURFACE	314.00				
	ML-SILT(FILL), some clay, some cobbles, hard, brown, damp	313.70	CONCRETE SEAL			
1.0	ML-SILT(GLACIOLACUSTRINE), little to some fine grained sand, trace clay, tan, damp	313.09		1CS		
	ML/CL-SILT(TILL), some clay, some sand, some pebbles and cobbles, extremely hard, massive, no fracturing, brown, damp					
2.0	- becomes light brown to grey, lots of cobbles		254.0mmø BOREHOLE	2CS		
3.0			BENTONITE GROUT			
4.0	- preferential parting in horizontal plane, fewer cobbles and gravel, damp to moist			3CS		
5.0	- some pebbles and small cobbles					
6.0	- more fractured			4CS		
7.0	- fewer pebbles, some horizontal fracturing, minor vertical fracturing, less damp		101.6mmø PVC PIPE	5CS		
8.0						
9.0	- little fine sand, little gravel, very hard, damp to moist		158.8mmø BOREHOLE			
10.0	- boulder					
11.0				6SS		>100
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

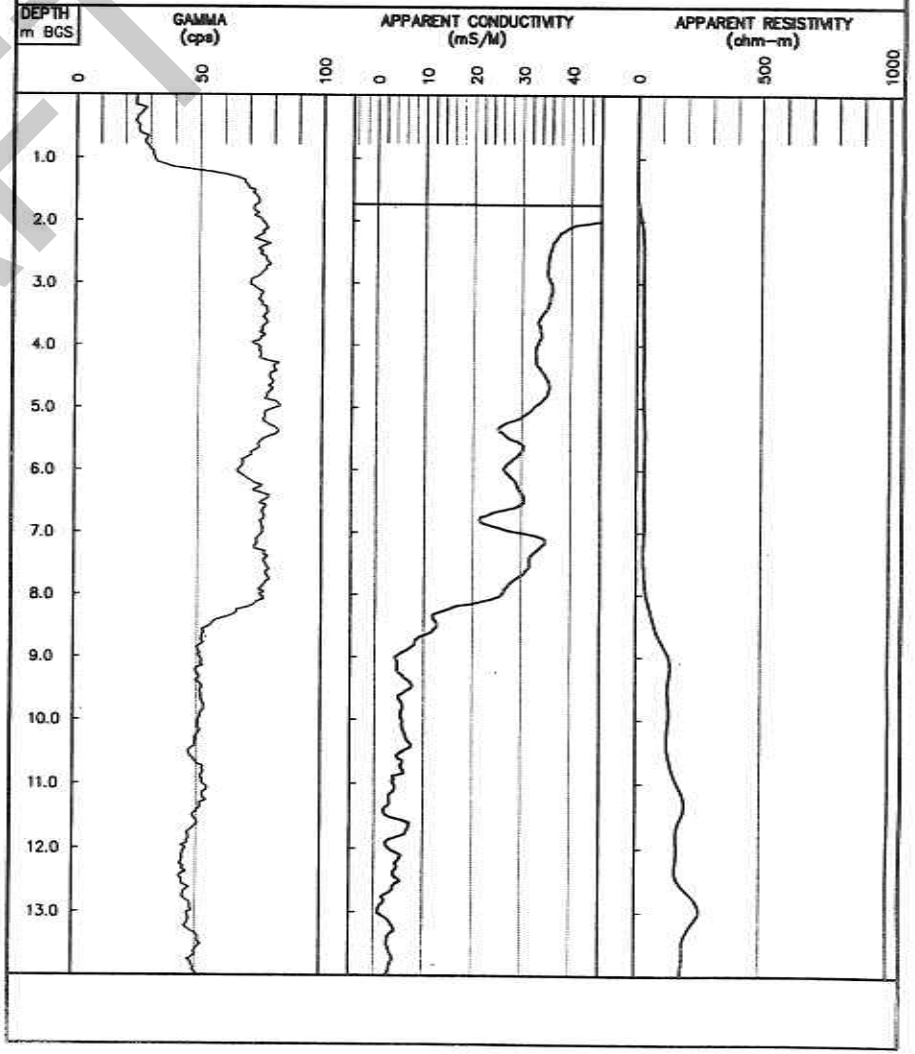
GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-03)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OWBA-91 (Page 1 of 4)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 6 1/4" ID HSA
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-03)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW8A-91 (Page 2 of 4)
DATE COMPLETED: OCTOBER 3, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
14.0	– boulder, moist		158.8mmø BOREHOLE			
15.0						
16.0	– firm, moist to wet, dilatant			7SS	☒	75
17.0			101.6mmø PVC PIPE			
18.0	END OF OVERBURDEN HOLE @ 17.83 m BGS. CONTINUED ON BEDROCK LOG	296.17				
19.0						
20.0						
21.0						
22.0						
23.0						
24.0						
25.0						
26.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

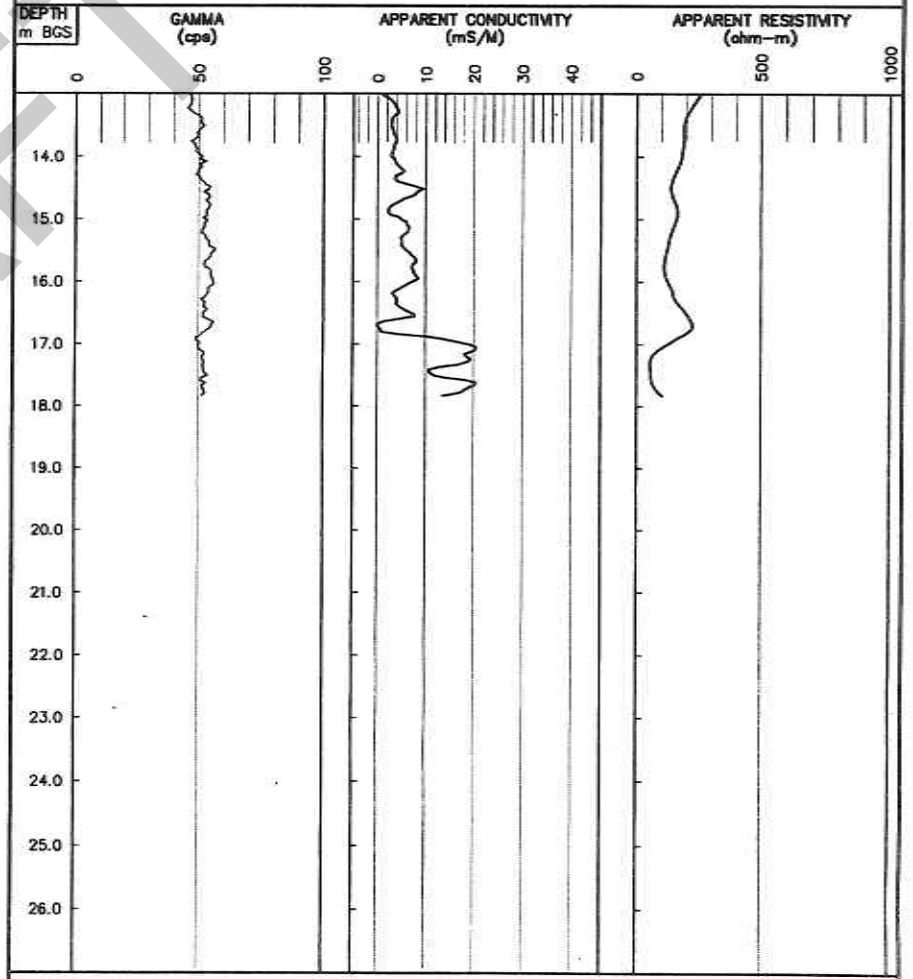
GRAIN SIZE ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-03)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW8A-91 (Page 2 of 4)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 6 1/4" ID HSA
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-04)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OWBA-91 (Page 3 of 4)
DATE COMPLETED: OCTOBER 3, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ CORE
CRA SUPERVISOR: J.C. MUGFORD

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIENDTRE ORCVKAL	RHUUNMBER	CRORECOVERY	RQD	WRETURN
m BGS		m AMSL				%	%	%
	See Overburden log							
17.0								
18.0	LIMESTONE(Dundee Formation): light brown to brown and light to dark grey, fine grained, sugary texture argillaceous, soft, dry (as described from drilling returns)	296.17						
19.0								
20.0			158.8mmø BOREHOLE					
21.0								
22.0			BENTONITE GROUT					
23.0								
24.0								
25.0			101.6mmø PVC PIPE					
26.0	LIMESTONE(Lucas Formation):	288.00						
27.0			BENTONITE PELLET SEAL					
			SAND PACK					
28.0	– water bearing fracture (28.19 to 28.35m BGS)	288.22						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

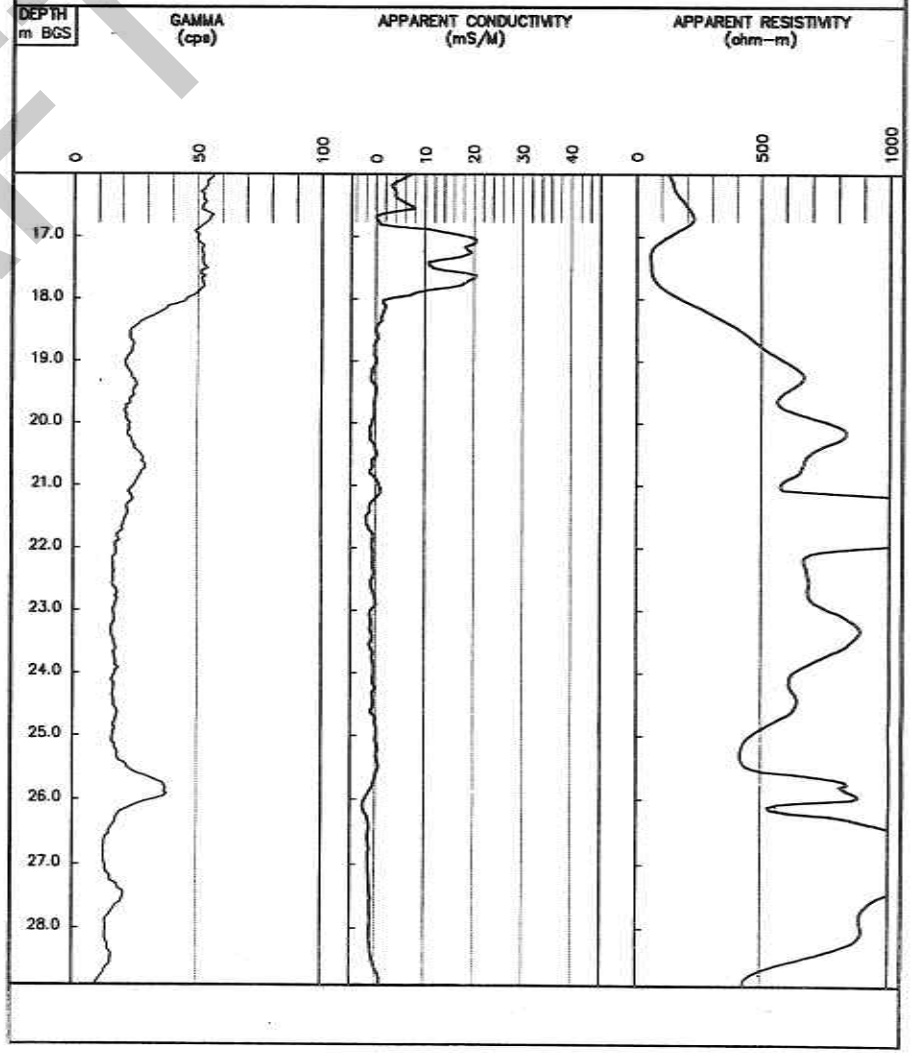
▽ WATER FOUND ▼ STATIC WATER LEVEL (OCT 26/91) NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-04)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OWBA-91 (Page 3 of 4)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ CORE
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-04)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OWBA-91 (Page 4 of 4)
DATE COMPLETED: OCTOBER 3, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ CORE
CRA SUPERVISOR: J.C. MUGFORD

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIT/CORE	RUN NUMBER	CORE RECOVERY	ROD	WATER RETURN
m BGS		m AMSL				%	%	%
29.0	– light grey to brown, solution cavities and vugs (up to 2cm thick) with calcite infilling, stylolites – iron staining (28.35 to 28.65m BGS) – brown (28.65m to 29.11m BGS) – water bearing fracture (@ 28.80m BGS) – grey (29.11 to 29.72m BGS) – water bearing fracture (@ 29.11m BGS) – brown (29.72 to 32.00m BGS) – water bearing fracture (29.72m BGS) – porous (29.72 to 29.87m BGS) – water bearing fracture (@ 30.02m BGS) – water bearing fracture (@ 30.33m BGS) – rough and open water bearing fracture (@ 30.94m BGS) – porous (31.89 to 31.55m BGS) – water bearing fracture (@ 31.69m BGS) – water bearing fracture (@ 32.00m BGS) – grey (32.00 to 32.36m BGS) END OF HOLE @ 32.36 m BGS.	281.64	158.8mm ø BOREHOLE SAND PACK 101.6mm ø PVC PIPE WELL SCREEN SCREEN DETAILS: Screened Interval: 30.58 to 32.11m BGS Length –1.5m Diameter –101.6mm Slot # 10 Material –Stainless Steel Sand pack interval: 26.36 to 32.10m BGS Material –# 3 Silica Sand		1	100	40	
30.0								
31.0								
32.0								
33.0								
34.0								
35.0								
36.0								
37.0								
38.0								
39.0								
40.0								

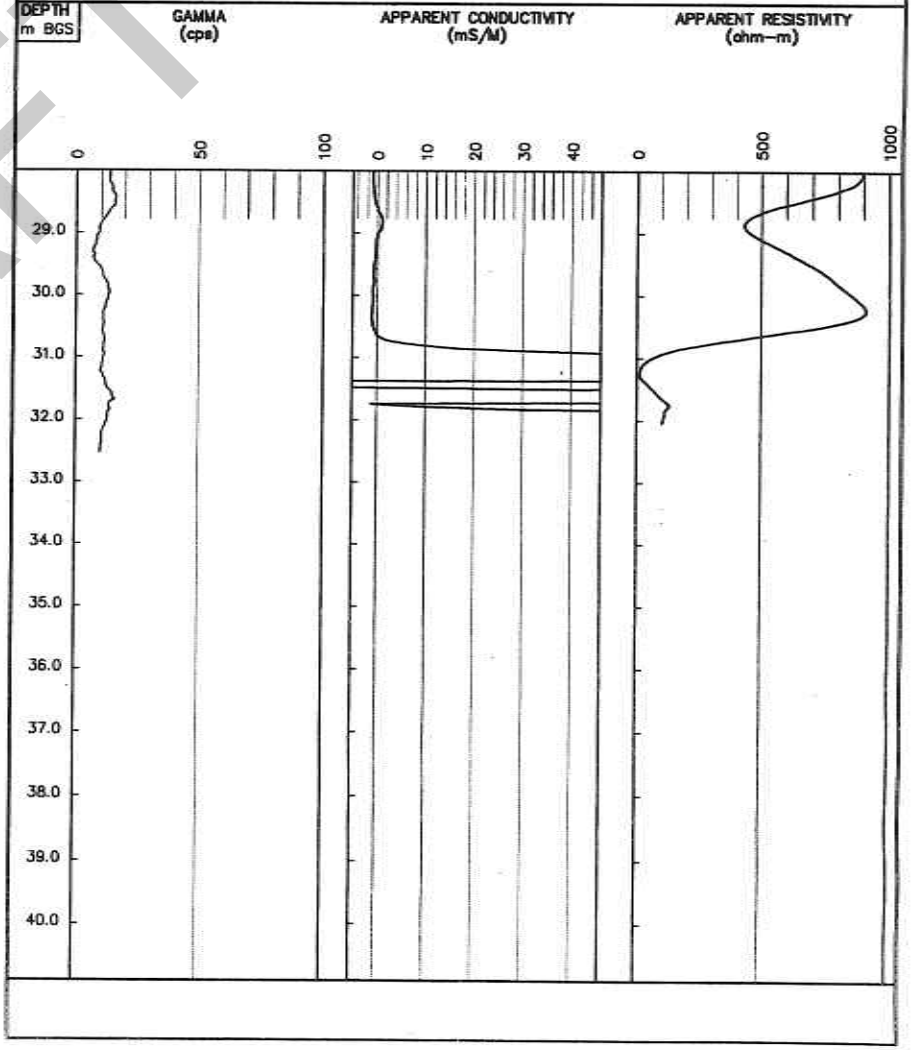
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-04)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OWBA-91 (Page 4 of 4)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ CORE
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-05)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW8B-91
DATE COMPLETED: OCTOBER 4, 1991
DRILLING METHOD: 15cm AIR ROTARY
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser) GROUND SURFACE	314.690 313.72				
	For stratigraphy from 0.0 to 5.49m BGS see log OW8A-91		CONCRETE SEAL 158.8mmø BOREHOLE CEMENT/ BENTONITE GROUT 50.8mmø PVC PIPE BENTONITE PELLET SEAL SAND PACK WELL SCREEN			
6.0	ML/CL-SILT(TILL), some clay, some sand, some stone, very hard, medium grey to brown, very damp	308.23 307.67		1SS	X	>100
	END OF HOLE @ 6.05 m BGS.					
	NOTES: 1. At completion borehole remained dry.		SCREEN DETAILS: Screened Interval: 5.13 to 6.05m BGS Length -0.9m Diameter -50.8mm Slot # 10 Material -Stainless Steel Sand pack interval: 3.96 to 6.05m BGS Material -# 3 Silica Sand			

7.0
8.0
9.0
10.0
11.0
12.0
13.0

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-06)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW9A-91 (Page 1 of 4)
DATE COMPLETED: OCTOBER 1, 1991
DRILLING METHOD: 159mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	318.490				
	GROUND SURFACE	317.75				
	For stratigraphy from 0.0 to 6.55m BGS see log OW9B-91		CONCRETE SEAL			
1.0						
2.0						
3.0			254.0mmø BOREHOLE			
4.0						
5.0			BENTONITE GROUT			
6.0						
	ML-SILT(TILL), little to some fine sand and gravel, little to some clay, very compacted, damp	311.20				
7.0			101.6mmø PVC PIPE			
8.0						
9.0						
10.0						
11.0			158.8mmø BOREHOLE			
			BENTONITE GROUT			
12.0	- boulder - sand content increasing					
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

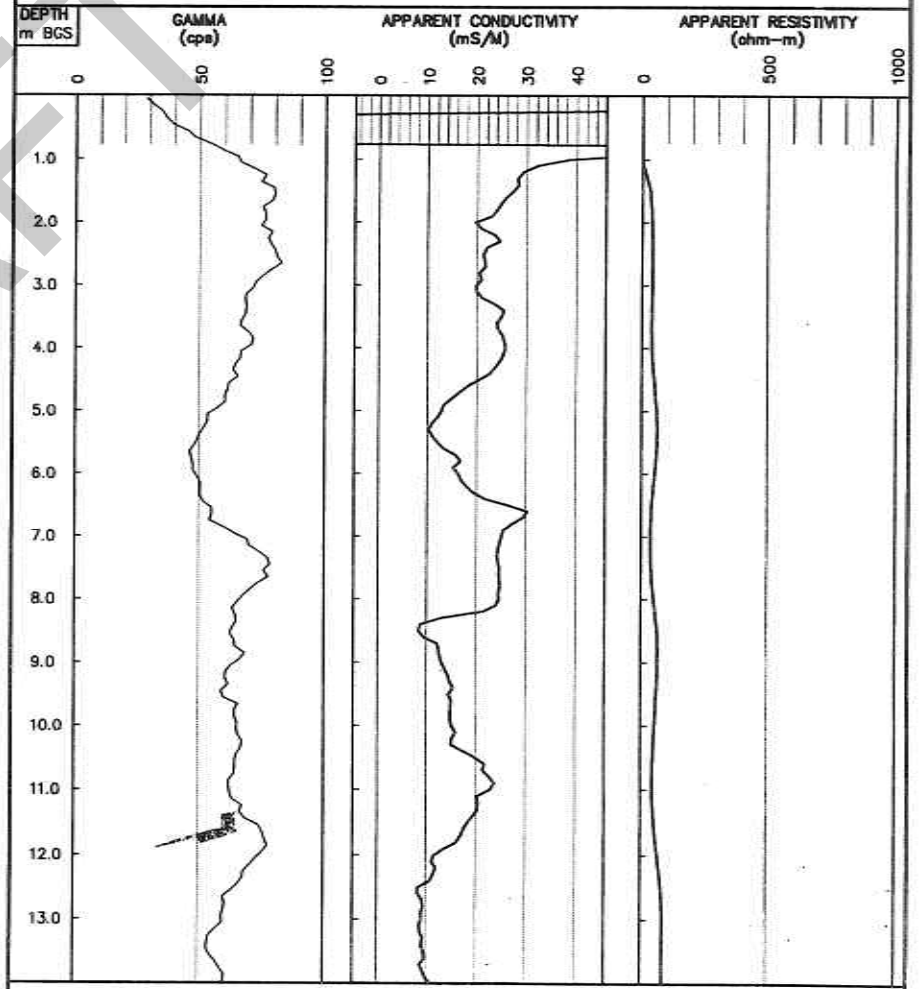
GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-06)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW9A-91 (Page 1 of 4)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 159mm ID HSA
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-06)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW9A-91 (Page 2 of 4)
DATE COMPLETED: OCTOBER 1, 1991
DRILLING METHOD: 159mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
14.0						
15.0						
16.0	– few pebbles, very dense					
17.0			101.6mmø PVC PIPE			
18.0						
19.0						
20.0	– becoming clayey silt		BENTONITE GROUT			
21.0						
22.0	BEDROCK END OF OVERBURDEN HOLE @ 21.34 m BGS.	296.41	158.8mmø BOREHOLE			
23.0						
24.0						
25.0						
26.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

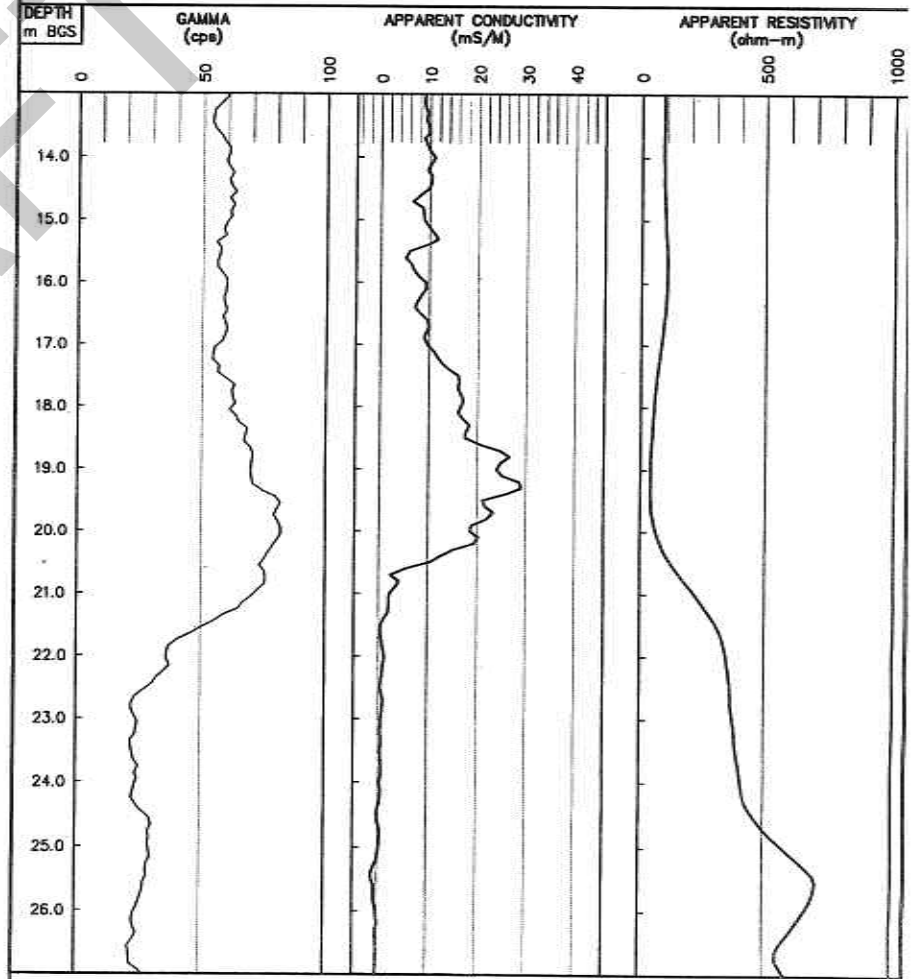
GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-06)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW9A-91 (Page 2 of 4)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 159mm ID HSA
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-07)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW9A-91 (Page 3 of 4)
DATE COMPLETED: OCTOBER 4, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ CORE
CRA SUPERVISOR: J.C. MUGFORD

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIENDTRERORCVKAL	RMUUNMBER	CRORECOVERY	RQD	WRATTEURRH
m BGS		m AMSL				%	%	%
21.0	Overburden							
	LIMESTONE(Dundee Formation): cream/beige, rock flour	296.41						
22.0								
23.0			158.8mmø BOREHOLE					
24.0	– light brown, softer							
			BENTONITE GROUT					
25.0								
26.0			101.6mmø PVC PIPE					
27.0	LIMESTONE(Lucas Formation):	290.75						
28.0								
29.0								
30.0			CAVE					
	– light brown argillaceous limestone, soft, damp							
31.0								
			SAND PACK					
32.0		285.54 ▽						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

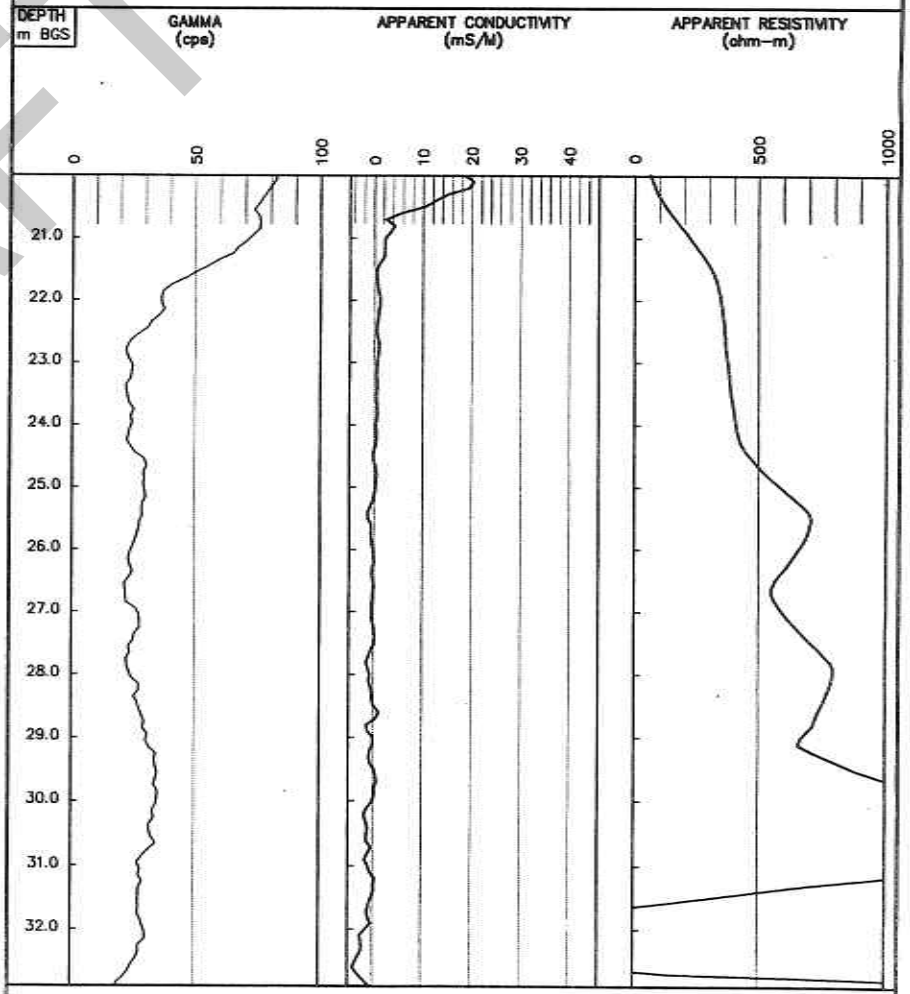
▽ WATER FOUND ▼ STATIC WATER LEVEL (OCT 26/91) NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-07)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW9A-91 (Page 3 of 4)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ CORE
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-07)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW9A-91 (Page 4 of 4)
DATE COMPLETED: OCTOBER 4, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ CORE
CRA SUPERVISOR: J.C. MUGFORD

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIODISTURBED ORCVKAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
m BGS		m AMSL				%	%	%
33.0			158.8mm⌀ BOREHOLE					
34.0			SAND PACK					
35.0								
36.0	– light brown to buff argillaceous limestone, medium to high porosity – lighter colored with slight color laminations							
37.0	– water bearing fracture (@ 36.58m BGS)							
38.0	– darker colored with high concentrations of stylolites – water bearing fracture (@ 38.25m BGS) – water bearing fracture (@ 38.40m BGS)				1	100	45	
39.0	– water bearing fracture (@ 38.86m BGS) – water bearing fracture (@ 39.17m BGS) – water bearing fracture (@ 39.47m BGS)							
40.0			WELL SCREEN					
	END OF HOLE @ 40.39 m BGS.	277.36						
41.0								
42.0								
43.0								
44.0								

SCREEN DETAILS:
Screened Interval:
38.86 to 40.39m BGS
Length –1.5m
Diameter –50.8mm
Slot # 10
Material –Stainless Steel
Sand pack interval:
37.19 to 40.39m BGS
Material –# 3 Silica Sand

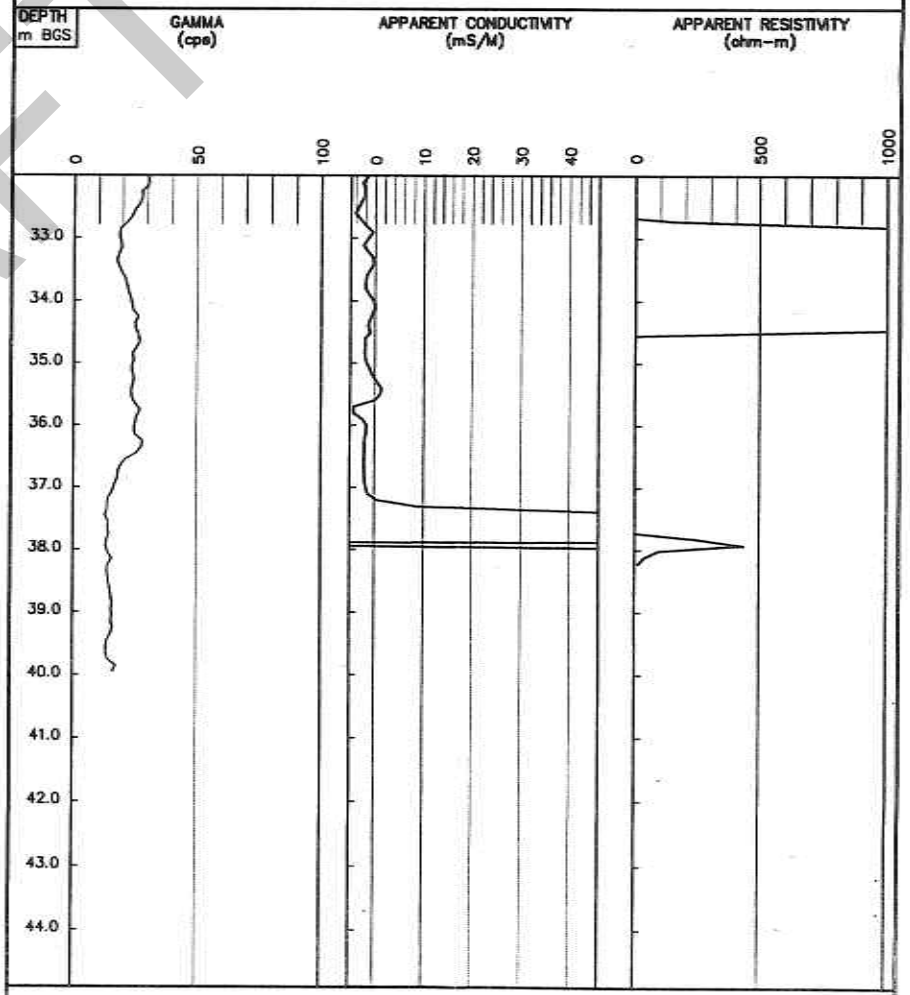
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (GEOPHYSICS)

(L-07)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW9A-91 (Page 4 of 4)
DATE COMPLETED: OCTOBER 11, 1991
DRILLING METHOD: 15cm AIR ROTARY / HQ CORE
SURVEY BY HYD-ENG GEOPHYSICS INC.



STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-08)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW9B-91
DATE COMPLETED: OCTOBER 1, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	318.580				
	GROUND SURFACE	317.74				
1.0	ML/CL-SILT(TILL), some clay, some sand and small pebbles, rootlets, stiff to hard, well fractured, grey to brown, damp to moist - well developed sub-vertical fracture (0.3 to 0.45m BGS) - hard, some pebbles (small to large), no obvious fracturing		CONCRETE SEAL	1CS		
2.0			203.2mmø BOREHOLE			
			BENTONITE GROUT	2CS		
3.0			50.8mmø PVC PIPE			
		314.13 ▽				
4.0			BENTONITE PELLET SEAL	3CS		
5.0						
	GM-GRAVEL, fine to medium grained, some sand, silt and stones, few cobbles, saturated	312.56	SAND PACK	4CS		
6.0			WELL SCREEN	5CS		
	ML-SILT(TILL), little to some fine grained sand and fine gravel, little clay, very compacted, damp to moist	311.64				
7.0	- trace fine grained sand, trace clay, extremely dense, non-plastic, laminated, light grey and brown, damp	311.19		6SS		>100
	END OF HOLE @ 6.55 m BGS.					
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

SCREEN DETAILS:
Screened Interval:
5.18 to 6.10m BGS
Length -0.9m
Diameter -50.8mm
Slot # 10
Material -Stainless Steel
Sand pack interval:
4.57 to 6.55m BGS
Material -# 3 Silica Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼ (OCT 26, 1991)

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-14)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW15-91
DATE COMPLETED: OCTOBER 21, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser) GROUND SURFACE	318.670 317.82				
0	ML/CL-SILT(TILL), some clay and sand, damp to moist		CONCRETE SEAL			
1.0						
2.0			203.2mmø BOREHOLE BENTONITE GROUT			
3.0		314.77	50.8mmø PVC PIPE			
	ML-SILT(TILL), some clay and sand, trace gravel, slightly layered, firm, light brown, damp to moist	314.13	BENTONITE PELLET SEAL	1CS (3.5 - 4.6m)		
4.0	ML/CL-SILT and CLAY(GLACIOLACUSTRINE), trace gravel, little very fine sand, layered, tan, moist	313.25	SAND PACK	2CS (4.6 - 5.8m)		
5.0	SW/GW-SAND and GRAVEL, medium to coarse, some cobbles, salt and pepper color, saturated		WELL SCREEN			
		312.03		3CS		
6.0	ML-SILT(TILL), some clay and sand, cobbles, dense, light brown, moist	311.62	BENTONITE PELLET SEAL	4CS		
	END OF HOLE @ 6.20 m BGS.					
7.0			SCREEN DETAILS: Screened Interval: 4.57 to 5.49m BGS Length -0.9m Diameter -50.8mm Slot # 10 Material -Stainless Steel Sand pack interval: 3.91 to 5.49m BGS Material -# 3 Silica Sand			
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-16)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW17-91
DATE COMPLETED: NOVEMBER 16, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	318.39 317.39				
1.0	ML/CL-SILT(TILL), some clay, little sand, little gravel, few cobbles, very stiff, grey, damp - very cobbly		CONCRETE SEAL 50.8mmø PVC PIPE	1CS		
2.0			BENTONITE GROUT	2CS		
3.0		314.26	BENTONITE PELLET SEAL 190.5mmø BOREHOLE			
	ML/SM-SILT and SAND, very fine grained, compact, brown, saturated	314.04 313.73		3SS		26
4.0	SW-SAND, little fine gravel, coarse grained, well graded, compact, brown, saturated	313.07		4SS		20
5.0	ML/CL-SILT(TILL), some clay, little sand and gravel, stiff, grey, moist - sand and gravel seams, wet (4.88 to 4.98m BGS and 5.08 to 5.13m BGS)		SAND PACK WELL SCREEN	5SS 6SS		41 >60
	ML-SILT(TILL), some sand, little to some clay, little gravel, very hard, light brown, damp	311.90		7SS		53
6.0	- sand seam, wet (5.49 to 5.59m BGS)			8SS		53
7.0				9SS		58
8.0			BENTONITE PELLET SEAL	10SS		>50
9.0						
	END OF HOLE @ 9.45 m BGS.	307.94		11SS		>70
10.0			SCREEN DETAILS: Screened Interval: 2.74 to 5.79m BGS Length -3.0m Diameter -50.8mm Slot # 10 Material -PVC Sand pack interval: 2.34 to 6.05m BGS Material -# 2 Filter			
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼ (NOV 22, 1991)

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-20)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW21-91
DATE COMPLETED: DECEMBER 9, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	REFERENCE POINT (Top of Riser)	320.760				
	GROUND SURFACE	319.99				
0	ML-SILT(TILL), little to some clay and sand, trace gravel, damp		CONCRETE SEAL			
1.0						
	- hard, moist to wet		50.8mmø PVC PIPE			
2.0						
	- damp	317.53 ▼	BENTONITE GROUT			
3.0						
4.0			190.5mmø BOREHOLE			
	- very hard, damp					
5.0			BENTONITE PELLET SEAL	1SS	⊠	68
	ML/CL-SILT and CLAY (GLACIOLACUSTRINE), little sand and fine gravel, damp	314.61		2SS	⊠	71
6.0	- little to some clay and fine sand, extremely dense, non-cohesive, tan, damp, layered			3SS	⊠	>100
	- moist		SAND PACK	4SS	⊠	93
	- some sand and clay, little fine gravel, very hard, brown, damp	312.92	WELL SCREEN	5SS	⊠	>100
7.0	ML-SILT and SAND(TILL), little clay, little gravel, extremely hard, light brown to grey, damp to moist	312.29				
8.0	END OF HOLE @ 7.70 m BGS.					
9.0						
10.0						
11.0						
12.0						
13.0						

SCREEN DETAILS:
Screened Interval:
6.17 to 7.70m BGS
Length -1.5m
Diameter -50.8mm
Slot # 10
Material -Stainless Steel
Sand pack interval:
5.33 to 7.70m BGS
Material -# 2 Filter

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼ (DEC 12, 1991)

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-24)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW25-91
DATE COMPLETED: DECEMBER 11, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser) GROUND SURFACE	323.420 322.86				
	OL-SILT(TOPSOIL), little sand and clay, organics, black, moist		CONCRETE SEAL			
		322.25				
1.0	ML/CL-SILT, some clay, little to some sand, stiff, light brown, moist, cohesive					
2.0				1AR		
			190.5mmø BOREHOLE			
3.0	- hard, grey-brown					
			BENTONITE GROUT	2AR		
4.0						
			50.8mmø PVC PIPE			
5.0	- stone					
				3AR		
6.0						
				4SS		41
7.0			BENTONITE PELLET SEAL			
		315.54				
	SP-SAND, trace silt and fine gravel, fine to medium grained fining upwards, very dense, salt and pepper colour, dry					
8.0	- silt and clay layer (2cm thick)			5SS		50
	- medium grained, wet	314.35				
			SAND PACK	6SS		37
9.0	GW-GRAVEL, some sand and silt, fine, wet	313.93				
		313.50	WELL SCREEN	7SS		28
	ML-SILT, some sand, little to some clay, few large pebbles, very stiff, light grey-brown, moist to wet					
10.0	- gravel seam (5cm thick)			8SS		49
		312.50				
	END OF HOLE @ 10.36 m BGS.					
11.0						
12.0						
13.0						

SCREEN DETAILS:
Screened Interval:
8.84 to 9.75m BGS
Length -0.9m
Diameter -50.8mm
Slot # 10
Material -Stainless Steel
Sand pack interval:
7.01 to 10.36m BGS
Material -# 2 Filter

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼(DEC 13, 1991)

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: ST. MARYS LANDFILL
PROJECT NUMBER: 0645
CLIENT: TOWN OF ST. MARYS
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW32-96
DATE COMPLETED: AUGUST 7, 1996
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser) GROUND SURFACE	*323.43* *322.54*					
0.5	ML-SILT (FILL), little sand and clay, trace gravel, brown, damp – light and dark grey		CONCRETE SEAL	1CS			
1.0		*321.47*					
	ML-SILT (BURIED TOPSOIL), little sand and clay, little vegetal matter, dark brown, moist	*321.32*					
1.5	ML-SILT (TILL), little sand and clay, firm, some fine fracturing, highly mottled light grey and brown		203mm Ø BOREHOLE	2CS			
2.0	– some fine sand, wet (2.0 to 2.3m BGS)						
2.5	– little coarse sand and fine gravel, stiff, slightly mottled, moist to wet – little gravel, hard augering, light brown, moist		BENTONITE GROUT	3CS			
3.0							
3.5	– becoming grey, moist						
4.0	– grey, damp to moist						
4.5			51mm Ø PVC PIPE	4CS			
5.0	– massive						
5.5			BENTONITE GRAVEL				
6.0	– boulder			5CS			
6.5			SAND PACK				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ⧩ STATIC WATER LEVEL ⧩

STRATIGRAPHIC AND [illegible] (OVERBURDEN)

PROJECT NAME: ST. MARYS LANDFILL
PROJECT NUMBER: 0645
CLIENT: TOWN OF ST. MARYS
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW32-96
DATE COMPLETED: AUGUST 7, 1996
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
		315.38					
7.5	ML-SILT (WATER LAID TILL), trace to little fine sand, trace clay, slightly stratified, light grey, damp to moist		SAND PACK	6CS			
8.0							
8.5		313.85	51mm Ø PVC PIPE				
9.0	ML-SILT (TILL), little sand, gravel and clay, massive, grey-brown, moist			7CS			
9.5			203mm Ø BOREHOLE				
10.0							
10.5	- seams of wet sand and silt @ 10.36 to 10.59 and 10.92 to 10.97m BGS			8CS			
11.0	- massive till			9CS			
11.5		310.96	WELL SCREEN				
12.0	END OF HOLE @ 11.58m BGS						
12.5							
13.0							
13.5							

SCREEN DETAILS
Screened interval:
9.91 to 11.43m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: #10
Material: PVC
Sand Pack:
6.10 to 11.58m BGS
Material: #1 Silica Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: ST. MARYS LANDFILL
PROJECT NUMBER: 0645
CLIENT: TOWN OF ST. MARYS
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW33-96
DATE COMPLETED: AUGUST 8, 1996
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser) GROUND SURFACE	*321.57* *320.66*					
	ML-SILT (TOPSOIL), little sand, little vegetal matter, dark brown, moist	*320.36*	CONCRETE SEAL				
0.5	ML-SILT (TILL), little sand, trace gravel and clay, firm, light brown, damp to moist			1CS			
1.0	- massive						
1.5							
	- stone			2CS			
2.0			203mm Ø BOREHOLE				
2.5	- moist						
3.0	- hard, damp						
				3CS			
3.5							
4.0	- massive, grey, damp to moist		BENTONITE GROUT				
4.5							
				4CS			
5.0	- 25mm seam of wet sand, silt and gravel @ 5.03m BGS - slightly stratified below 5.03m BGS						
5.5							
	- highly stratified						
6.0	- wet (dilatant) outwash silts		51mm Ø PVC PIPE				
				5CS			
6.5	- massive, very hard, grey, damp to moist						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: ST. MARYS LANDFILL
PROJECT NUMBER: 0645
CLIENT: TOWN OF ST. MARYS
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW33-96
DATE COMPLETED: AUGUST 8, 1996
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
7.5			BENTONITE GROUT	5CS			
8.0			51mm Ø PVC PIPE	6CS			
8.5	- sand and gravel, some silt, wet 8.61 to 8.71m BGS						
9.0	- till with little gravel, damp to moist - cobbles @ 8.84, 9.14, 9.45 and 9.75m BGS		BENTONITE GRAVEL	7CS			
9.5							
10.0			203mm Ø BOREHOLE				
10.5	- very moist - hard, dry						
11.0				8CS			
11.5			SAND PACK				
12.0	- damp to moist						
12.5			WELL SCREEN	9CS			
13.0	- layers of silt, sand and clay - very moist to wet (12.70 to 12.75m BGS) - dry						
13.5	- some sand, hard, brown, damp to moist	307.10		10CS			
	Refusal END OF HOLE @ 13.58m BGS						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ⊽ STATIC WATER LEVEL ⊽

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: ST. MARYS LANDFILL
PROJECT NUMBER: 0645
CLIENT: TOWN OF ST. MARYS
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW33-96
DATE COMPLETED: AUGUST 8, 1996
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	MONITOR INSTALLATION	SAMPLE			
				NUMBER	STATE	'N' VALUE	PID (ppm)
14.5			SCREEN DETAILS Screened Interval: 11.89 to 13.41m BGS Length: 1.52m Diameter: 51mm Slot Size: #10 Material: PVC Sand Pack: 9.85 to 13.56m BGS Material: #1 Silica Sand				
15.0							
15.5							
16.0							
16.5							
17.0							
17.5							
18.0							
18.5							
19.0							
19.5							
20.0							
20.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE: REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▼ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: ST. MARYS LANDFILL
PROJECT NUMBER: 0645
CLIENT: TOWN OF ST. MARYS
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW34-96
DATE COMPLETED: AUGUST 9, 1996
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser) GROUND SURFACE	*321.59* *320.77*					
	Refer to OW33-96 for stratigraphic details.		CONCRETE SEAL 203mm Ø BOREHOLE BENTONITE GROUT 51mm Ø PVC PIPE BENTONITE GRAVEL SAND PACK WELL SCREEN				

-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
-6.5

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: ST. MARYS LANDFILL
PROJECT NUMBER: 0645
CLIENT: TOWN OF ST. MARYS
LOCATION: AS PER PLAN

HOLE DESIGNATION: OW34-96
DATE COMPLETED: AUGUST 9, 1996
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
7.5			SAND PACK				
	ML-SILT (TILL), little sand, clay and gravel, trace cobbles, very hard, massive, brown, damp to moist	313.15	203mm Ø BOREHOLE	1CS			
8.0							
8.5	- dry to damp - wet		WELL SCREEN	2CS			
9.0		311.63					
	END OF HOLE @ 9.14m BGS						
9.5			SCREEN DETAILS Screened interval: 5.94 to 8.99m BGS Length: 3.05m Diameter: 51mm Slot Size: #10 Material: PVC Sand Pack: 4.42 to 9.14m BGS Material: #1 Silica Sand				
10.0							
10.5							
11.0							
11.5							
12.0							
12.5							
13.0							
13.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE
WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: St. Marys Landfill
PROJECT NUMBER: 645
CLIENT: Town of St. Marys
LOCATION: Town of St. Marys

HOLE DESIGNATION: MW32A-02
DATE COMPLETED: September 17, 2002
DRILLING METHOD: MUD ROTARY
FIELD PERSONNEL: B. KEMPEL

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
	TOP OF RISER GROUND SURFACE	322.640 322.09					
0.5	TOPSOIL	321.93					
	ML - SILT (TILL), trace to with sand, trace to with clay, mottled grey and brown						
1.0							
1.5							
2.0							
2.5							
3.0			152 mm ø BOREHOLE				
3.5	- grey at 3.66m BGS						
4.0							
4.5			102 mm ø STEEL WELL CASING				
5.0							
5.5							
6.0			CEMENT GROUT				
6.5							
7.0							
7.5			51 mm ø SCH 40 PVC RISER PIPE				
8.0							
8.5							
9.0			BENTONITE GROUT				
9.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: St. Marys Landfill
PROJECT NUMBER: 645
CLIENT: Town of St. Marys
LOCATION: Town of St. Marys

HOLE DESIGNATION: MW32A-02
DATE COMPLETED: September 17, 2002
DRILLING METHOD: MUD ROTARY
FIELD PERSONNEL: B. KEMPEL

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
10.5							
11.0							
11.5							
12.0			152 mm ø BOREHOLE				
12.5							
13.0							
13.5			102 mm ø STEEL WELL CASING				
14.0							
14.5							
15.0			CEMENT GROUT				
15.5							
16.0							
16.5							
17.0			51 mm ø SCH 40 PVC RISER PIPE				
17.5							
18.0							
18.5			BENTONITE GROUT				
19.0							
19.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: St. Marys Landfill
PROJECT NUMBER: 645
CLIENT: Town of St. Marys
LOCATION: Town of St. Marys

HOLE DESIGNATION: MW32A-02
DATE COMPLETED: September 17, 2002
DRILLING METHOD: MUD ROTARY
FIELD PERSONNEL: B. KEMPEL

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE REC (%)	SAMPLE 'N' VALUE
20.5							
21.0							
21.5			152 mm ø BOREHOLE				
22.0							
22.5							
23.0			102 mm ø STEEL WELL CASING				
23.5							
24.0	- with cobbles at 23.77m BGS						
24.5			CEMENT GROUT				
25.0	- 2' thick quartz boulder at 24.69m BGS						
25.5							
26.0			51 mm ø SCH 40 PVC RISER PIPE				
26.5			102 mm ø BOREHOLE				
27.0							
27.5			BENTONITE GROUT				
28.0	END OF OVERBURDEN HOLE @ 27.74m BGS						
28.5							
29.0							
29.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: St. Marys Landfill
PROJECT NUMBER: 645
CLIENT: Town of St. Marys
LOCATION: Town of St. Marys

HOLE DESIGNATION: MW32A-02
DATE COMPLETED: September 17, 2002
DRILLING METHOD: MUD ROTARY
FIELD PERSONNEL: B. KEMPEL

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITOR INSTALLATION	RUN NUMBER	CORE RECOVERY %	RQD %
27.5			BENTONITE GROUT			
28.0	BEDROCK - LIMESTONE (Dundee Formation), light brown, competent	294.35				
28.5						
29.0			102 mm Ø BOREHOLE	1		
29.5						
30.0						
30.5			51 mm Ø SCH 40 PVC RISER PIPE			
31.0						
31.5						
32.0				2		
32.5						
33.0						
33.5						
34.0						
34.5						
35.0				3		
35.5						
36.0			BENTONITE HOLEPLUG			
36.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: St. Marys Landfill
PROJECT NUMBER: 645
CLIENT: Town of St. Marys
LOCATION: Town of St. Marys

HOLE DESIGNATION: MW32A-02
DATE COMPLETED: September 17, 2002
DRILLING METHOD: MUD ROTARY
FIELD PERSONNEL: B. KEMPEL

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEV. m	MONITOR INSTALLATION	RUN NUMBER	CORE RECOVERY %	RQD %
37.5						
38.0						
38.5				4		
39.0						
39.5						
40.0			SAND PACK			
40.5	- begin to lose drilling fluid to formation at 40.23m BGS					
41.0						
41.5			WELL SCREEN	5		
42.0						
42.5						
43.0						
43.5	END OF BOREHOLE @ 43.28m BGS	278.80	WELL DETAILS Screened interval: 281.85 to 278.80m Length: 3.05m Diameter: 51mm Slot Size: 10 Sand Pack: 285.51 to 278.80m Material: #2 SILCA SAND			
44.0						
44.5						
45.0						
45.5						
46.0						
46.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

Ontario Ministry of the Environment

Measurements recorded in: ☑ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* A108429

Well Record

Regulation 903 Ontario Water Resources Act

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Corporation of the Town of St. Marys	tsmythe@town.stmarys.on.ca	

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
408 James Street South	St. Marys	ON	N4X 1B6	[illegible]

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
221 Water St. South	Town of St. Marys	35	Thames Concession

County/District/Municipality	City/Town/Village	Province	Postal Code
Perth County	St. Marys	**Ontario**	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	4875778	4787041		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
Brown	Gravel	Sand	Packed	0.0	1.22
Grey	Clay		Dense	1.22	6.4

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0.0	4.57	Bentonite chip	0.59

Method of Construction

☐ Cable Tool ☐ Diamond ☐ Rotary (Conventional) ☐ Jetting ☐ Rotary (Reverse) ☐ Driving ☑ Boring ☐ Digging ☐ Air percussion ☐ Other, specify

Well Use

☐ Public ☐ Commercial ☐ Not used ☐ Domestic ☐ Municipal ☐ Dewatering ☐ Livestock ☐ Test Hole ☑ Monitoring ☐ Irrigation ☐ Cooling & Air Conditioning ☐ Industrial ☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
5.39	Plastic	0.??	0.0	5.49

Status of Well

☐ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☒ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
6.03	Plastic	10	5.49	6.4

Water Details

Water found at Depth (m/ft)	Kind of Water
☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify
☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify
☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	6.4	20.4

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Aardvark Drilling + Investigative Services Ltd	7241

Business Address (Street Number/Name)	Municipality
3217 Harlech Hill Court	Elmira

Province	Postal Code	Business E-mail Address
ON	N3B 2Z3	[illegible]

Bus.Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
519 664 3381	[illegible]

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
5 5 6 8		2010 12 06

Results of Well Yield Testing

After test of well yield, water was: ☐ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping ___ hrs + ___ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft)

Recommended pump rate (l/min / GPM)

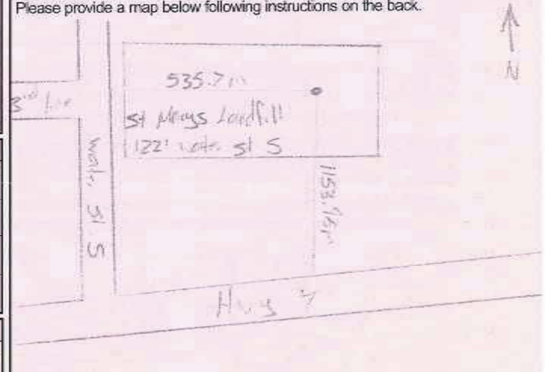
Well production (l/min / GPM)

Disinfected? ☐ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☐ Yes ☒ No	YYYY MM DD	2010 10 25

Ministry Use Only

Audit No. Z102059

Received

DRAFT

0506E (12/2007) **Well Owner's Copy**

Ontario Ministry of the Environment

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
A-[illegible] - [illegible]

Well Record

Regulation 903 Ontario Water Resources Act

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Corporation of the Town of St. Marys	[illegible]	

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
408 Jones Street South	St. Marys	ON	N4X1B6	519 284 [illegible]

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
1221 Water St. South	Town of St. Marys	35	Thames Concession

County/District/Municipality	City/Town/Village	Province	Postal Code
Perth County	St. Marys	**Ontario**	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	485 78	4787041		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth *(m/ft)* From	Depth *(m/ft)* To
			Bentonite Chip	0.0	6.4

Annular Space

Depth Set at *(m/ft)* From	To	Type of Sealant Used *(Material and Type)*	Volume Placed *(m³/ft³)*

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, specify ____

If pumping discontinued, give reason:

Pump intake set at *(m/ft)*

Pumping rate *(l/min / GPM)*

Duration of pumping ____ hrs + ____ min

Final water level end of pumping *(m/ft)*

If flowing give rate *(l/min / GPM)*

Recommended pump depth *(m/ft)*

Recommended pump rate *(l/min / GPM)*

Well production *(l/min / GPM)*

Disinfected? ☐ Yes ☐ No

Draw Down Time *(min)*	Water Level *(m/ft)*	Recovery Time *(min)*	Water Level *(m/ft)*
Static Level			
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, specify ____

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify ____

Construction Record - Casing

Inside Diameter *(cm/in)*	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness *(cm/in)*	Depth *(m/ft)* From	To

Status of Well

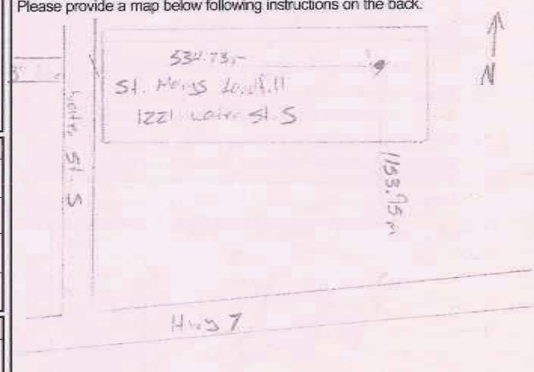
☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☒ Abandoned, other, specify Decomissioned
☐ Other, specify ____

Construction Record - Screen

Outside Diameter *(cm/in)*	Material (Plastic, Galvanized, Steel)	Slot No.	Depth *(m/ft)* From	To

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Water Details

Water found at Depth *(m/ft)*	Kind of Water
☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify
☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify
☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth *(m/ft)* From	To	Diameter *(cm/in)*
0.0	6.4	20.9

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Allard Drilling + Investigative Services Ltd.	7 2 8 2

Business Address (Street Number/Name)	Municipality
3217 [illegible] Hill Drive	Elmira

Province	Postal Code	Business E-mail Address
ON	N3B2Z3	[illegible]

Bus. Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
519 [illegible] 3331	[illegible]

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
3 5 6 8		2010 [illegible]

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☐ Yes ☐ No	YYYYMMDD	2010 [illegible] 25

Ministry Use Only

Audit No. Z 102053

Received

0506E (12/2007)

Well Owner's Copy

54560

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-09)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH10-91 (Page 1 of 2)
DATE COMPLETED: OCTOBER 15, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND SURFACE	317.37				
1.0	ML-SILT(TILL), little fine sand, little to some clay, little gravel, stoney, soft, moist, fractured to 0.30m - very hard, light brown, dry to damp - little to some clay, some sand, very stiff, light to medium grey-brown, damp		CONCRETE SEAL	1CS		
2.0				(2CS) (1.2 - 2.1m)		
3.0	- some clay, softer, massive, moist			3CS		
4.0	ML-SILT(GLACIOLACUSTRINE), some clay, soft, layered, moist to wet, dilatant - some clay, occasional pebble, more massive, less layering	313.56				
5.0			203.2mmø BOREHOLE	4CS		
6.0	GW/SW-GRAVEL and SAND, gravel is fine, sand is fine to coarse grained, little to some silt, brown, saturated	312.19 311.43				
	ML-SILT, (GLACIOLACUSTRINE), trace to some clay, few pebbles, slightly layered, light brown and grey, damp	310.97		5CS		
7.0	ML-SILT(TILL), some clay, some sand, occasional pebbles, stones, very hard, stiff, brown to dark brown, damp - increasing gravel content		BENTONITE GROUT			
8.0				(6CS) (7.3 - 8.5m)		
9.0	SW-SAND, fine to coarse grained, some coarse gravel, little to some silt, brown, saturated	308.84 308.68				
10.0	ML-SILT(TILL), some clay, little to some coarse sand and gravel, few cobbles, very hard, stiff, brown and grey, damp - few cobbles			7CS		
11.0				8CS		
12.0	- fine to coarse sand seam wtih some silt and gravel, wet (2cm thick) - horizontal fracturing					
13.0				9CS		

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS (oval) WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-09)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH10-91 (Page 2 of 2)
DATE COMPLETED: OCTOBER 15, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
14.0				10CS		
15.0			203.2mmø BOREHOLE			
16.0				11CS		
17.0			BENTONITE GROUT			
	– fine to medium grained sand seam, little silt, wet, (6cm thick)			12CS		
18.0	– trace sand, moist					
19.0				13CS		
				14CS		
20.0	LIMESTONE (BEDROCK)	*297.56*				
	END OF HOLE @ 20.12 m BGS.	*297.25*				
21.0						
22.0						
23.0						
24.0						
25.0						
26.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-10)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH11-91 (Page 1 of 2)
DATE COMPLETED: OCTOBER 10, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND SURFACE	316.25				
1.0	SM-SAND, some silt, some roots, loose, brown moist	316.10	CONCRETE SEAL	1CS		
	ML-SILT(TILL), little to some clay and sand, little gravel, hard, very stiff, light brown and grey, damp	315.34				
2.0	ML/SM-SILT and SAND(GLACIOLACUSTRINE), fine grained, little clay, trace pebbles	314.42		2CS (1.8 - 3.1m)		
	ML/CL-SILT(TILL), some clay, little sand, trace gravel, hard, very stiff, unfractured, light brown to grey, damp to moist					
3.0						
4.0	SM/ML-SILT(GLACIOLACUSTRINE), some fine grained sand, trace clay, poorly graded, well layered (undulating), tan, damp to moist	312.44		3CS		
	- fine sand seam, little to some silt, saturated (4.45m to 4.50m BGS)		203.2mmø BOREHOLE			
5.0				4CS		
6.0						
	ML/CL-SILT(TILL), some clay, some fine to coarse gravel, little sand, few cobbles, very hard, stiff, light brown to grey, damp	310.00				
7.0	- oblique fracture with silt infilling		BENTONITE GROUT	5CS		
	- dry to damp					
8.0				6CS		
9.0						
10.0	- 2cm wet pocket (@ 9.9m BGS) - softer (10.0m to10.5m BGS)			7CS		
11.0						
				8CS		
12.0						
13.0	ML-SILT(GLACIOLACUSTRINE), little to some clay, little fine sand, occasional pebble, layered, varved, light grey to light brown, damp to moist	303.45		9CS		

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-10)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH11-91 (Page 2 of 2)
DATE COMPLETED: OCTOBER 10, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
14.0	ML-SILT(TILL), little to some fine sand and clay, little gravel, very dense, hard, damp	301.95	203.2mmø BOREHOLE; BENTONITE GROUT	10CS		
15.0						
16.0	- becoming silt with some sand and little clay, partially cemented			11CS		
17.0				12CS		
	LIMESTONE(BEDROCK), light grey and brown, layered, massive	298.88				
18.0	END OF HOLE @ 17.68 m BGS.	298.57				
19.0						
20.0						
21.0						
22.0						
23.0						
24.0						
25.0						
26.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-11)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH12-91 (Page 1 of 2)
DATE COMPLETED: OCTOBER 16, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND SURFACE	317.07				
1.0	ML-SILT(TILL), some clay, little sand, trace gravel, few cobbles, soft, well fractured, light brown to brown, damp		CONCRETE SEAL	1CS		
	- very hard, occasional fracture					
2.0				2CS		
3.0		314.17				
	ML-SILT(OUTWASH), some very fine grained sand, trace clay, occasional pebble, compact, poorly graded, tan, saturated			3CS (2.9 - 4.1m)		
4.0		312.96				
	ML-SILT(TILL), some clay, some sand, little gravel, hard, very stiff, slight horizontal fracturing and layering, brown, damp		203.2mmø BOREHOLE	4CS (4.3 - 5.8m)		
5.0						
6.0				5CS		
7.0	- trace to little gravel, frequent pebbles and cobbles, stiff, medium brown, damp		BENTONITE GROUT			
8.0	- sand, silt and gravel seam (8.23 to 8.38m BGS)			6CS		
9.0	- wet seam					
	- wet seam			7CS		
10.0	- little clay and sand, trace gravel, crumbly and fissile, light brown-grey, dry to damp					
11.0				8CS		
	- dry sand seam (2cm thick)					
12.0						
				9CS		
13.0	- frequent sub-horizontal to oblique fractures, dark brown, moist (13.4 to 14.3m BGS)					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-11)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH12-91 (Page 2 of 2)
DATE COMPLETED: OCTOBER 16, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
14.0	– occasional thin varved intervals		203.2mmø BOREHOLE	10CS		
15.0	– oblique fractures, moist (14.94 to 15.40m BGS) – little clay, trace to little gravel, hard, blocky structure, medium brown–grey, damp			11CS		
16.0			BENTONITE GROUT			
17.0	– less pebbles			12CS		
18.0	– layered silts (18.29 to 19.20m BGS)					
19.0				13CS		
	SP–SAND, fine grained, little to some silt, poorly graded, dry	297.87				
20.0	LIMESTONE(BEDROCK) END OF HOLE @ 19.96 m BGS.	297.11		14CS		
21.0						
22.0						
23.0						
24.0						
25.0						
26.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-12)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH13-91 (Page 1 of 2)
DATE COMPLETED: OCTOBER 18, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND SURFACE	313.79				
	ML-SILT(OUTWASH), little sand, little clay, few pebbles, stiff, interlayered, brown and tan, damp		CONCRETE SEAL	1CS		
1.0	ML/CL-SILT(TILL), some clay, some sand, trace gravel, hard, stiff, damp	312.88				
	- fractured			2CS		
2.0	- fine to coarse grained sand seam, trace silt, wet (2cm thick)					
3.0				3CS		
4.0				4CS		
	- horizontal fracture, shiny		203.2mmø BOREHOLE			
5.0				5CS (4.6 - 5.6m)		
	- no fractures observed					
6.0				6CS		
7.0			BENTONITE GROUT			
8.0				7CS		
9.0	- frequent horizontal to sub-vertical fractures, shiny, smooth, moist (9.14 to 10.67m BGS)			8CS		
10.0						
	- dry to damp					
11.0				9CS		
	- little to some clay, damp					
12.0		301.54				
	ML-SILT and SAND(TILL), little gravel, trace to little clay, compact, non-cohesive, tan to light brown, moist, partially cemented			10CS		
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-12)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH13-91 (Page 2 of 2)
DATE COMPLETED: OCTOBER 18, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
14.0	– very moist		203.2mmø BOREHOLE; BENTONITE GROUT	11CS (13.3 – 14.8m)		
15.0				12CS		
	LIMESTONE(BEDROCK)	298.25				
16.0	END OF HOLE @ 15.54 m BGS.					
17.0						
18.0						
19.0						
20.0						
21.0						
22.0						
23.0						
24.0						
25.0						
26.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-13)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH14-91
DATE COMPLETED: OCTOBER 21, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	317.60				
0.0	ML/CL-SILT(TILL), some sand and clay, damp		CONCRETE SEAL			
1.0						
2.0			203.2mmø BOREHOLE			
3.0	ML-SILT(GLACIOLACUSTRINE), some clay, little fine grained sand, few pebbles, soft to firm, layered, light brown to brown, moist	314.60				
4.0			BENTONITE GROUT	1CS		
	ML-SILT(TILL), little to some sand, little clay, trace gravel, few cobbles, firm, light brown, moist	313.13				
5.0				2CS		
	ML-SILT(OUTWASH), little to some very fine sand, trace clay, occasional pebble, compact, tan, wet - occasional fine to medium grained sand seam, wet (2cm thick)	312.42				
6.0				3CS		
	ML/CL-SILT(TILL), some clay and sand, trace gravel, very stiff, medium to dark brown, moist - damp	311.20				
7.0				4CS		
	END OF HOLE @ 7.57 m BGS.	310.03				
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-15)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH16-91
DATE COMPLETED: OCTOBER 21, 1991
DRILLING METHOD: 108mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	317.24				
1.0	ML-SILT(TILL), some clay and sand, damp to moist		CONCRETE SEAL			
2.0			203.2mmø BOREHOLE			
3.0	ML/CL-SILT and CLAY(GLACIOLACUSTRINE), trace to little fine sand, layered, firm, tan to light brown, moist	314.50		1CS (2.7 - 3.4m)		
	ML-SILT(TILL), some fine grained sand, little clay, firm, tan, saturated	313.89				
4.0	SW-SAND, coarse grained, little silt, little gravel, little fine grained sand, saturated	313.43	BENTONITE GROUT	2CS		
5.0				3CS		
6.0	- some gravel			4CS		
		310.53				
7.0	ML/CL-SILT(TILL), some clay, stiff, brown, damp to moist					
	- fine to medium grained sand seam, wet (20cm thick)	309.92				
8.0	END OF HOLE @ 7.32 m BGS.					
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-17)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH18-91
DATE COMPLETED: NOVEMBER 16, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	317.00				
	GM-GRAVEL(FILL), some silt, some sand, loose brown, moist		CONCRETE SEAL			
		316.39				
1.0	ML-SILT(TILL), some sand, little to some clay, little gravel, hard, light brown, damp to moist					
2.0			190.5mmø BOREHOLE	1SS		50
3.0	- damp					
		313.42		2SS		52
4.0	ML/CL-SILT and CLAY(GLACIOLACUSTRINE), occasional pebble, hard, layered, damp		BENTONITE GROUT	3SS		48
5.0		312.12		4SS		77
	ML-SILT(OUTWASH), little sand and clay, fining upwards, very dense, brown, wet, dilatant	311.77				
	ML-SILT(TILL), some sand, some clay, little gravel, grey-brown, hard, damp to moist			5SS		79
6.0		310.75		6SS		27
	SW-SAND, trace silt, well graded, medium dense, salt and pepper colour, saturated	310.29				
7.0	ML/CL-SILT(TILL), some clay, some sand, little gravel, hard, grey-brown, damp			7SS		43
	END OF HOLE @ 7.47 m BGS.	309.53				
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-18)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH19-91
DATE COMPLETED: NOVEMBER 16, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE
	GROUND SURFACE	317.39				
1.0	ML/CL-SILT(TILL), some clay and sand, moist		CONCRETE SEAL			
2.0	SW/GM-SAND and GRAVEL, little silt, loose, wet, occasional silt layer	315.56	190.5mmø BOREHOLE			
3.0				1SS	X	35
4.0			BENTONITE GROUT			
	- coarse grained sand					
5.0				2SS	X	80
	SM-SILT and SAND, very fine grained, very dense, light brown, wet	312.36 312.21				
6.0	ML/CL-SILT(TILL), some clay, some sand, little gravel, hard, medium brown-grey, damp			3SS	X	76
	END OF HOLE @ 6.71 m BGS.	310.68				
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-19)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH20-91
DATE COMPLETED: DECEMBER 9, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	315.62				
1.0	ML-SILT(TILL), little to some clay and sand, trace gravel, hard, damp		CONCRETE SEAL	1SS	X	69
		314.09		2SS	X	69
2.0	ML-SILT(TILL, REWORKED LACUSTRINE), some clay, trace to little fine sand, hard, light brown, damp - few dark brown moist clayey seams, few small pebbles, no obvious layering		190.5mmø BOREHOLE			
		313.09		3SS	X	91
3.0	- laminated silt and clay layers, hard, light brown, damp					
	ML/SM-SILT(LACUSTRINE), little to some very fine sand, trace clay, tan, dilatant, wet, dense, trace layering, non-cohesive			4SS	X	86
4.0	- very dense, slight layering, few dilatant sand pores	311.50	BENTONITE GROUT	5SS	X	77
				6SS	X	76
5.0	- undulating silt and sand bedding layers (2 to 4cm thick)			7SS	X	67
	ML-SILT(TILL), some clay and sand, trace gravel, hard, brown			8SS	X	54
6.0	- fine to medium sand and silt layers, wet (0.5 to 1.5cm thick @ 4.27, 4.36, 4.45 and 4.54m BGS)					
	- little to some sand, few large pebbles, extremely hard, damp			9SS	X	54
		308.91				
7.0	- little gravel					
	END OF HOLE @ 6.71 m BGS.					
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-21)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH22-91
DATE COMPLETED: DECEMBER 10, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	314.22				
1.0	SW-SAND, little silt, trace gravel, fine to medium grained, loose, brown, saturated	313.61	CONCRETE SEAL	1SS		21
	ML-SILT(TILL), some sand, little gravel, trace to little clay, hard, brown, moist	313.15	190.5mmø BOREHOLE	2SS		74
	GW-GRAVEL, some sand, little silt, saturated	312.70		3SS		53
2.0	ML-SILT(TILL), some sand, little clay and gravel, hard, light brown, moist		BENTONITE GROUT	4SS		50
3.0	- some clay, grey			5SS		40
	- very stoney (3.66 to 4.27m BGS)					
4.0	END OF HOLE (REFUSAL) @ 4.27 m BGS.	309.95				
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-22)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH23-91
DATE COMPLETED: DECEMBER 11, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	313.97				
	ML-SILT(LACUSTRINE), little to some very fine sand, trace clay, occasional small pebble, non-cohesive, medium dense, tan, moist	313.51	CONCRETE SEAL	1SS		25
1.0	ML-SILT(TILL), some sand, little clay, little gravel, stiff, brown, damp	313.21		2SS		56
	SM-SAND and SILT, some gravel, very dense, brown, moist to wet	312.45	190.5mmø BOREHOLE	3SS		38
2.0	ML-SILT(TILL), some clay and sand, trace gravel, hard, brown, damp to moist - stones and gravel (2.29to 3.05m BGS)					
3.0	- damp		BENTONITE GROUT	4SS		60
4.0						
	- stoney			5SS		>100
5.0	END OF HOLE @ 5.18 m BGS.	308.79				
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-23)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH24-91
DATE COMPLETED: DECEMBER 11, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	313.97				
0	ML-SILT(TILL), some sand and clay, little gravel, hard, light brown, damp		CONCRETE SEAL	1AR		
1.0						
	- stoney, brown		190.5mmø BOREHOLE			
2.0				2AR		
			BENTONITE GROUT			
3.0						
4.0				3AR		
	END OF HOLE @ 4.57 m BGS.	309.40				
5.0						
6.0						
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-25)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH26-91
DATE COMPLETED: DECEMBER 12, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	316.96				
1.0	ML-SILT(TILL), some clay and sand, little gravel, hard, grey-brown, moist, cohesive	315.95	CONCRETE SEAL	1SS		38
2.0	ML/SM-SILT(LACUSTRINE), some fine sand, little clay, very dense, tan, moist to wet, faint layering, non-cohesive	315.13		2SS		40
3.0	ML-SILT(TILL, REWORKED LACUSTRINE), some fine sand, little to some clay, trace gravel light grey-brown, damp to moist, cohesive -occasional clay seam with thin (.5cm thick) silt and fine sand layering, damp to moist, occasional moist oblique fracture		190.5mmø BOREHOLE	3SS		28
4.0	- trace fine pebbles			4SS		38
5.0	GW-GRAVEL, some sand, trace silt, stoney, very dense, saturated	312.24	BENTONITE GROUT	5SS		47
6.0	SW-SAND, some gravel, fine to coarse grained, very dense, salt and pepper colour, saturate	311.63		6SS		76
7.0	ML/SM-SILT, some fine sand, trace clay, tan, saturated	311.02		7SS		43
8.0	ML-SILT(TILL), some sand and clay, trace to little gravel, hard, light grey-brown, damp to moist	310.71		8SS		36
9.0	END OF HOLE @ 8.23 m BGS.	308.73		9SS		80
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-26)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH27-91
DATE COMPLETED: DECEMBER 12, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	316.01				
1.0	ML-SILT(TILL), some sand and clay, little gravel, light brown, damp		CONCRETE SEAL			
		314.49				
2.0	ML-SILT(LACUSTRINE), some clay and fine sand, dense, tan, damp, layered			1SS		40
3.0			190.5mmø BOREHOLE	2SS		47
		312.20				
4.0	SW-SAND, some gravel, fine to coarse grained, well graded, very dense, saturated		BENTONITE GROUT			
		311.29				
5.0	ML-SILT(TILL), some sand and clay, little gravel, very hard, light brown, damp to moist			3SS		50
6.0				4SS		>50
7.0						
8.0				5SS		94
	END OF HOLE @ 8.23 m BGS.	307.78				
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-27)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH28-91
DATE COMPLETED: DECEMBER 12, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	313.50				
0	ML-SILT(TILL), some sand and clay, little gravel, very stoney, hard, brown, damp		CONCRETE SEAL			
1.0						
2.0			190.5mmø BOREHOLE	1SS		32
3.0						
	- moist		BENTONITE GROUT	2SS		44
4.0						
	- damp			3SS		
5.0						
6.0				4SS		54
	END OF HOLE @ 6.55 m BGS.	306.95				
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-28)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH29-91
DATE COMPLETED: DECEMBER 13, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	314.24				
1.0	GW-GRAVEL(FILL), some silt and sand, dense, moist	313.33	CONCRETE SEAL			
2.0	ML-SILT(TILL), some clay and sand, little gravel, hard, brown, damp - sand seam (0.5cm thick)		190.5mmø BOREHOLE	1SS		32
3.0	- very hard			2SS		43
4.0			BENTONITE GROUT			
5.0				3SS		66
6.0						
7.0	END OF HOLE @ 6.71 m BGS.	307.53		4SS		86
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-29)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH30-91
DATE COMPLETED: DECEMBER 13, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	317.61				
1.0	ML-SILT(TILL), some sand and clay, little gravel, stoney, hard, brown, damp		CONCRETE SEAL	1AR		
2.0		315.32				
3.0	ML-SILT(LACUSTRINE), some clay, little to some fine sand, medium dense, tan, moist	314.56	190.5mmø BOREHOLE	2AR		
4.0	ML/SM-SILT(OUTWASH), some fine sand, trace clay, very dense, tan, wet - fine to medium grained sand and silt seam, wet (3.35 to 3.51m and 3.81 to 4.11m BGS) - occasional pebble, coarsely layered, very dense, wet			3SS		72
5.0	- silt with little fine sand and clay		BENTONITE GROUT	4SS		>50
6.0	ML-SILT(TILL), some clay and sand, little gravel, stoney, very hard, brown, damp - moist	312.43		5SS		>100
7.0				6SS		36
8.0				7SS		36
9.0	END OF HOLE @ 8.23 m BGS.	309.38		8SS		69
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-30)

PROJECT NAME: ST. MARY'S LANDFILL
PROJECT NO.: 0645
CLIENT: TOWN OF ST. MARY'S
LOCATION: AS PER PLAN

HOLE DESIGNATION: BH31-91
DATE COMPLETED: DECEMBER 13, 1991
DRILLING METHOD: 95mm ID HSA
CRA SUPERVISOR: J.C. MUGFORD

DEPTH m BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION m AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	GROUND SURFACE	316.52				
0	ML-SILT(TILL), some sand and clay, trace gravel, hard, brown, damp		CONCRETE SEAL			
1.0						
2.0				1SS		49
		313.78	190.5mmø BOREHOLE			
3.0	ML/SM-SILT(LACUSTRINE), little fine sand, little to some clay, hard, tan, moist to wet gradational layering - silt with some fine sand (3.20 to 3.51m BGS)			2SS		58
4.0		312.25	BENTONITE GROUT			
	ML-SILT(TILL), some sand and clay, little gravel, hard, brown, damp			3SS		52
5.0						
6.0				4SS		46
7.0						
	- very hard, dry to damp			5SS		>100
8.0		308.44				
	END OF HOLE @ 8.08 m BGS.					
9.0						
10.0						
11.0						
12.0						
13.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

Appendix C4
Landfill Test Pit Logs
St. Marys Landfill

Test Pit No	Depth Interval	Soil Description	Soil Sample No.	Soil Sample Depth	Groundwater
TP 1		Elevation: 314.61 masl			
	0 - 0.25	Medium grey clayey SILT; friable; contains roots; moist (FILL)			
	0.25 - 0.30	Dark grey SILT, organic matter (TOPSOIL)			
	0.30 - 2.10	Medium grey silty CLAY, some sand, some gravel; bedded to 0.66 then massive; stiff to very stiff; moist (TILL) Becoming gravelly at bottom of pit with sandy seams, trace cobbles; wet	S1 S2	0.45 1.0	No water seepage observed
TP 2		Elevation: 316.14 masl			
	0 - 1.75	Light to medium grey gravelly SILT, some clay, some sand, some cobbles; weathered; soft to firm; moist becoming wet around 1.0 m Becoming sandy at bottom of pit Steel pipe in pit bottom (FILL)	S1 S2	1.05 1.75	No water seepage observed
TP 3		Elevation: 318.52 masl			
	0 - 2.70	Medium grey gravelly sandy SILT, trace clay, some cobbles (rounded to subrounded); loose to soft; some caving of pit sidewalls; moist (FILL) Wet seams and inclusions of stiff clay and hard till below 2.2 m	S1 S2 S3	1.05 2.25 2.70	No water seepage observed
TP 4		Elevation: 316.34 masl			
	0 - 0.20	Medium brown SILT, some organic matter (TOPSOIL)			
	0.20 - 2.30	Light brown SILT, some gravel, some sand, trace cobbles, trace boulder; seams of stiff clay; stiff; weathered (FILL)	S1	1.00	
	2.30 - 2.60	Black SILT, some sand; wire fragment; slight odour; moist (FILL)			No water seepage observed
TP 5		Elevation: 318.29 masl			
	0 - 0.60	Light brown cobbly SILT, some sand, some gravel; loose, friable; moist (FILL)			
	0.60 - 1.90	Light grey SILT and fine SAND; low plastic; massive; dense; moist (native waterlaid deposit)	S1	1.40	
	1.90 - 2.00	Medium grey SILT and CLAY, some sand, some gravel, trace cobbles; hard; moist (TILL)	S2	2.00	No water seepage observed

Appendix C4
Landfill Test Pit Logs
St. Marys Landfill

Test Pit No	Depth Interval	Soil Description	Soil Sample No.	Soil Sample Depth	Groundwater
TP 6		Elevation: 314.10 masl			
	0 - 0.70	Light brown silty SAND and GRAVEL, some cobbles; compact; saturated	S1	0.35	
	0.70 - 2.50	Light grey SILT and fine SAND; low plastic; massive; dense; moist (native waterlaid deposit) Becoming saturated around 2.3-2.4 m	S2 S3	1.2 2.5	No water seepage observed Cattails in water filled depression nearby likely due to poor drainage and not a shallow water table
TP 7		Elevation: 314.93 masl			
	0 - 2.20	Light brown sandy, gravelly SILT, some cobbles (rounded/subrounded), trace small boulders; massive; stiff; moist (FILL) Caving sidewalls Becoming saturated around 1.9 m	S1 S2	1.4 2.2	No water seepage observed
TP 8		Elevation: 314.62 masl			
	0 - 0.25	Medium brown SILT and CLAY, some organic matter containing roots; friable; moist to wet (TOPSOIL)			
	0.25 - 1.50	Medium grey-brown SILT and CLAY, trace sand, trace gravel, trace cobbles; fractured to 0.5 m very stiff to hard; moist (TILL)	S1	0.90	No water seepage observed
TP 9		Elevation: 314.14 masl			
	0 - 0.30	Dark brown SILT, some fine sand, some organic matter; wet (TOPSOIL)			
	0.30 - 0.60	Meduim brown SILT, fine sand; moist			
	0.60 - 0.75	Mediumb rown silty fine to coarse SAND & fine GRAVEL; loose to compact; wet	S1	0.65	
	0.75 - 1.40	Light grey silty fine SAND; varved; dense; moist	S2	1.30	No water seepage observed
TP 10		Elevation: 312.47 masl			
	0 - 0.15	Medium brown SILT, some sand, some gravel, some organic matter (TOPSOIL)			
	0.15 - 1.00	Meduim brown SILT, SAND, GRAVEL (rounded), ROCK fragments (angular) (FILL) Difficult to dig below 1.0 m due to amount of rock rubble	S1	1.00	Water seepage around 1.0 m

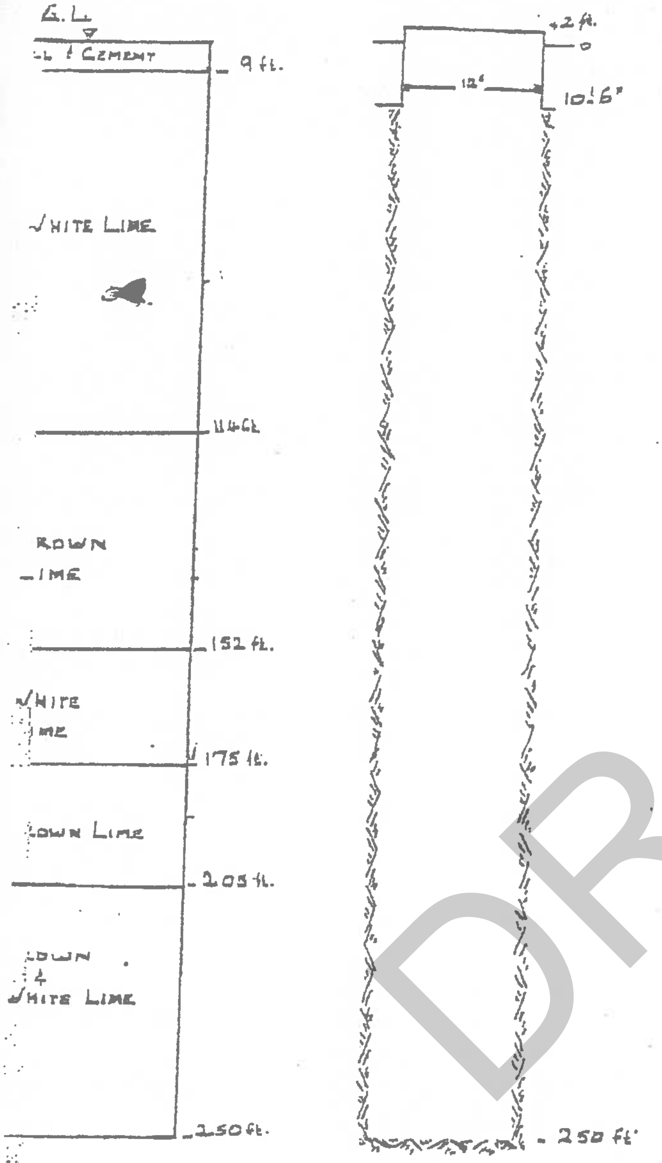
Appendix C4
Landfill Test Pit Logs
St. Marys Landfill

Test Pit No	Depth Interval	Soil Description	Soil Sample No.	Soil Sample Depth	Groundwater
TP 11		Elevation: 313.23 masl			
	0 - 0.30	Medium grey SILT and CLAY, some sand, trace gravel, some organic matter (FILL)			
	0.30 - 1.40	Medium grey CLAY and SILT, some sand, trace gravel, trace cobbles (rounded); weathered to 1.3 m; very stiff to hard; moist (TILL)	S1	1.30	No water seepage observed
TP 12		Elevation: 314.14 masl			
	0 - 0.10	Dark brown SILT, organic matter (TOPSOIL)			
	0.10 - 1.30	Light grey-brown SILT, some clay, trace sand, trace gravel; stiff to very stiff; moist	S1	1.30	No water seepage observed
TP 13		Elevation: 315.86 masl			
	0 - 0.15	Medium grey CLAY and SILT, trace organic matter; loose; moist			
	0.15 - 1.30	Medium grey CLAY and SILT, trace sand, trace gravel, trace cobbles; weathered to 0.7 m; very stiff to hard; moist (TILL)	S1	0.80	No water seepage observed
CKD		Elevation: 323.94 masl			
	0 - 0.30	Dark Brown SILT, some organic matter; moist (TOPSOIL)			
	0.30 - 0.50	Light grey, silt like, loose, dry (cement kiln dust)	S1	0.50	No water seepage observed

Logged on November 5, 2015 by J. Rutherford

All measurements are in metres unless otherwise indicated.

Soil samples will be retained for three months from date of report.



Well Material

Outer Casing: 10'6" x 12" T&C
Inner Casing
Screen
Plug
Gravel

Pump

No. 38414	Setting BP-MB 100'
No. Stages 6	Length Bowls 5'-7"
Bowl 10"	Size & Lgth. Suction 10" x 8"
Head TF	Size Column 8"

Materials or setting details other than standard
Impellers: Trim
BOWL ALL BRONZE. LINE SHAFT & COUPLINGS - st. St./12

Motor

Make G.E.	Phase 3
H. P. 60	Cycles 60
R. P. M. 1800	Volts 550
Type K	Amps. 58.5
Frame 444-P	Serial YPJ 1105030
Bearing Nos.	

Special Equipment

Installation: Feb. 20. 1958.

Well No. 4

B. P. referred to original ground level +2'
Clear depth below B. P. 249'-10"
Started June 17. 1957 Final Test Feb. 20. 1958
Preliminary Test Jul. 8. 1957 Static Level 38'9"
Final Test .... Pumping Level 50'
Guarantee .... I G P M Capacity 846 I G P M (8 hr. Prel. Test)
Contract Pressure .... # Pressure Pump 75 .... #
Length Air Line 114' Main .... #

INTERNATIONAL WATER SUPPLY LTD.

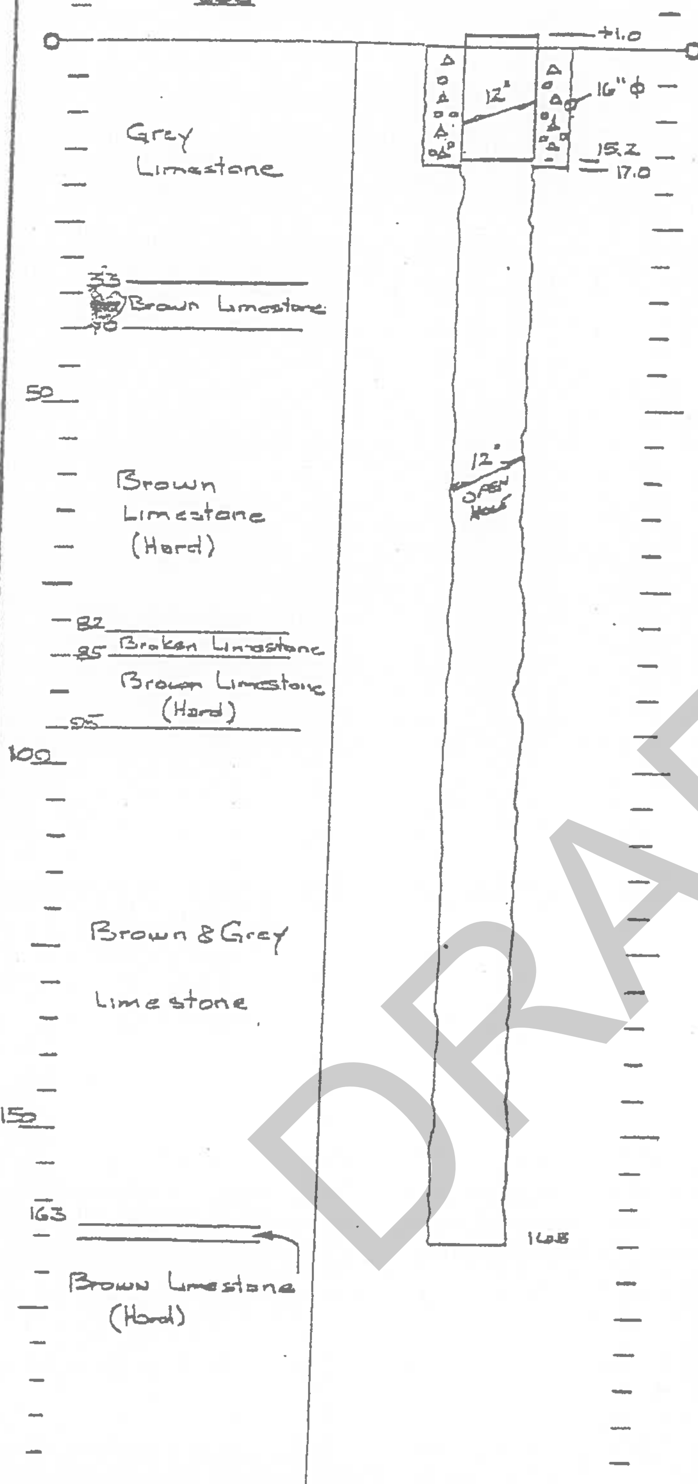
MONTREAL, OAKVILLE — LONDON, CANADA — WATER SUPPLY CONTRACTORS — SASKATOON, VANCOUVER

ST. MARYS CEMENT CO.
ST. MARYS ONT

DRILLED BY: J. McGeachy
INSTALLED BY: G. Keyes
DRAWN BY PGB
APPROVED BY [signature]

WELL DIAGRAM

LOG



WELL MATERIAL

Outer Casing: 12 " dia., ____ " Wall Thk. Matl.: ST

Cemented from 0 ' 0 " to 17 ' 0 "

Inner Casing: — " dia., — " Wall Thk. Matl.: —

Screen: Make — " dia., Opening & Matl.: —

Plug: Type — Matl — Other: —

Gravel: Type — Size — Quantity —

WELL TEST DATA

Preliminary Test Date: Sept 29/75 by T. Kyle

Static Level: 5.78 ft ' — " below M.P. +1.70

Pumping Rate IGM: 785

Pumping Duration: 8 hrs. — min

Pumping Level at Test End: 53.0 ft (Air Line) '

Performance Plots: dd-t Dwg. A-75556

dd-r Dwg. A-75557

Final Test: Date ____ by ____

Rated Well Capacity IGM ____

Pumping Rate IGM ____ Static level ____ ' ____ "

Pumping level ____ ' ____ " at ____ hrs. ____ min.

Pump pressure: ____ psi: Main pressure ____ psi

Shut off: AGH ____ psi: W.L. ____ ' ____ "

Clear Well Depth from B.P. ____ ' ____ " Air Line ____ ' ____ "

PUMP & MOTOR DATA (cert. Curve)

Pump Make Layne Rating 625 IGM @ 344 ' TH

Head: Type TF 818 S.N. 80911

Column: 70 ' X 8 " X 1½ ": Shaft Mtl: SS

Bowl: 10 THC Stage 8 : Curve: TS 193-36

Suction: 8 " dia. 10 ' 0 " Long

Special: Zinc Sleeves ____ : Taped Oil Line ____

Other ____

Motor Make: West Frame: 404TP SN: L-1957222

100 HP, 3 ph. 60 hz. 1800 rpm 575

Bearing No. Upper 7222

Lower 6314 ZZC3

Special Equipment

① Amercoated Column Pipe In & Out

② SS 8" Cone Strainer

WELL REVISIONS AND REHABILITATION

DATE	WORK DONE	BY

International Water Supply Limited

SASKATOON – BARRIE – MONTREAL

CLIENT: ST. MARYS CEMENT CO.

WELL NO: Well 1/75 (No 6)

DRILLED BY: T. KYLE	DATE: Sept 75	DRAWN: BLH
INSTALLED BY:	DATE:	DATE: OCT 3/75

Printed in Canada

GC10205

ENGRCORDING CHARTS GRAPHIC CONTROLS CANADA LTD.

PROJECT: 04-1112-056

RECORD OF DRILLHOLE: BH-S3

SHEET 1 OF 6

LOCATION: N 4786842.9 ;E 488576.4

DRILLING DATE: Aug. 7, 2003 - Aug. 13, 2003

DATUM: NAD 83

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: ALL-TERRAIN

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; BR - Broken Rock; MB- Mechanical Breakeymbols. NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
0		GROUND SURFACE		325.03															
0	159mm I.D. HOLLOW STEM AUGER	UPPER GLACIAL TILL (0.0m to 5.39m) Stiff to hard, medium reddish brown becoming medium dark grey below 3 m, moist, massive textured SILTY CLAY with sand and trace to some matrix supported gravel, occasional cobbles and boulders of limestone, dolostone and igneous composition.		0.00	1														Top of Casing elev. 325.757 Top of Pipe elev. 325.655
1																			
2					2														Concrete Seal in Upper 1m; 159mm Borehole
3					3														
4																			
5	August 8, 2003			319.64															123mm Borehole
5		GLACIOLACUSTRINE SILT (5.39m to 6.16m) Firm to compact, light grey, moist to wet, dilatent, bedded SILT and CLAYEY SILT.		5.39	4														
6	123mm PQ CORE HOLE			318.87															
6		LOWER GLACIAL TILL (6.16m to 18.29m) Hard, medium brownish grey, moist, massive textured SILTY CLAY to CLAYEY SILT with sand and trace to some matrix supported gravel, cobbles and boulders of limestone, dolostone and igneous composition.		6.16	5														Bentonite Grout
7																			
8					6														Sch 40, 51mm dia. flush threaded pvc riser pipe
9																			
10		CONTINUED NEXT PAGE			7														

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KJC

CHECKED:

MISS-ROCK-2 041112056AARCK.GPJ GAL-CANADA.GDT 4/1/05 JDR

PROJECT: 04-1112-056

RECORD OF DRILLHOLE: BH-S3

SHEET 2 OF 6

LOCATION: N 4786842.9 ;E 488576.4

DRILLING DATE: Aug. 7, 2003 - Aug. 13, 2003

DATUM: NAD 83

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: ALL-TERRAIN

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
10		— CONTINUED FROM PREVIOUS PAGE —																
10		LOWER GLACIAL TILL (6.16m to 18.29m) Hard, medium brownish grey, moist, massive textured SILTY CLAY to CLAYEY SILT with sand and trace to some matrix supported gravel, cobbles and boulders of limestone, dolostone and igneous composition.			7													
11					8													
12	August 8, 2003																	123mm Borehole
13					9													
14					10													
15	123mm PQ CORE HOLE																	Bentonite Grout
16					11													
17	August 11, 2003																	
18		BEDROCK SURFACE		306.74	12													
		DUNDEE FORMATION		18.29	1													
19	August 12, 2003				2													
20					3													PVC
		CONTINUED NEXT PAGE																

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KJC

CHECKED:

PROJECT: 04-1112-056

RECORD OF DRILLHOLE: BH-S3

SHEET 3 OF 6

LOCATION: N 4786842.9 ;E 488576.4

DRILLING DATE: Aug. 7, 2003 - Aug. 13, 2003

DATUM: NAD 83

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: ALL-TERRAIN

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; BR - Broken Rock; MB- Mechanical Breakeymbols. NOTE: For additional abbreviations refer to list of abbreviations &

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
20		— CONTINUED FROM PREVIOUS PAGE —																	
	123mm PQ CORE HOLE	DUNDEE FORMATION LIMESTONE (18.29m to 24.32m depth) Fresh, weathered on open bedding partings, light creamy grey to light tan grey, very fine to fine grained, non-porous, thin to medium bedded, partly fossiliferous (rugose corals) LIMESTONE. Limestone tends to separate on open bedding partings. Formation has sharp basal contact. ·□from 18.29 to 23.10 m, predominately very fine to fine grained thin to medium bedded creamy grey limestone ·□from 23.10 to 24.32 bioturbated limestone with numerous burrow casts			3													Monitoring well pipe
21															B,(2,1),, J,(2,1),,				
22					4										B,(2,1),, J,(2,1),,				Bentonite Grout
23					5										B,(2,1),,				Bentonite gravel seal; PVC Washer
24				300.71	6										B,(2,1),, J,(2,1),,				
	August 12, 2003	UPPER LUCAS FORMATION LIMESTONE (25.91m to 37.19m) Fresh, weathered on open bedding partings, light to medium tan to brownish grey, interbedded very fine to fine grained, non-porous to faintly porous, locally pitted to vuggy, thin to medium bedded, laminar textured (stromatolitic) in part and locally oolitic, weakly stylolitic, partly fossiliferous LIMESTONE with dark tan sections of porous, faintly petroliferous limestone. Basal contact marked by porous horizon. ·□from 24.32 to 25.37 m laminar textured limestone with soft sediment slump structures ·□from 25.37 to 25.65 m Dundee Marker Bed, medium grey, mottled lithoclastic dolostone with rip-up clasts at base. ·□from 30.57 to 30.80 m medium grey, mottled porous to pitted dolostone marker bed, sharp basal contact ·□from 31.73 to 31.94 m dark grey, porous, laminar, faintly petroliferous argillaceous dolostone bed		24.32											B,(2,1),,				
25															B,(2,1),, B,(2,1),,				
				299.66 25.37	7										B,(2,1),,				
				299.38 25.65											B,(2,1),,				
				299.12 25.91															
26															B,(2,1),,				
	96mm HQ CORE HOLE														B,(2,1),, B,(2,1),,				
					8										B,(2,1),,				Open 96mm Drillhole
27															J,(2,1),,				
															B,(2,1),,				
															B,(2,1),,				
28															B,(2,1),,				
					9										B,(2,1),, B,(2,1),,				
															B,(2,1),,				
29															B,(2,1),,				
					10										B,(2,1),, B,(2,1),, B,(2,1),, B,(2,1),, B,(2,1),,				
30		CONTINUED NEXT PAGE																	

DRAFT

DEPTH SCALE 1 : 50

LOGGED: KJC

CHECKED:

Golder Associates

MISS-ROCK-2 041112056AARCK.GPJ GAL-CANADA.GDT 4/1/05 JDR

PROJECT: 04-1112-056

RECORD OF DRILLHOLE: BH-S3

SHEET 4 OF 6

LOCATION: N 4786842.9 ;E 488576.4

DRILLING DATE: Aug. 7, 2003 - Aug. 13, 2003

DATUM: NAD 83

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: ALL-TERRAIN

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Breakesymbols; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR, % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
30		— CONTINUED FROM PREVIOUS PAGE —																	
					10										B,(2,1),,				
				294.46															
				30.57															
				294.23															
				30.80															
31																			
				293.30															
				31.73															
				293.09															
	August 12, 2003			31.94															
32		UPPER LUCAS FORMATION DOLOMITIC LIMESTONE (25.91m to 37.19m) Fresh, weathered on open bedding partings, light to medium tan to brownish grey, interbedded very fine to fine grained, non-porous to faintly porous, locally pitted to vuggy, thin to medium bedded, laminar textured (stromatolitic) in part and locally oolitic, weakly stylolitic, partly fossiliferous dolomitic LIMESTONE with dark tan sections of porous, faintly petroliferous limestone. Basal contact marked by porous horizon. · from 30.57 to 30.80 m medium grey, mottled porous to pitted dolostone marker bed, sharp basal contact · from 31.73 to 31.94 m dark grey, porous, laminar, faintly petroliferous argillaceous dolostone bed			11														
33																			
34					12														
35	96mm HQ CORE HOLE	UPPER LUCAS FORMATION becomes dolomitic limestone from 30.57 m to 37.19 m																	Open 96mm Drillhole
36					13														
37				287.84															
		LOWER LUCAS FORMATION DOLOSTONE (37.19m to 50.44m) Transitional contact with overlying strata. Fresh, faintly weathered in some beds, moderately weathered on open bedding partings, light to medium tan to brownish grey, very fine to fine grained, non-porous to faintly to moderately porous, thin to medium bedded laminar textured DOLOSTONE with faintly petroliferous beds. · from 37.19m to 37.34m dark brownish grey, argillaceous dolostone · from 38.05m to 38.19m angular intraformational dolostone breccia · from 38.79m to 39.03m dark grey argillaceous partings and brown porous, faintly petroliferous dolostone with void at 39.03m where drill water circulation lost		37.19														
				37.34	14														
38				286.98															
				38.05															
				38.19															
				286.24															▽ Aug 18/03
				38.79															
39				286.00	15														
				39.03															
				285.57															
				39.50															
					16										J,(2,1),,				
40		CONTINUED NEXT PAGE																	

DRAFT

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: KJC

CHECKED:

MISS-ROCK-2 04111205GAARCK.GPJ GAL-CANADA.GDT 4/1/05 JDR

PROJECT: 04-1112-056

RECORD OF DRILLHOLE: BH-S3

SHEET 5 OF 6

LOCATION: N 4786842.9 ;E 488576.4

DRILLING DATE: Aug. 7, 2003 - Aug. 13, 2003

DATUM: NAD 83

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: ALL-TERRAIN

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH	COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3m	DISCONTINUITY DATA: β Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC 'Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
		— CONTINUED FROM PREVIOUS PAGE —																	
40				284.35	16										B,(2,1),,				
				40.68											B,(2,1),,				
				40.78															
41															J,(2,1),,				
															B,(2,1),,				
															B,(2,1),,				
42					17										B,(2,1),,				
															B,(2,1),,				
															B,(2,1),,				
				282.51											B,(2,1),,				
				42.52											B,(2,1),,				
43															B,(2,1),,				
				281.66											J,(2,1),,				
				43.37	18														
				281.28											B,(2,1),,				
				43.75											B,(2,1),,				
44		LOWER LUCAS FORMATION CONTINUED · at 39.27m 10 mm thick black argillaceous bed · from 39.46m to 39.50m medium grey mottled marker bed · from 40.68m to 40.78 m dark grey argillaceous dolostone · from 40.78m to 42.52m and 43.37m to 43.75m weathered vuggy dolostone developed from solution of fossils · from 44.56m to 44.81m yellowish weathered porous dolostone · from 45.31m to 45.96m thinly bedded dolostone with open weathered bedding partings with additional open partings at 46.15m, 47.06m, 47.24m, 47.27m and 47.55m, weathered and porous between 47.27m and 47.55m · from 47.55m to 50.43m fresh limestone and dolomitic limestone												B,(2,1),,				
				280.47											B,(2,1),,				
				44.56											B,(2,1),,				
				280.22											B,(2,1),,				
				44.81															
45					19														Open 96mm Drillhole
				279.72															
				45.31											B,(2,1),,				
															B,(2,1),,				
46				279.07															
				45.96															
				278.88											B,(2,1),,				
				46.15															
					20														
															B,(2,1),,				
47				277.97											B,(2,1),,				
				47.06											B,(2,1),,				
				277.70											B,(2,1),,				
				47.27															
				277.48											B,(2,1),,				
				47.55															
															B,(2,1),,				
48					21										B,(2,1),,				
															J,(2,1),,				
															B,(2,1),,				
															B,(2,1),,				
															B,(2,1),,				
49															J,(2,1),,				
															B,(2,1),,				
															B,(2,1),,				
					22														
															B,(2,1),,				
															J,(2,1),,				
															B,(2,1),,				
															B,(2,1),,				
50		CONTINUED NEXT PAGE																	

96mm HQ CORE HOLE August 13, 2003

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: KJC

CHECKED:

PROJECT: 04-1112-056

RECORD OF DRILLHOLE: BH-S3

LOCATION: N 4786842.9 ;E 488576.4

DRILLING DATE: Aug. 7, 2003 - Aug. 13, 2003

DATUM: NAD 83

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75

DRILLING CONTRACTOR: ALL-TERRAIN

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate; BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage; PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular; PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Breakymbols.; BR - Broken Rock

NOTE: For additional abbreviations refer to list of abbreviations &

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	PENETRATION RATE (m/min)	FLUSH COLOUR % RETURN	RECOVERY TOTAL CORE %	RECOVERY SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3m	DISCONTINUITY DATA B Angle	DISCONTINUITY DATA DIP w.r.t. CORE AXIS	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC Q' AVG.	NOTES WATER LEVELS INSTRUMENTATION
50		— CONTINUED FROM PREVIOUS PAGE —																
		LOWER LUCAS FORMATION CONTINUED			22									B,(2,1),,				Open 96mm Drillhole
				274.59														
		END OF BOREHOLE		50.44														
51																		
52																		
53																		
54																		
55																		
56																		
57																		
58																		
59																		
60																		

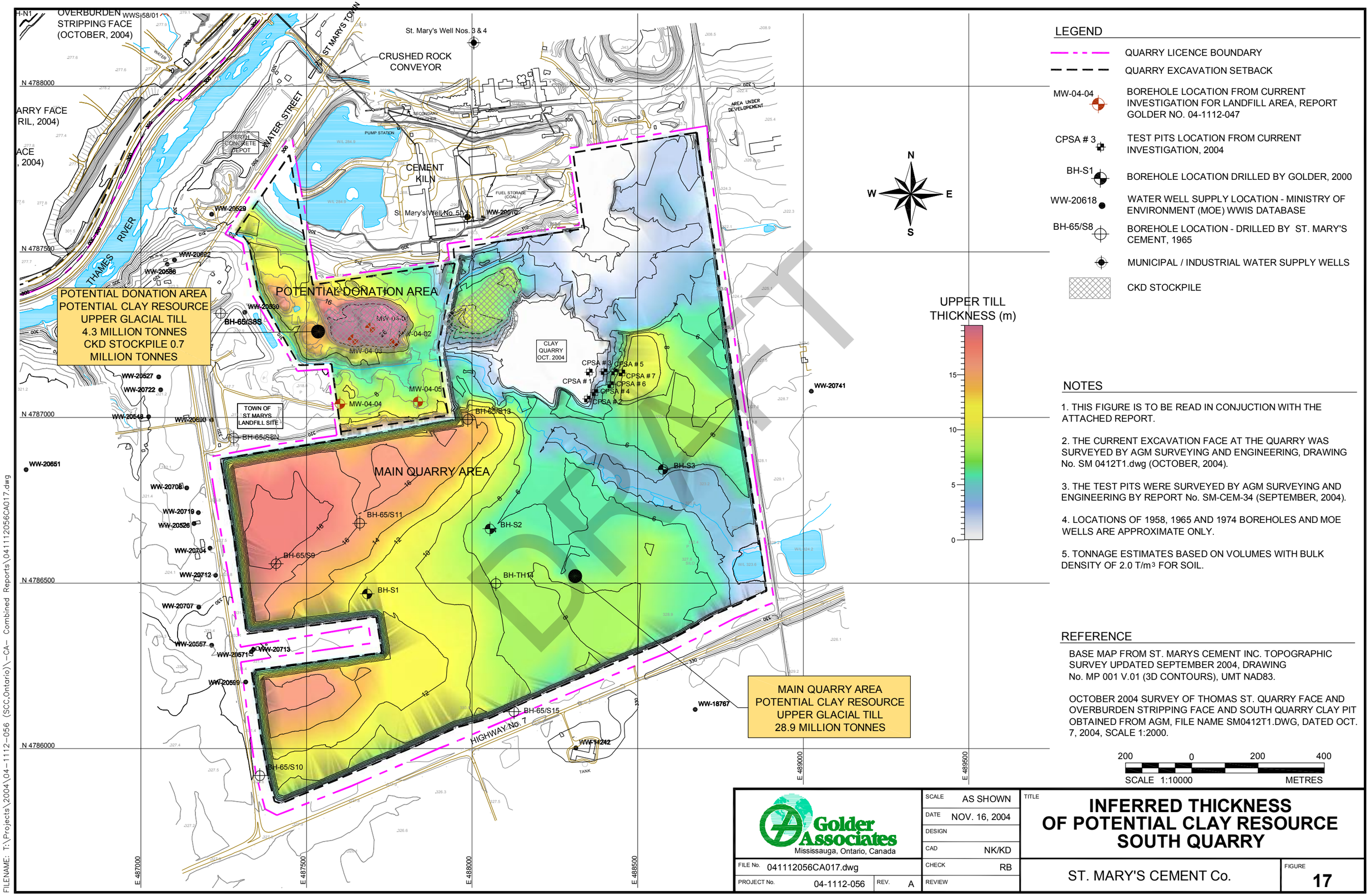
DEPTH SCALE

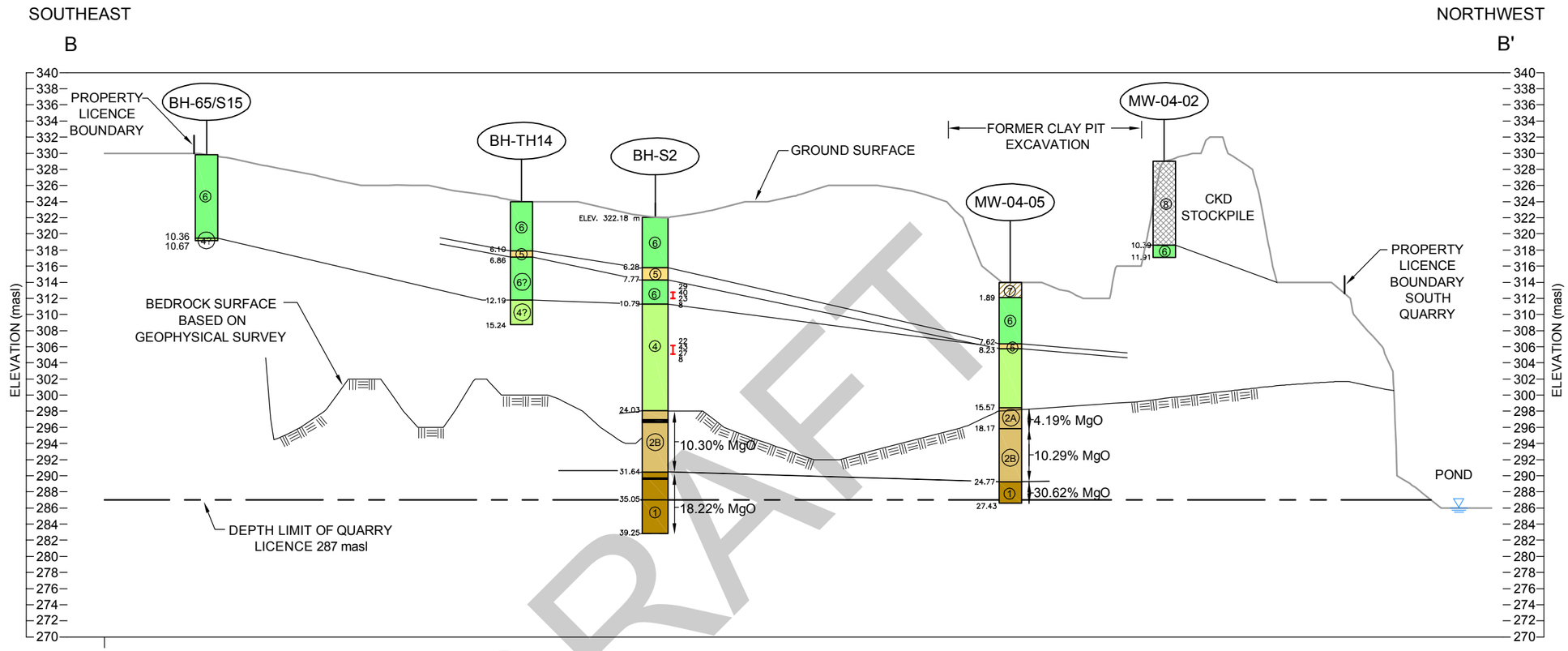
1 : 50

Golder Associates

LOGGED: KJC

CHECKED:


OVERBURDEN STRIPPING FACE (OCTOBER, 2004)
WWIS-58/01
St. Mary's Well Nos. 3 & 4
CRUSHED ROCK CONVEYOR
ST MARYS TOWN
WATER STREET
PERMA CONCRETE DEPOT
PUMP STATION
SECONDARY CRUSHER
AREA UNDER DEVELOPEMENT
CEMENT KILN
FUEL STORAGE (COAL)
St. Mary's Well No. 5
WW-20529
WW-20610
THAMES RIVER
WW-20682
WW-20586
POTENTIAL DONATION AREA
POTENTIAL CLAY RESOURCE
UPPER GLACIAL TILL
4.3 MILLION TONNES
CKD STOCKPILE 0.7
MILLION TONNES
WW-20530
BH-65/S8S
MW-04-01
MW-04-02
MW-04-03
MW-04-04
MW-04-05
CLAY QUARRY OCT. 2004
CPSA # 1
CPSA # 2
CPSA # 3
CPSA # 4
CPSA # 5
CPSA # 6
CPSA # 7
WW-20741
WW-20527
WW-20722
WW-20548
WW-20630
TOWN OF ST.MARYS LANDFILL SITE
BH-65/S8N
BH-65/S13
MAIN QUARRY AREA
BH-S3
BH-65/S11
BH-S2
BH-65/S9
BH-TH14
BH-S1
WW-20651
WW-20705
WW-20719
WW-20526
WW-20704
WW-20712
WW-20707
WW-20557
WW-20571
WW-20713
WW-20559
BH-65/S15
WW-18767
HIGHWAY No. 7
WW-14242
TANK
BH-65/S10
N 4788000
N 4787500
N 4787000
N 4786500
N 4786000
E 487000
E 487500
E 488000
E 488500
E 489000
E 489500
N
S
E
W
UPPER TILL THICKNESS (m)
15
10
5
0
LEGEND
QUARRY LICENCE BOUNDARY
QUARRY EXCAVATION SETBACK
MW-04-04 BOREHOLE LOCATION FROM CURRENT INVESTIGATION FOR LANDFILL AREA, REPORT GOLDER NO. 04-1112-047
CPSA # 3 TEST PITS LOCATION FROM CURRENT INVESTIGATION, 2004
BH-S1 BOREHOLE LOCATION DRILLED BY GOLDER, 2000
WW-20618 WATER WELL SUPPLY LOCATION - MINISTRY OF ENVIRONMENT (MOE) WWIS DATABASE
BH-65/S8 BOREHOLE LOCATION - DRILLED BY ST. MARY'S CEMENT, 1965
MUNICIPAL / INDUSTRIAL WATER SUPPLY WELLS
CKD STOCKPILE
NOTES
1. THIS FIGURE IS TO BE READ IN CONJUCTION WITH THE ATTACHED REPORT.
2. THE CURRENT EXCAVATION FACE AT THE QUARRY WAS SURVEYED BY AGM SURVEYING AND ENGINEERING, DRAWING No. SM 0412T1.dwg (OCTOBER, 2004).
3. THE TEST PITS WERE SURVEYED BY AGM SURVEYING AND ENGINEERING BY REPORT No. SM-CEM-34 (SEPTEMBER, 2004).
4. LOCATIONS OF 1958, 1965 AND 1974 BOREHOLES AND MOE WELLS ARE APPROXIMATE ONLY.
5. TONNAGE ESTIMATES BASED ON VOLUMES WITH BULK DENSITY OF 2.0 T/m3 FOR SOIL.
REFERENCE
BASE MAP FROM ST. MARYS CEMENT INC. TOPOGRAPHIC SURVEY UPDATED SEPTEMBER 2004, DRAWING No. MP 001 V.01 (3D CONTOURS), UMT NAD83.
OCTOBER 2004 SURVEY OF THOMAS ST. QUARRY FACE AND OVERBURDEN STRIPPING FACE AND SOUTH QUARRY CLAY PIT OBTAINED FROM AGM, FILE NAME SM0412T1.DWG, DATED OCT. 7, 2004, SCALE 1:2000.
MAIN QUARRY AREA
POTENTIAL CLAY RESOURCE
UPPER GLACIAL TILL
28.9 MILLION TONNES
200 0 200 400
SCALE 1:10000 METRES
DRAFT
Golder Associates
Mississauga, Ontario, Canada
FILE No. 041112056CA017.dwg
PROJECT No. 04-1112-056 REV. A
SCALE AS SHOWN
DATE NOV. 16, 2004
DESIGN
CAD NK/KD
CHECK RB
REVIEW
TITLE
INFERRED THICKNESS OF POTENTIAL CLAY RESOURCE SOUTH QUARRY
ST. MARY'S CEMENT Co.
FIGURE 17
PLOT DATE: November 22, 2004
FILENAME: T:\Projects\2004\04-1112-056 (SCC,Ontario)\-CA- Combined Reports\041112056CA017.dwg



STRATIGRAPHY

SURFICIAL DEPOSITS

⑧ FILL, loose to compact, grey, silt to sand, cement kiln dust

⑦ FILL, loose to compact, brown, silty sand to sand and gravel

⑥ UPPER GLACIAL TILL Very stiff to hard, medium dark grey, moist, massive textured, well graded SILTY CLAY with sand and trace to some matrix support gravel and occasional cobbles of limestone, dolostone, igneous composition.

⑤ MIDDLE GLACIOLACUSTRINE SILT Firm to compact, light grey, moist to wet, dialatent, massive textured, well graded to thinly bedded SILT and CLAYEY SILT.

④ LOWER GLACIAL TILL Hard, medium brownish grey, moist to dry appearing, massive textured SILTY CLAY to CLAYEY SILT with sand and trace to some matrix supported gravel, occasional cobbles and boulders of limestone, dolostone and igneous composition. Cobbles and boulders increase to 10 to 20 percent near base of sequence.

BEDROCK DEPOSITS

③ DUNDEE FORMATION LIMESTONE Fresh, weathered on open bedding partings, light creamy grey to light tan grey, very fine to fine grained, non-porous, thin to medium bedded, partly fossiliferous (rugose corals) LIMESTONE.(3A) and Dolomitic Limestone(3B) Limestone tends to separate on open bedding partings.

② UPPER LUCAS FORMATION DOLOMITIC LIMESTONE Fresh, weathered on open bedding partings, light to medium tan to brownish grey, interbedded very fine to fine grained, non-porous to faintly porous, locally pitted to vuggy, thin to medium bedded, laminar textured (stromatolitic) in part and locally oolitic, weakly stylolitic, partly fossiliferous LIMESTONE(2A) and Dolomitic Limestone(2B) with dark tan sections of porous, faintly petroliferous limestone.

① LOWER LUCAS FORMATION DOLOSTONE Fresh, faintly weathered in some beds, moderately weathered on open bedding partings, light to medium tan to brownish grey, very fine to fine grained, faintly to moderately porous, thin to medium bedded, laminar textured DOLOMITIC LIMESTONE to DOLOSTONE with faintly petroliferous beds.

LEGEND

GRAIN SIZE CLASSIFICATION TEST INTERVAL
22 → % CLAY SIZE (<0.002mm) % SILT SIZE [0.002mm to
51 → 0.075mm (No. 200 SEIVE)] % SAND SIZE [0.075mm to
19 → 4.75mm (No. 200 to No. 4 SEIVE)] % GRAVEL SIZE [4.75mm
8 → to 26.2mm (No. 4 to 3 SEIVE)]

STATIC GROUNDWATER LEVEL
BH-S1 MEASURED AUGUST 22, 2003
BH-S3 MEASURED AUGUST 18, 2003

12.49% MgO LENGTH AVERAGED MAGNESIUM OXIDE PERCENT CONCENTRATION OF SOIL AND BEDROCK BASED ON WHOLE ROCK ANALYSES

NOTE

FOR LOCATION OF SECTION B - B' REFER TO FIGURE 10

SCALE Horizontal 1:6000 METRES (120 0 120 240)

SCALE Vertical 1:600 METRES (12 0 12 24)

Golder Associates
Mississauga, Ontario, Canada

SCALE	AS SHOWN
DATE	NOV. 15, 2004
DESIGN	
CAD	KD
CHECK	RB
REVIEW	
FILE No.	041112056CA014.dwg
PROJECT No.	04-1112-056
REV.	A

TITLE
SUB-SURFACE CONDITIONS SECTION B-B' SOUTH QUARRY

ST. MARY'S CEMENT Co.

FIGURE 14

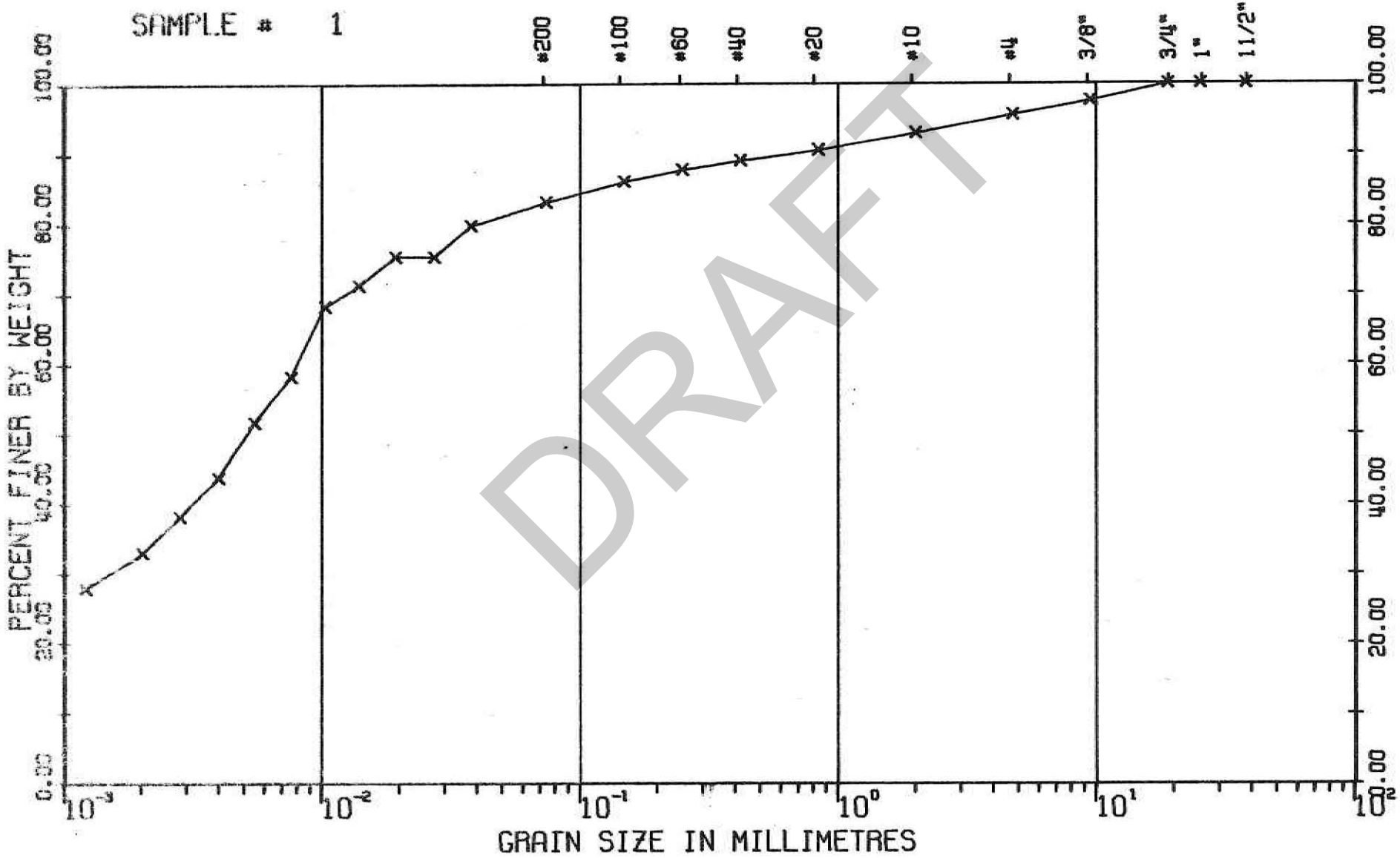
PLOT DATE: November 22, 2004
FILENAME: T:\Projects\2004\04-1112-056 (SCC,Ontario)\-CA- Combined Reports\041112056CA014.dwg

GRAIN SIZE DISTRIBUTION

ST. MARY'S LANDFILL SITE - 979-645.

OW4-80 - 2.5 FEET.

SAMPLE # 1

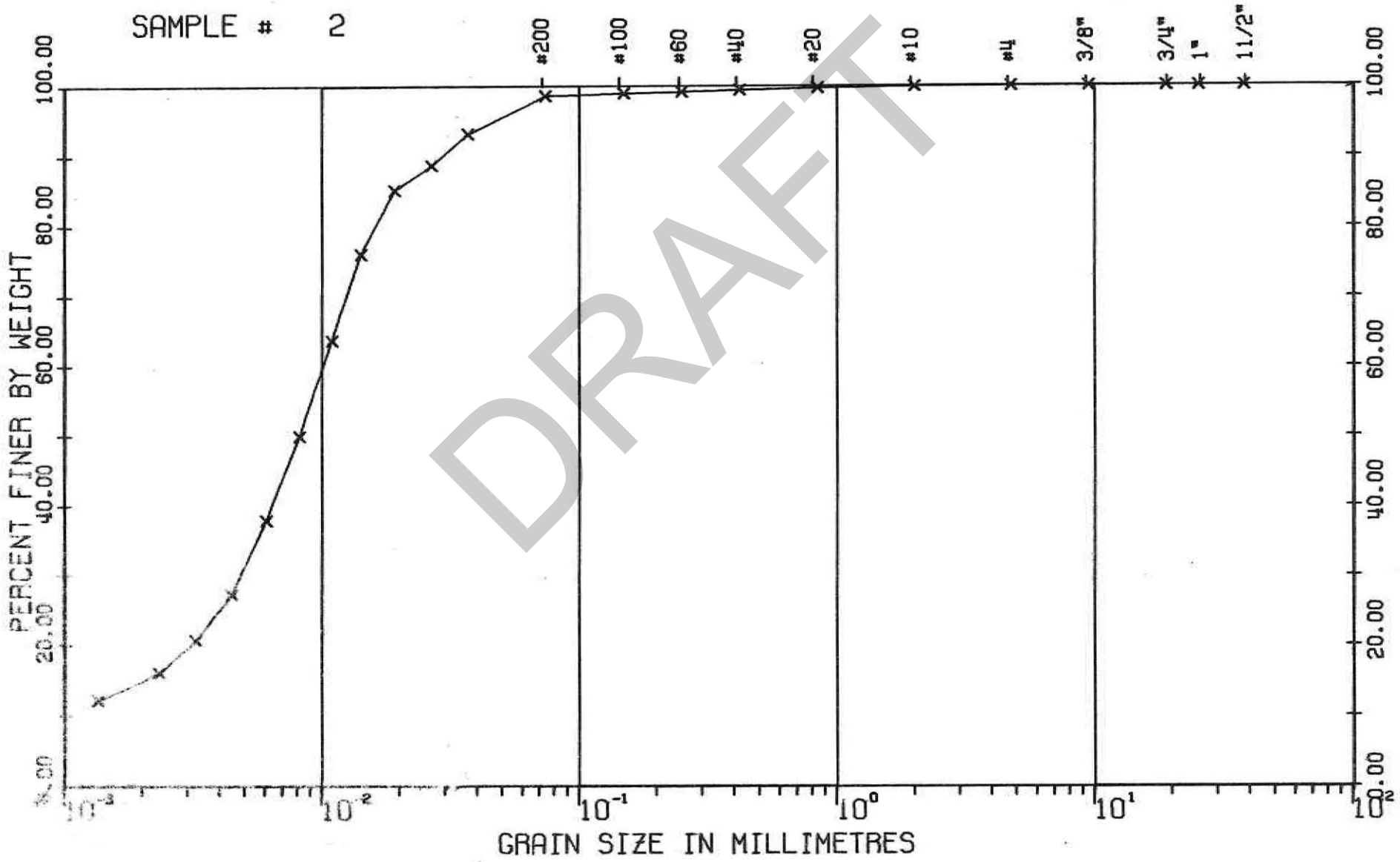


GRAIN SIZE DISTRIBUTION

ST. MARY'S LANDFILL. 979-645

0W4-80 - 5 FEET.

SAMPLE # 2

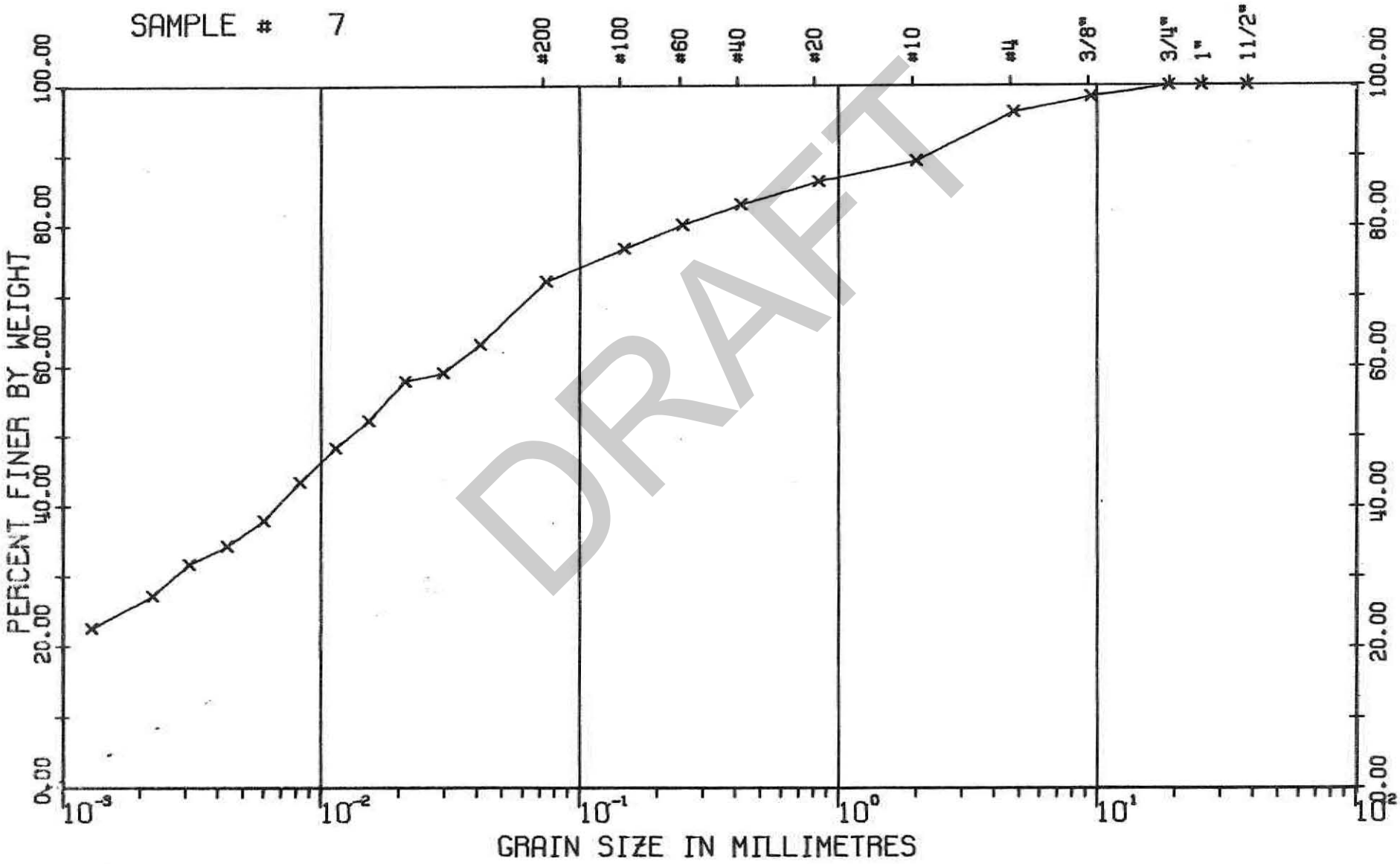


GRAIN SIZE DISTRIBUTION

ST. MARY'S LANDFILL. 979-645

OW4-80 - 17.5 FEET.

SAMPLE # 7

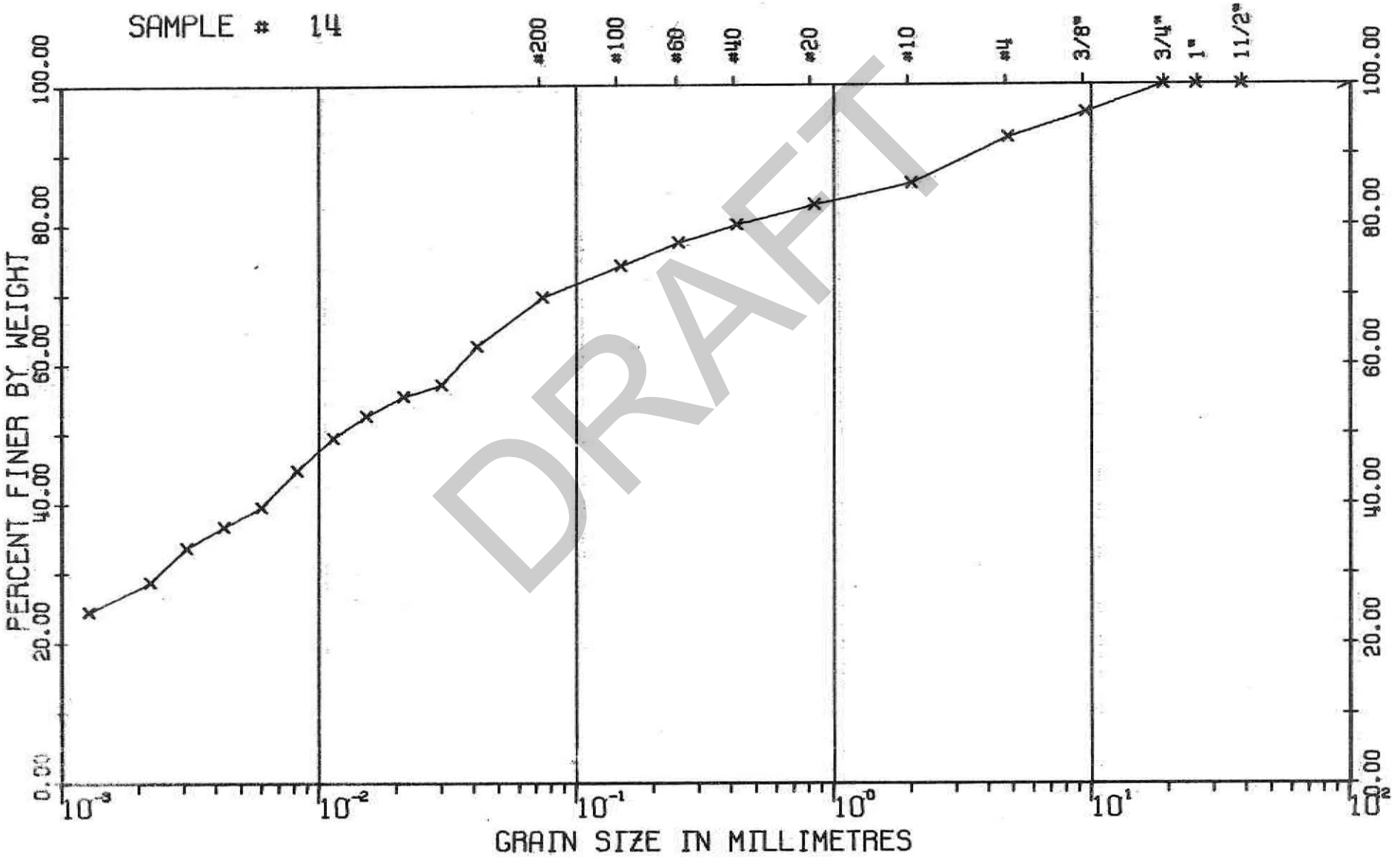


GRAIN SIZE DISTRIBUTION

ST. MARY'S LANDFILL, 979-645

OW1-80 - 20 FEET.

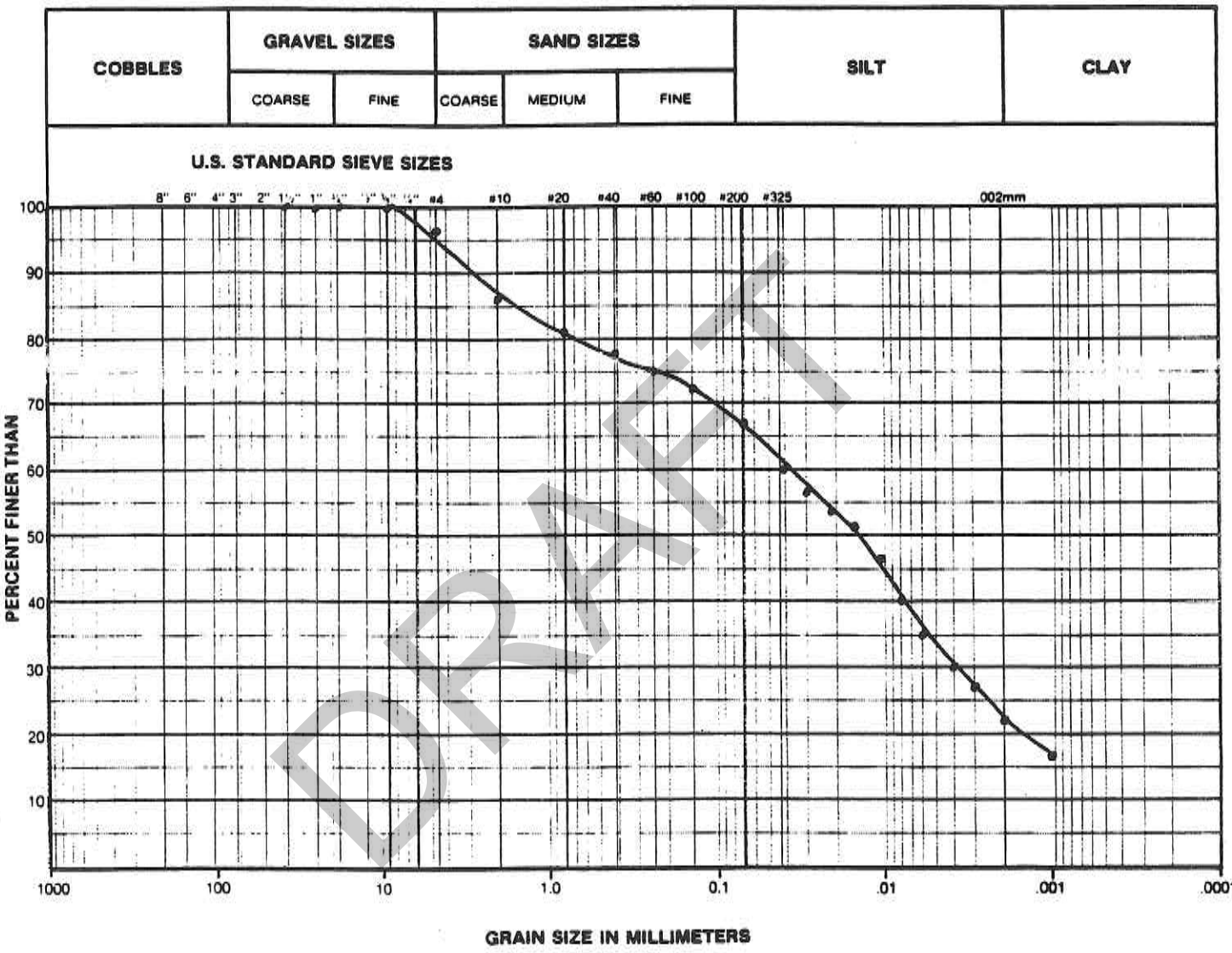
SAMPLE # 14



CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES

GRAIN SIZE CURVE

CLIENT:	ST. MARY'S LF
PROJECT NUMBER:	0645
LAB. NUMBER:	CR 3582
LOCATION:	BH 10-91
HOLE:	— SAMPLE: 2CS
DEPTH:	4 - 7 FT.
TECHNICIAN:	T. GERARDI DATE: NOVEMBER 4/91



HAZEN PERMEABILITY ESTIMATE $(D_{10})^2$ = 4.8E-07 cm/sec

NOTE: D_{10} = GRAINSIZE IN mm AT 10% FINER THAN

REMARKS : SILT, SOME SAND, LITTLE CLAY
TRACE GRAVEL

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

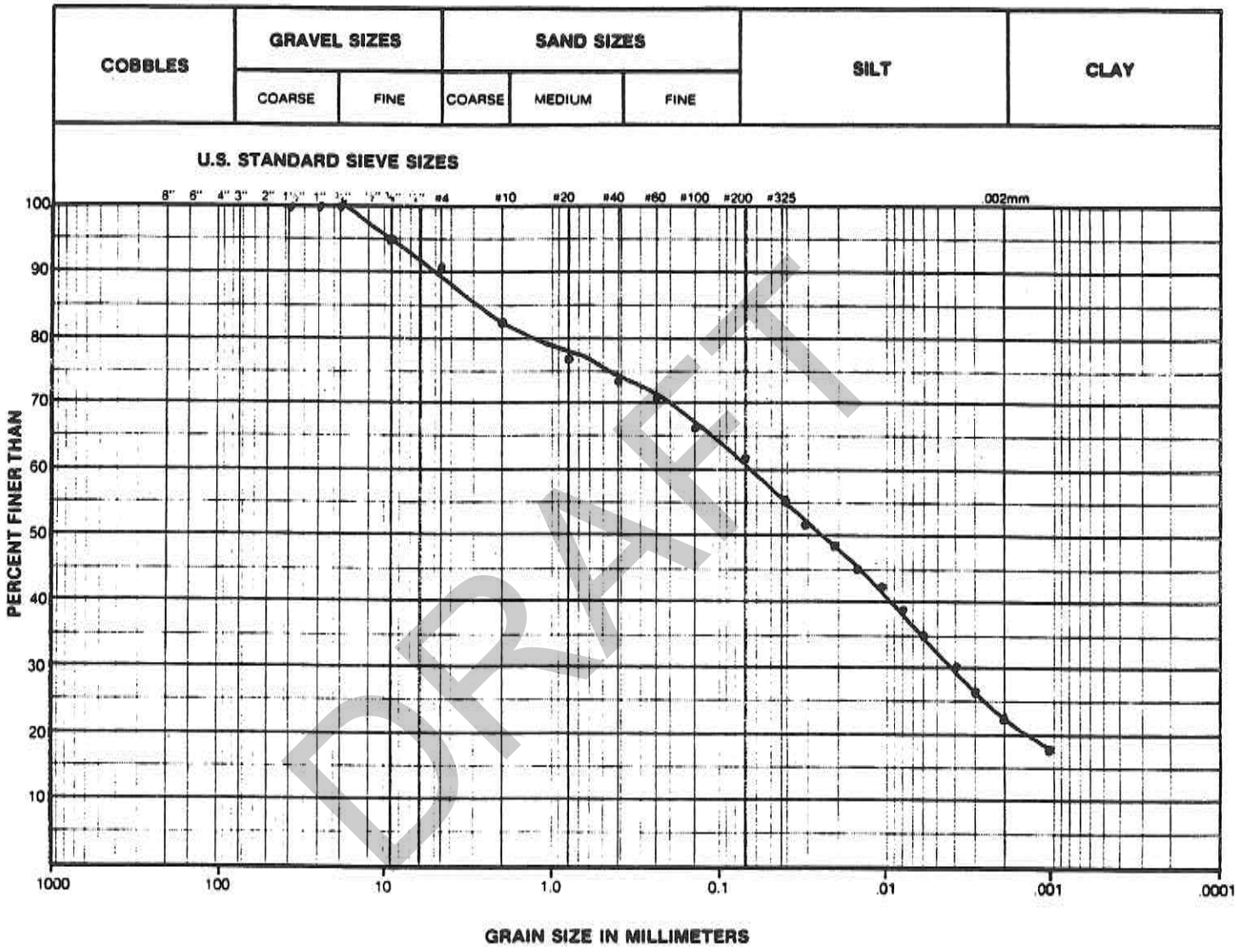
SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS	
AND	36-50%
SOME	21-35%
LITTLE	11-20%
TRACE	1-10%

SUMMARY	
GRAVEL	3.77 %
SAND	28.68 %
SILT	46.66 %
CLAY	20.88 %

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES

GRAIN SIZE CURVE

CLIENT:	ST. MARY's LF
PROJECT NUMBER:	0645
LAB. NUMBER:	CR 3583
LOCATION:	BH10 - 91
HOLE:	— SAMPLE: 6CS
DEPTH:	24 - 28 FT
TECHNICIAN:	T. GERRARD DATE: NOVEMBER 4/91



HAZEN PERMEABILITY ESTIMATE $(D_{10})^2$ = 4.1E-07 cm/sec

NOTE: D_{10} = GRAINSIZE IN mm AT 10% FINER THAN

REMARKS : SILT, SOME SAND, SOME CLAY, TRACE GRAVEL.

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

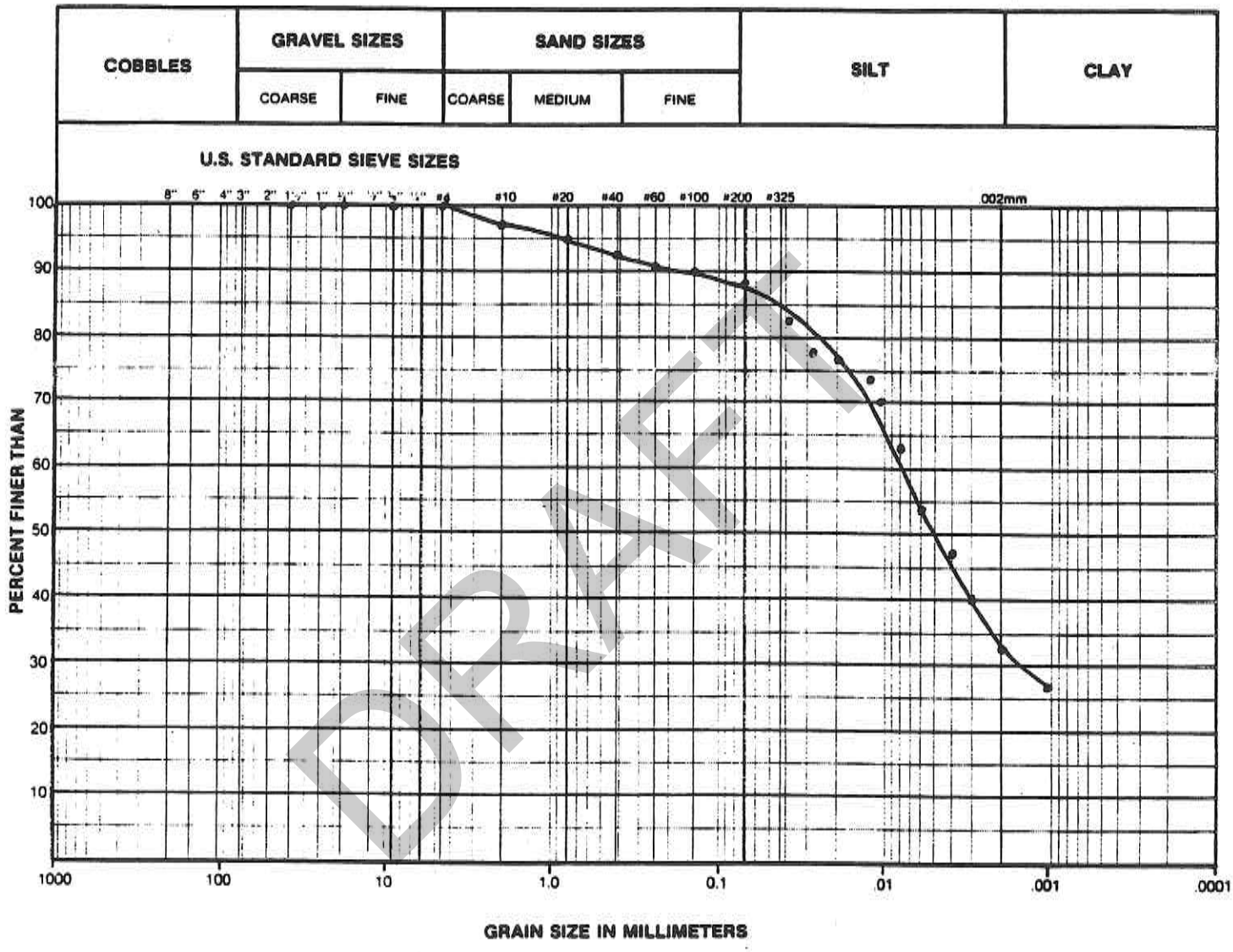
SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS	
AND	36-50%
SOME	21-35%
LITTLE	11-20%
TRACE	1-10%

SUMMARY	
GRAVEL	9.06 %
SAND	29.34 %
SILT	39.94 %
CLAY	21.66 %

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES

GRAIN SIZE CURVE

CLIENT:	ST. MARY'S LF
PROJECT NUMBER:	0645
LAB. NUMBER:	CR 3587
LOCATION:	BN11-91
HOLE:	—— SAMPLE: 2CS
DEPTH:	6-10 FT.
TECHNICIAN:	T. GERARDI DATE: NOVEMBER 4/91



HAZEN PERMEABILITY ESTIMATE $(D_{10})^2$ = 1.1E-07 cm/sec

NOTE: D_{10} = GRAINSIZE IN mm AT 10% FINER THAN

REMARKS : SILT, SOME CLAY, LITTLE SAND

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

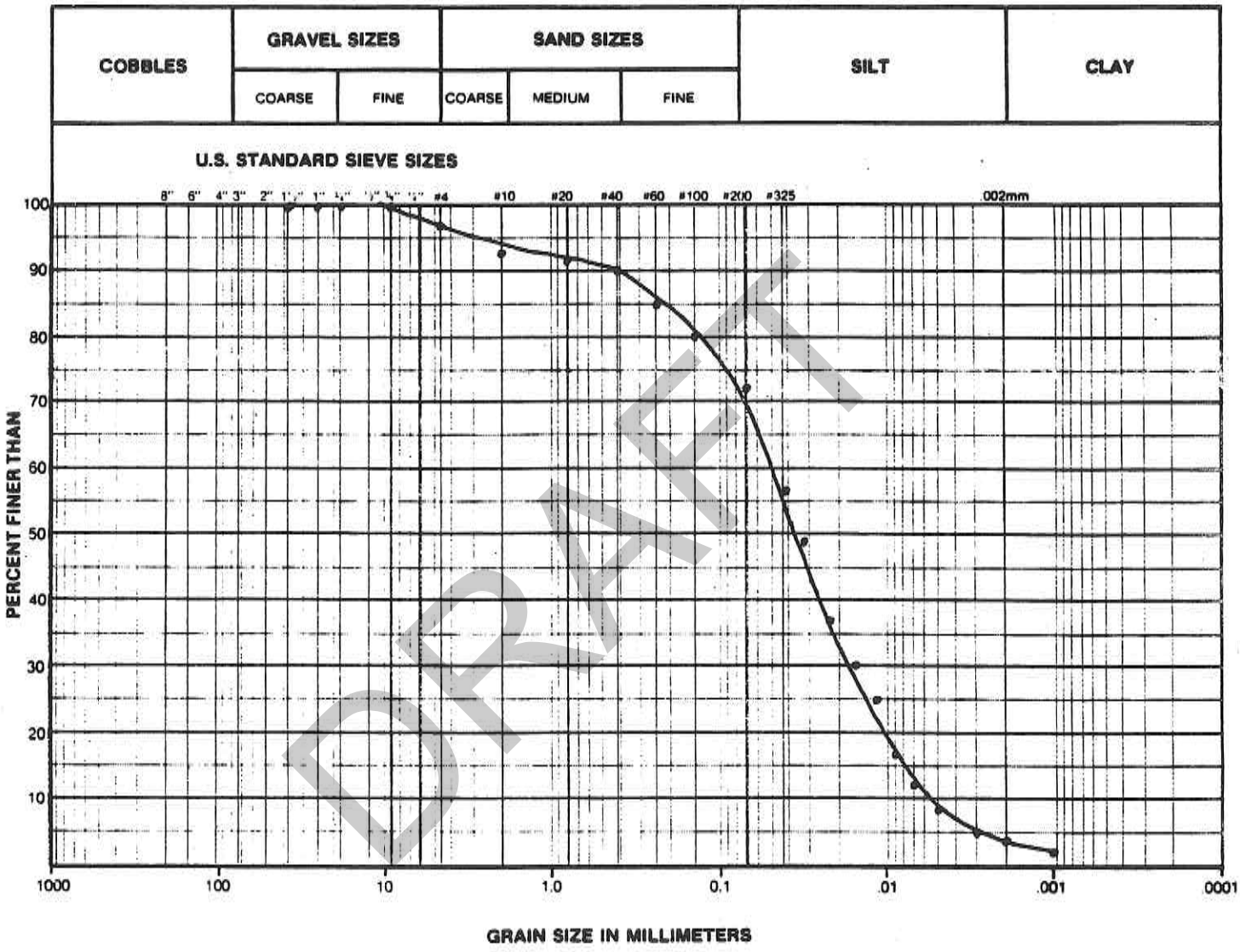
SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS	
AND	36-50%
SOME	21-35%
LITTLE	11-20%
TRACE	1-10%

SUMMARY	
GRAVEL	0 %
SAND	12.22 %
SILT	55.93 %
CLAY	31.85 %

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES

GRAIN SIZE CURVE

CLIENT:	ST. MARY'S LF
PROJECT NUMBER:	0645
LAB. NUMBER:	CR 3588
LOCATION:	BH12-91
HOLE:	—— SAMPLE: 3CS
DEPTH:	9.5 - 13.5 FT
TECHNICIAN:	T. GERARDI DATE: NOVEMBER 4/91



HAZEN PERMEABILITY ESTIMATE $(D_{10})^2$ = 3.5E-05 cm/sec

NOTE: D_{10} = GRAINSIZE IN mm AT 10% FINER THAN

REMARKS : SILT, SOME SAND, TRACE CLAY, TRACE GRAVEL

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

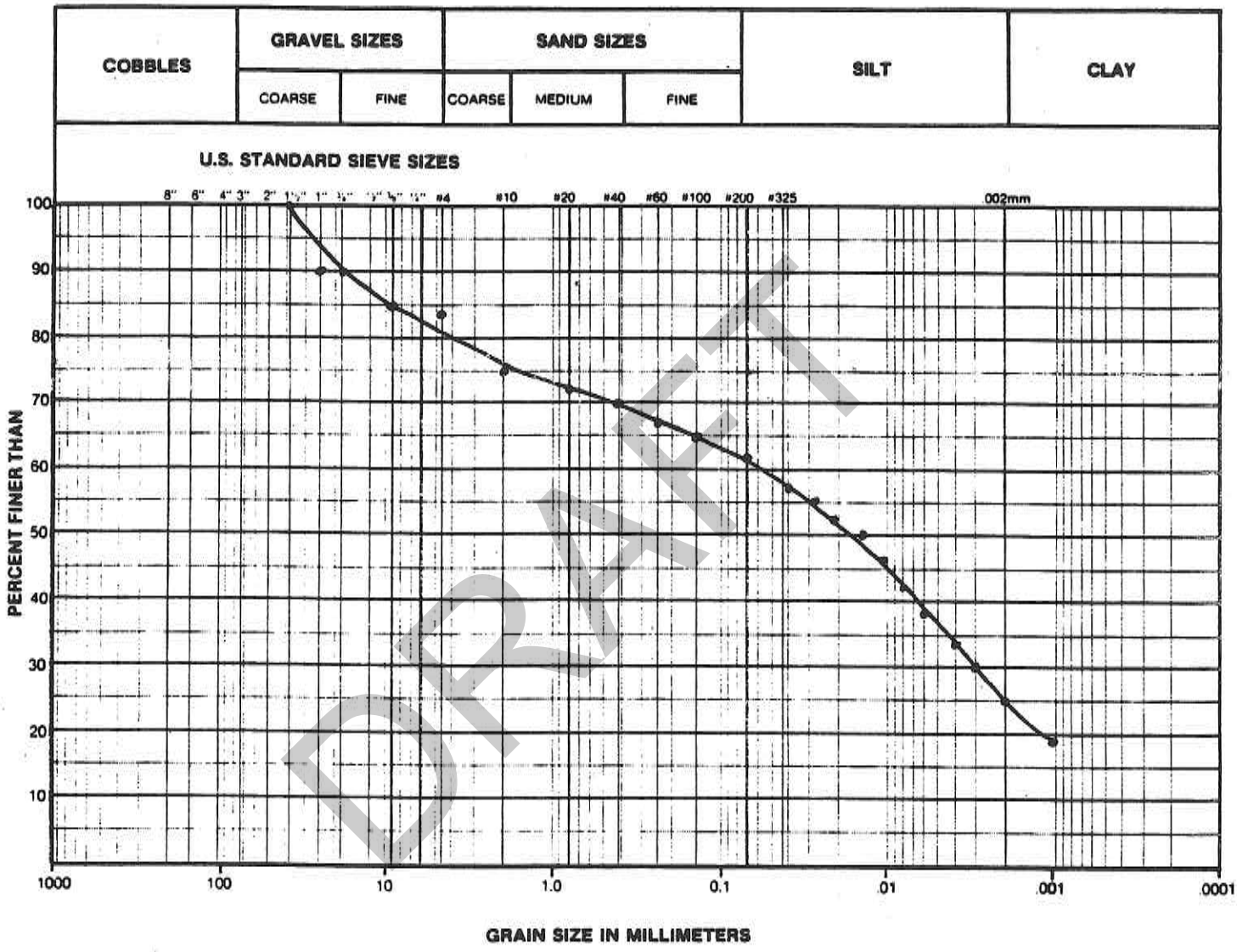
SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS	
AND	36-50%
SOME	21-35%
LITTLE	11-20%
TRACE	1-10%

SUMMARY	
GRAVEL	2.90 %
SAND	25.51 %
SILT	68.22 %
CLAY	3.36 %

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES

GRAIN SIZE CURVE

CLIENT:	ST. MARY'S LF
PROJECT NUMBER:	0645
LAB. NUMBER:	CR 3589
LOCATION:	BH12-91
HOLE:	— SAMPLE: 4CS
DEPTH:	14-19 FT
TECHNICIAN:	T. GERARDI DATE: NOVEMBER 6/91



HAZEN PERMEABILITY ESTIMATE $(D_{10})^2$ = 3.1E-07 cm/sec

NOTE: D_{10} = GRAINSIZE IN mm AT 10% FINER THAN

REMARKS : SILT, SOME CLAY, SOME SAND, LITTLE GRAVEL

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

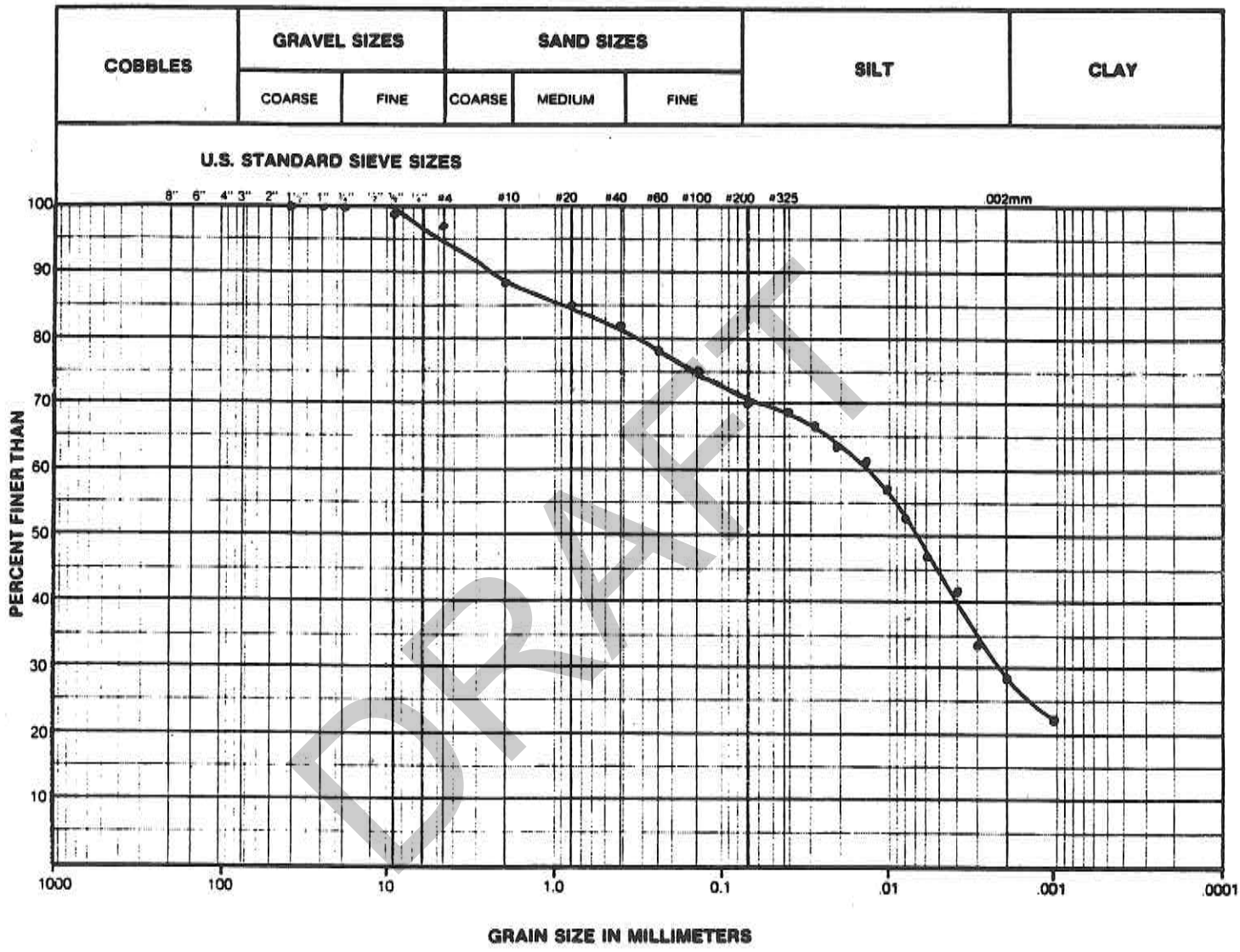
SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS	
AND	36-50%
SOME	21-35%
LITTLE	11-20%
TRACE	1-10%

SUMMARY	
GRAVEL	16.45 %
SAND	21.57 %
SILT	38.33 %
CLAY	23.64 %

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES

GRAIN SIZE CURVE

CLIENT:	ST. MARY'S LF
PROJECT NUMBER:	D645
LAB. NUMBER:	CR 3590
LOCATION:	BH 13 - 91
HOLE:	— SAMPLE: 4CS
DEPTH:	15 - 18.5 FT
TECHNICIAN:	T. GERARDI DATE: NOVEMBER 4/91



HAZEN PERMEABILITY ESTIMATE $(D_{10})^2$ = 2.7E-07 cm/sec

NOTE: D_{10} = GRAINSIZE IN mm AT 10% FINER THAN

REMARKS : SILT, SOME CLAY, SOME SAND, TRACE GRAVEL

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

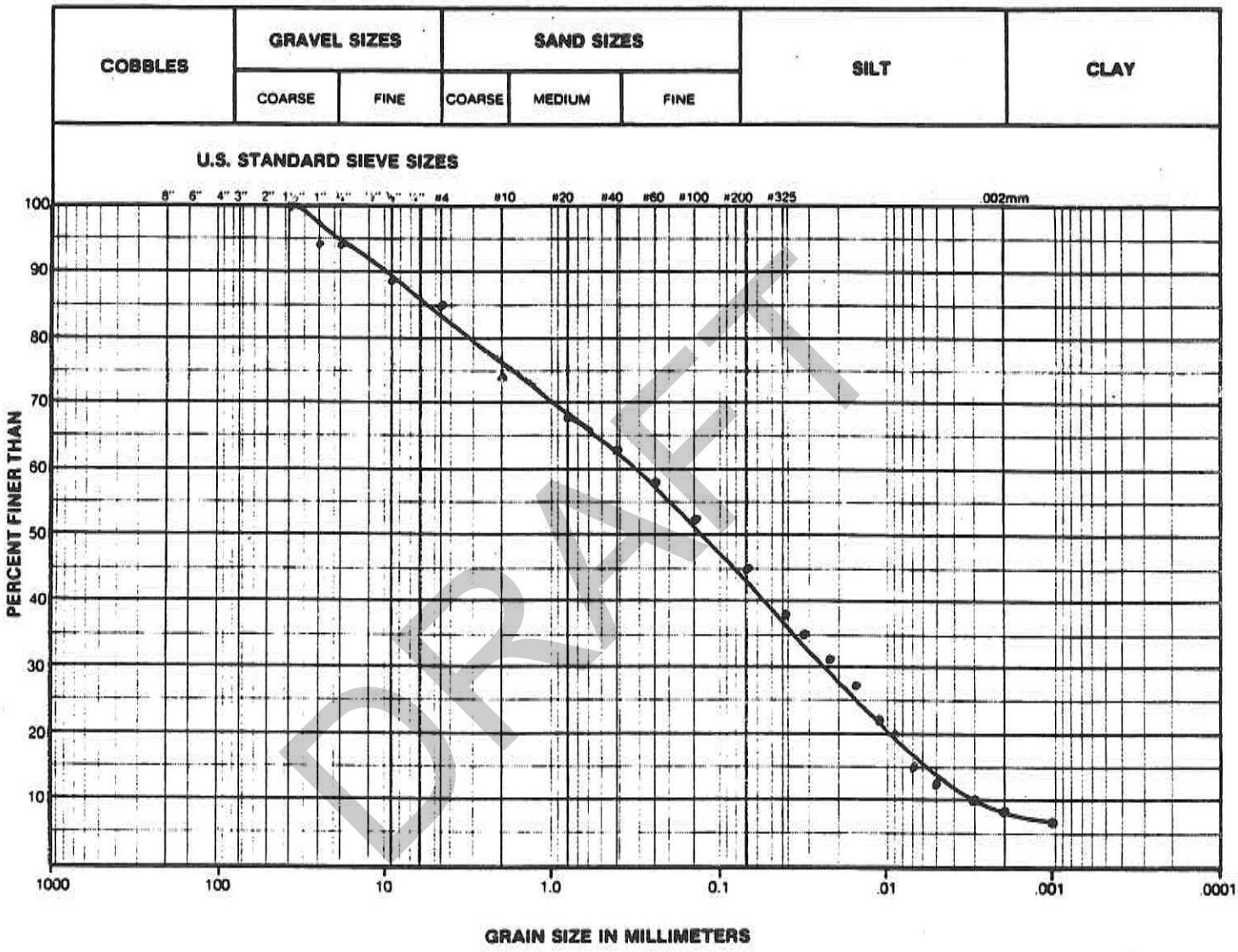
SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS	
AND	36-50%
SOME	21-35%
LITTLE	11-20%
TRACE	1-10%

SUMMARY	
GRAVEL	2.93 %
SAND	26.71 %
SILT	42.27 %
CLAY	28.09 %

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES

GRAIN SIZE CURVE

CLIENT:	ST. MARY'S LF
PROJECT NUMBER:	0645
LAB. NUMBER:	CR 3591
LOCATION:	BH13-91
HOLE:	— SAMPLE: 10CS
DEPTH:	43.5 - 48.5 FT
TECHNICIAN:	T. GERARDI DATE: NOVEMBER 6/91



HAZEN PERMEABILITY ESTIMATE $(D_{10})^2$ = 1.0E-05 cm/sec

NOTE: D_{10} = GRAINSIZE IN mm AT 10% FINER THAN

REMARKS : SAND AND SILT, LITTLE GRAVEL, TRACE CLAY

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

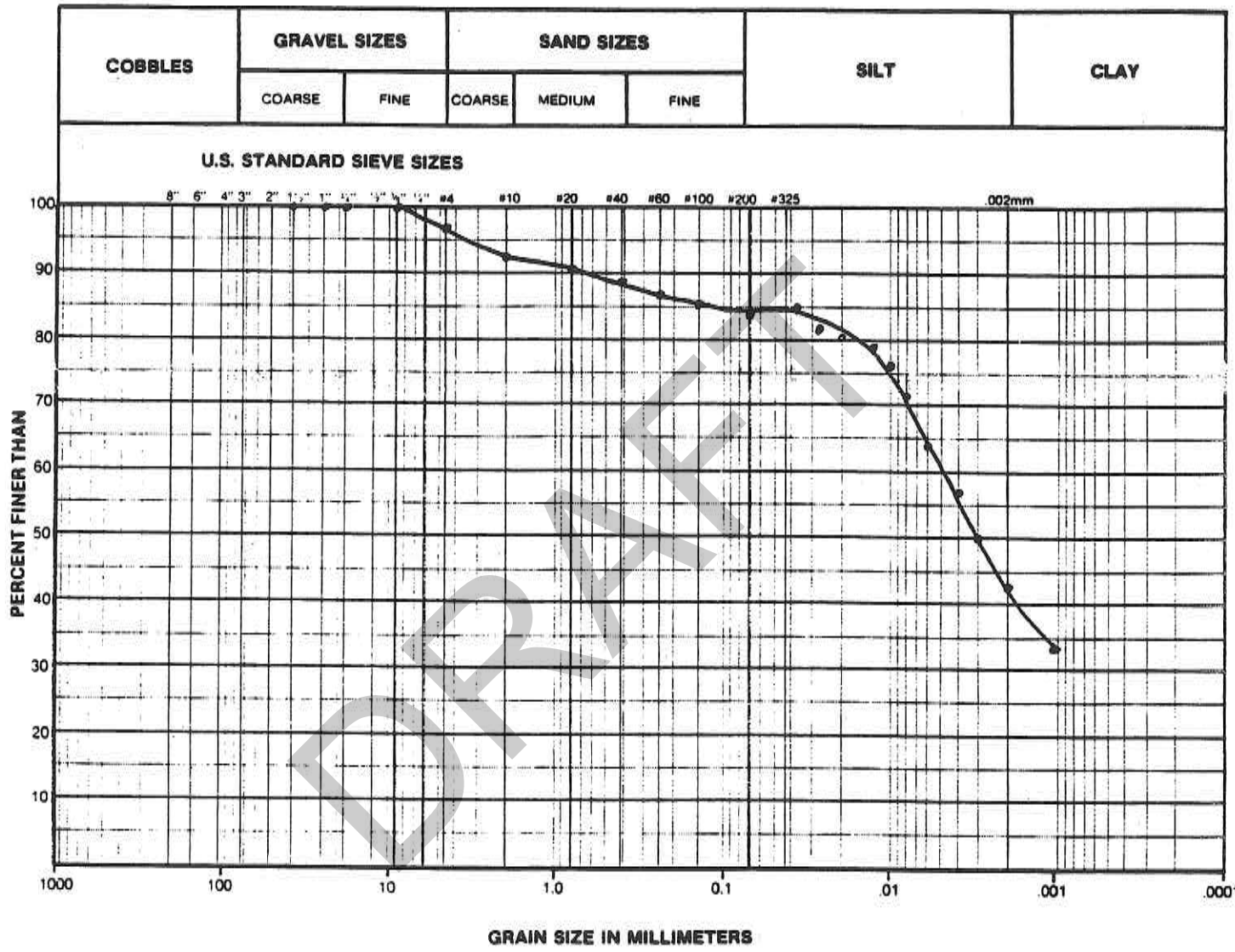
SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS	
AND	36-50%
SOME	21-35%
LITTLE	11-20%
TRACE	1-10%

SUMMARY	
GRAVEL	15.20 %
SAND	40.05 %
SILT	36.62 %
CLAY	8.13 %

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES

GRAIN SIZE CURVE

CLIENT:	ST. MARY'S LF
PROJECT NUMBER:	0645
LAB. NUMBER:	CR 3584
LOCATION:	DW15-91
HOLE: —	SAMPLE: 1C5
DEPTH:	11.5 - 15 FT
TECHNICIAN: T. GERARDI	DATE: NOVEMBER 4/91



HAZEN PERMEABILITY ESTIMATE $(D_{10})^2$ = 1.2E-07 cm/sec

NOTE: D_{10} = GRAINSIZE IN mm AT 10% FINER THAN

REMARKS : SILT AND CLAY, LITTLE SAND, TRACE GRAVEL

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

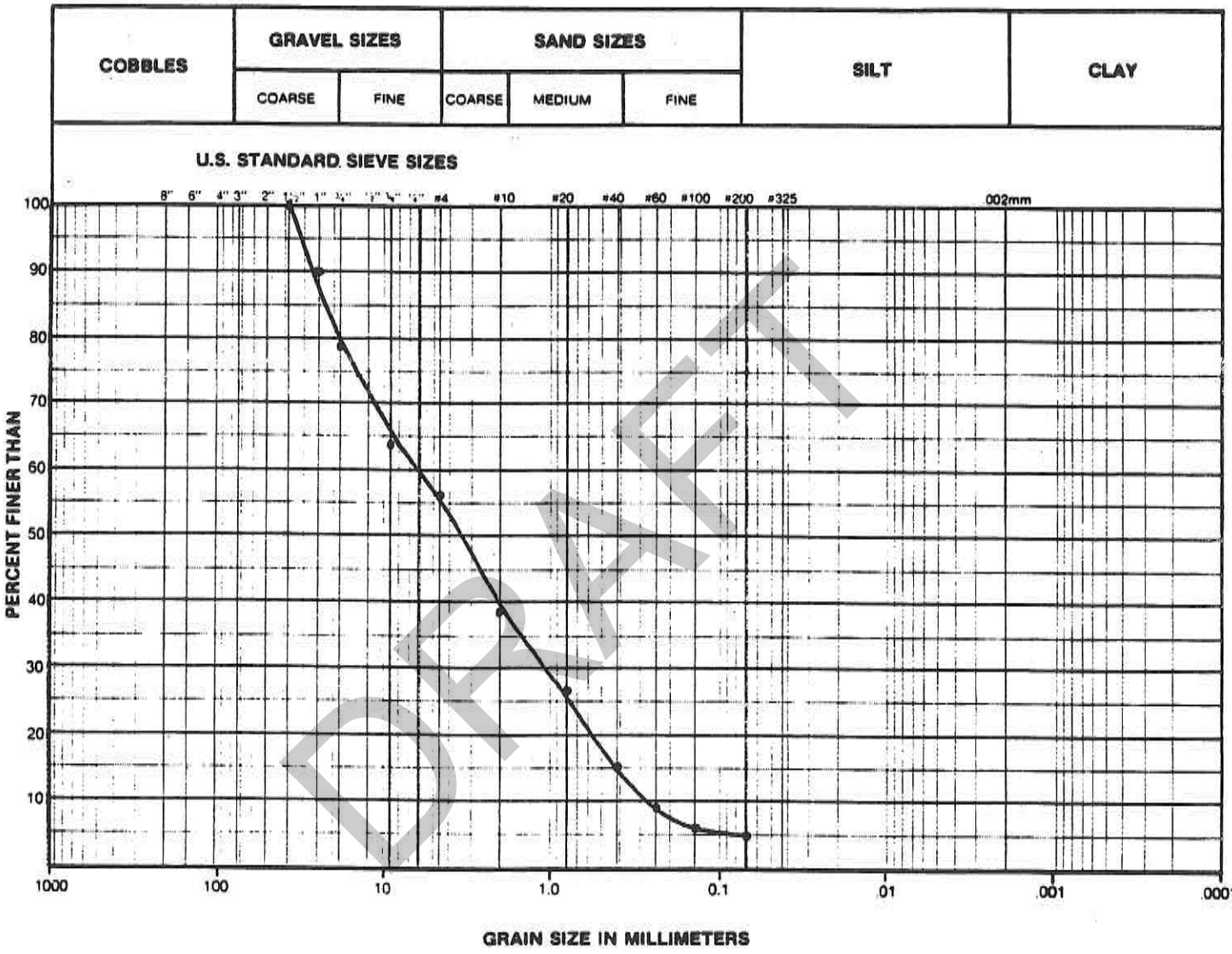
SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS	
AND	36-50%
SOME	21-35%
LITTLE	11-20%
TRACE	1-10%

SUMMARY	
GRAVEL	2.58 %
SAND	13.64 %
SILT	42.07 %
CLAY	41.72 %

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES

GRAIN SIZE CURVE

CLIENT:	ST. MARY'S LF
PROJECT NUMBER:	0645
LAB. NUMBER:	CR 3585
LOCATION:	DW15-91
HOLE:	— SAMPLE: 2C5
DEPTH:	15-19 FT.
TECHNICIAN:	T. GERARDI DATE: NOVEMBER 4/91



HAZEN PERMEABILITY ESTIMATE $(D_{10})^2$ = _____ cm/sec

NOTE: D_{10} = GRAINSIZE IN mm AT 10% FINER THAN

REMARKS: SAND AND GRAVEL, TRACE SILT & CLAY

NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

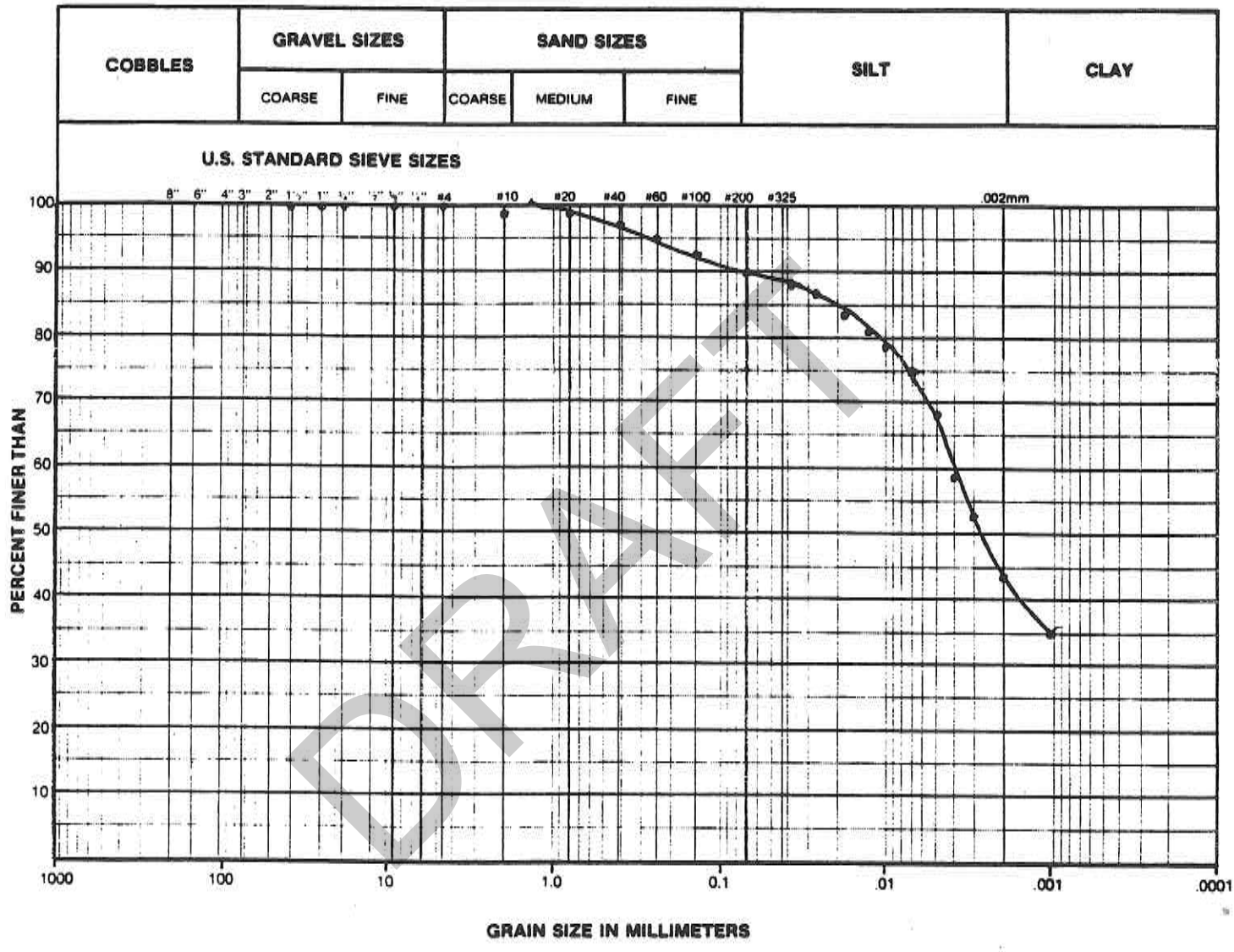
SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS	
AND	36-50%
SOME	21-35%
LITTLE	11-20%
TRACE	1-10%

SUMMARY	
GRAVEL	43.79 %
SAND	50.85 %
SILT	— %
& CLAY	5.36 %

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES

GRAIN SIZE CURVE

CLIENT:	ST. MARY'S LF
PROJECT NUMBER:	D645
LAB. NUMBER:	CR 3586
LOCATION:	BH16-91
HOLE:	— SAMPLE: 1CS
DEPTH:	9-11 FT
TECHNICIAN:	T. GERARDI DATE: NOVEMBER 6/91



HAZEN PERMEABILITY ESTIMATE $(D_{10})^2$ = 9.4E-08 cm/sec

NOTE: D_{10} = GRAINSIZE IN mm AT 10% FINER THAN

REMARKS : SILT AND CLAY, TRACE SAND

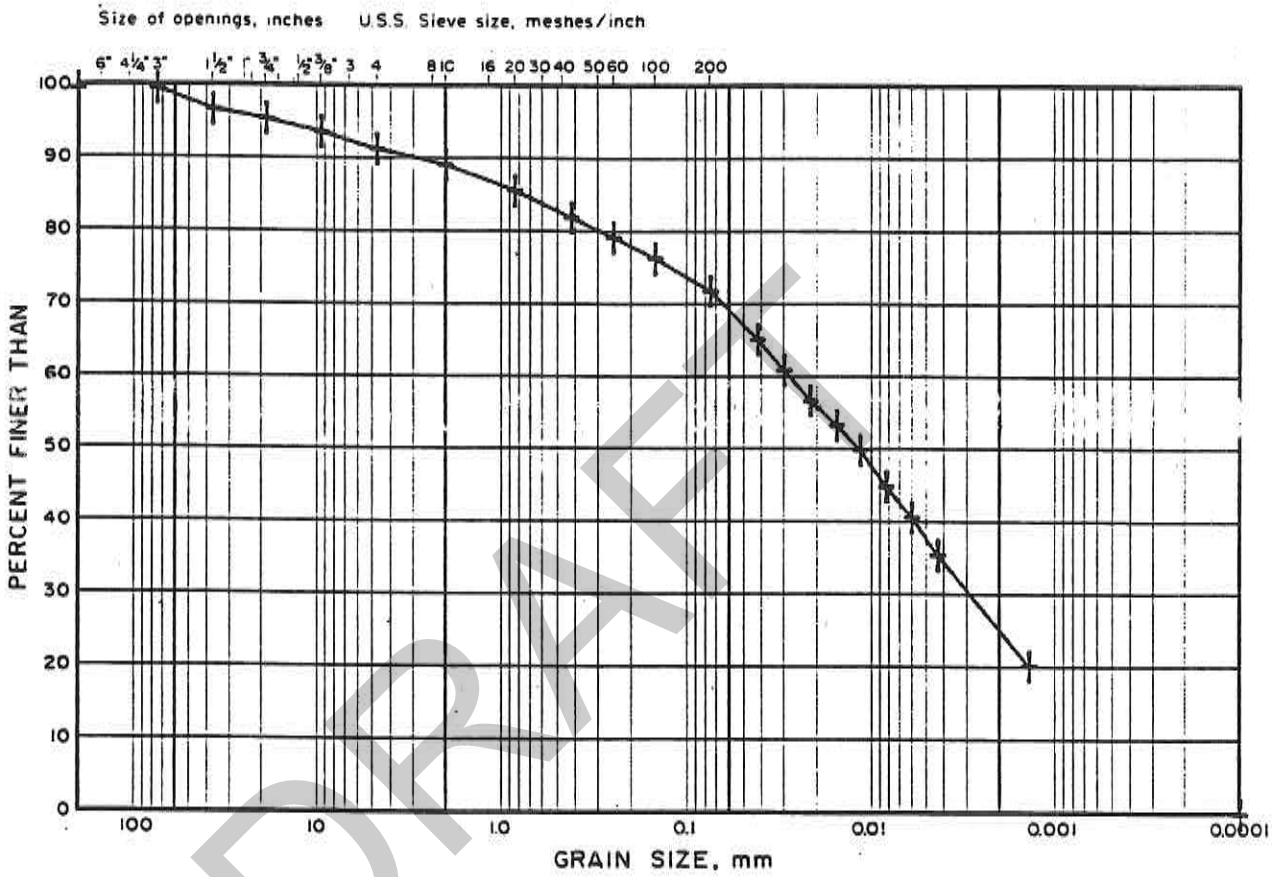
NOTE: UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS	
AND	36-50%
SOME	21-35%
LITTLE	11-20%
TRACE	1-10%

SUMMARY	
GRAVEL	0 %
SAND	10.32 %
SILT	46.18 %
CLAY	43.50 %

GRAIN SIZE DISTRIBUTION

FIGURE 2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (m)
+	17-91	1	1.22

Project 911-1403

Golder Associates

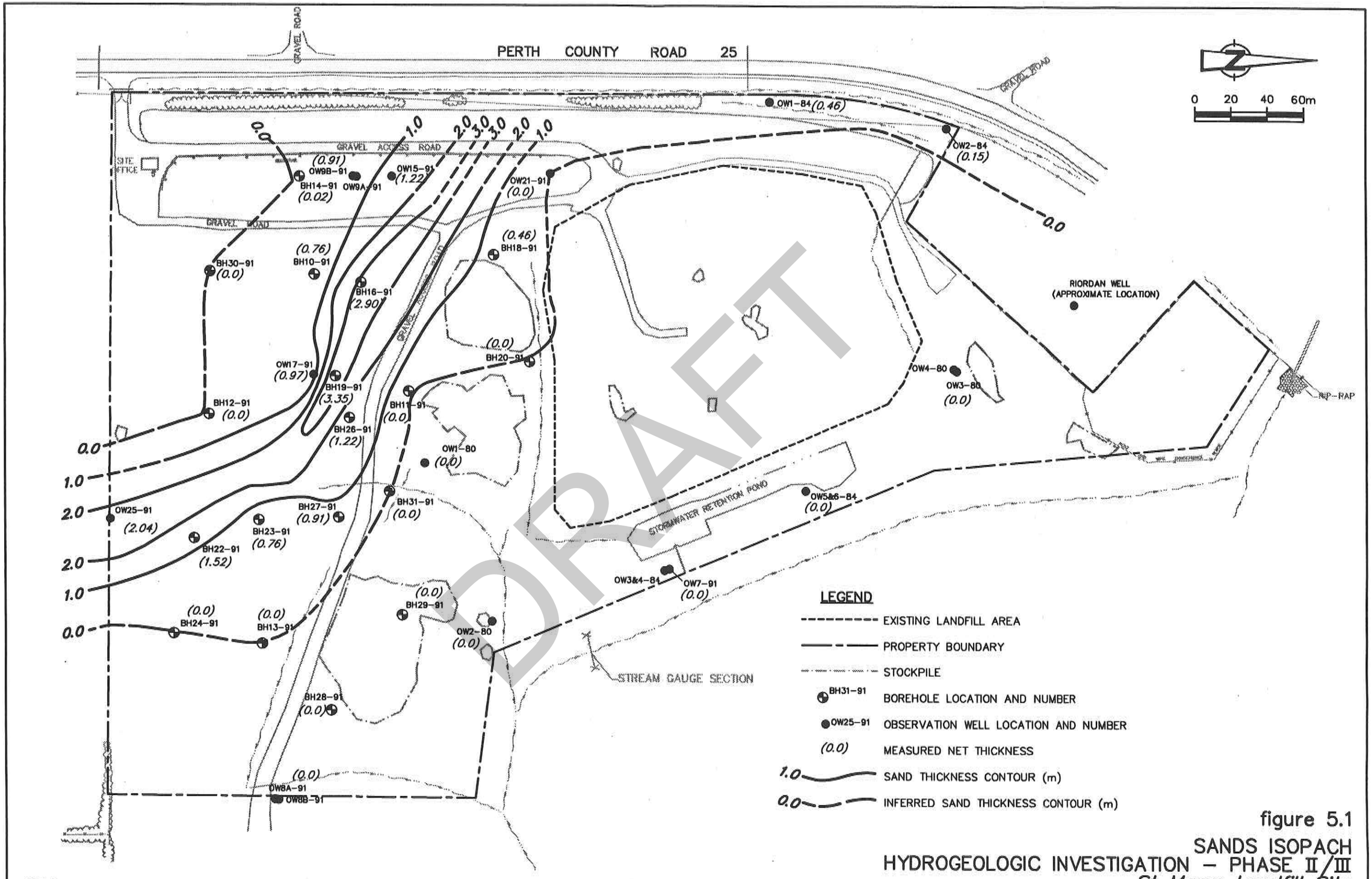


figure 5.1

SANDS ISOPACH

HYDROGEOLOGIC INVESTIGATION – PHASE II/III

St Marys Landfill Site

CRA

0645 (8) JAN. 16/92 – REV.0 (P-16)

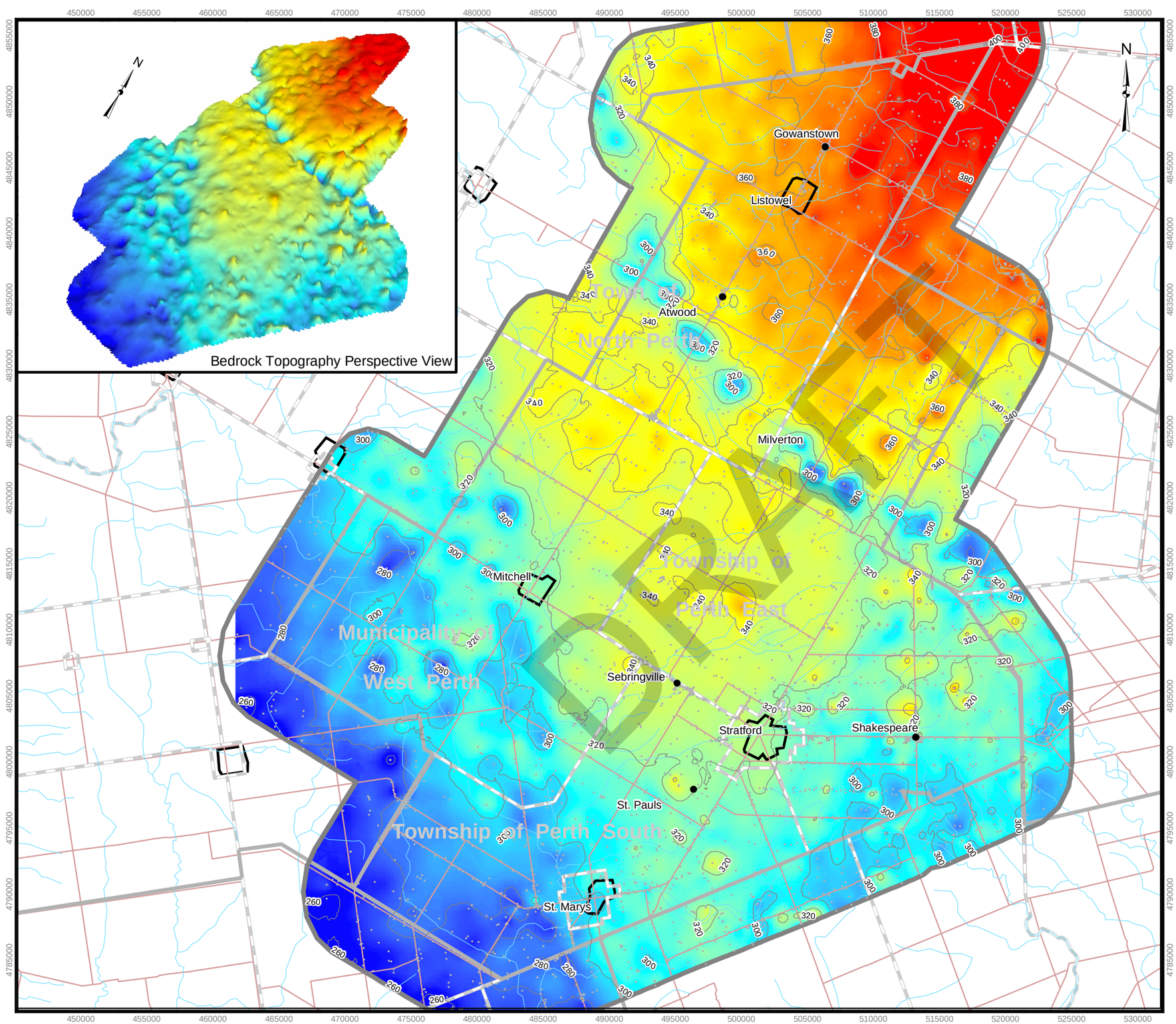
BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix D

Perth County Groundwater Study 2003 Mapping

Perth County Groundwater Management Study



Legend

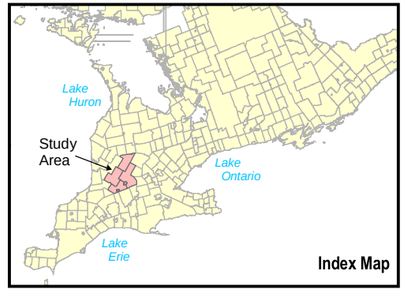
- County Boundaries
- Township Boundaries
- Study Area Boundary
- Rivers
- Roads
- Population Centres
- Bedrock Wells

Value

High : 410
Medium: 325
Low : 250
m asl

1:300,000

0 2 4 8 12
Kilometres



Disclaimer: This map is intended for illustrative purposes only. Figure is to be read in conjunction with the Perth County Groundwater Management Study.
Digital Mapping Sources: Base mapping features - Ministry of the Environment.
Water well information - Ministry of the Environment.

Date: April 2003

waterloo hydrogeologic
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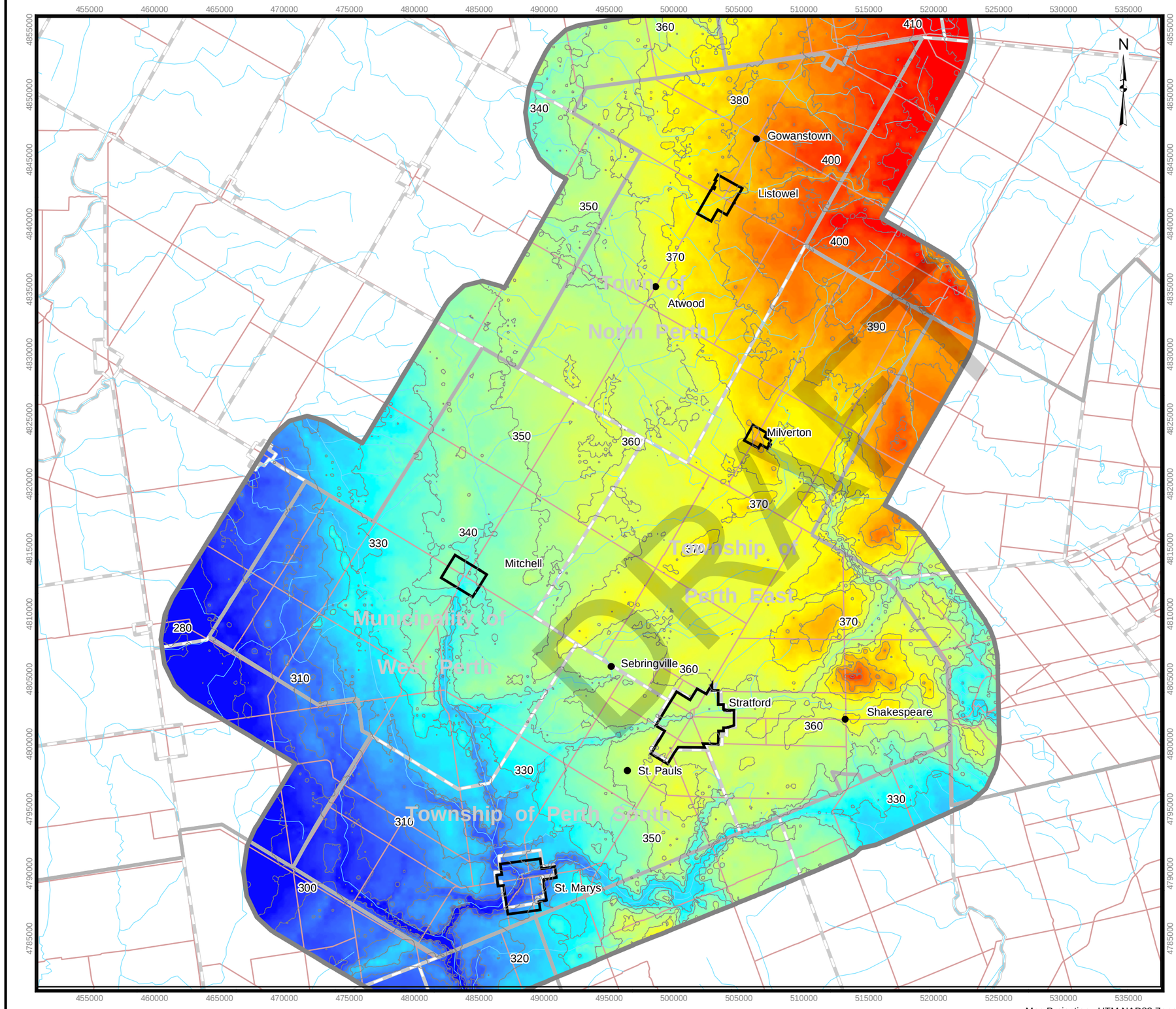
Perth Groundwater Study

Map Projection: UTM NAD83 Zone 17

Figure 2.17 : Bedrock Topography

Perth County Groundwater Management Study



Legend

- County Boundaries
- Township Boundaries
- Study Area Boundary
- Rivers
- Roads
- Population Centres

Value

High : 425

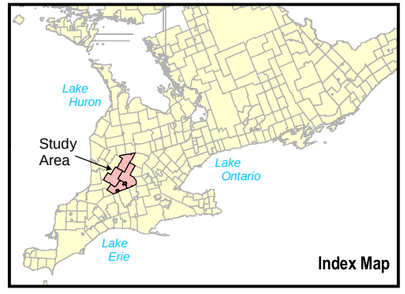
Low : 270

m asl

1:300,000

0 2 4 8 12

Kilometres



Disclaimer: This map is intended for illustrative purposes only. Figure is to be read in conjunction with the Perth County Groundwater Management Study.
Digital Mapping Sources: Base mapping features - Ministry of the Environment.
Water well information - Ministry of the Environment.

Date: April 2003

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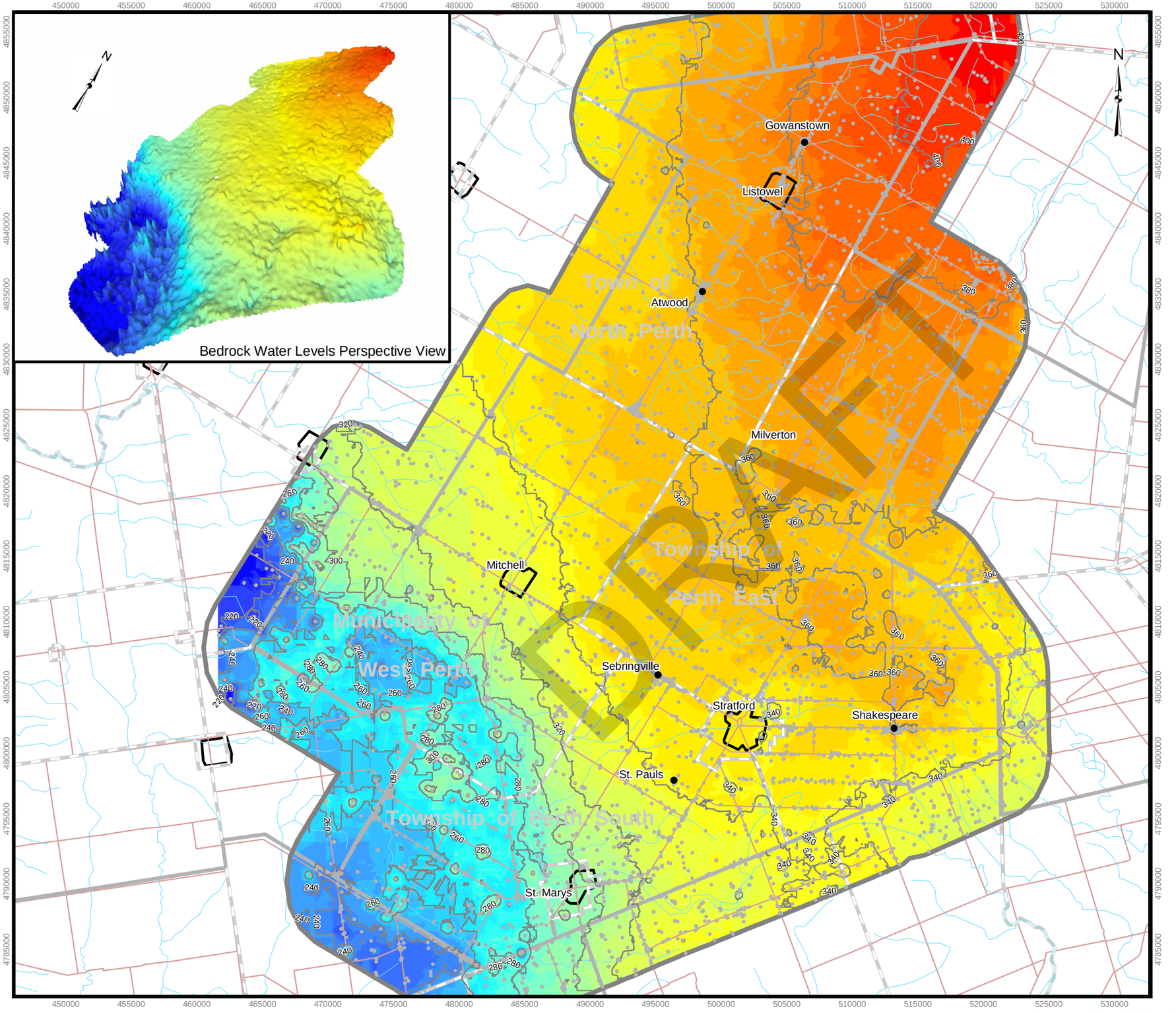
Map Projection: UTM NAD83 Zone 17

Figure 2.21 : Water Table Elevation



Map Projection: UTM NAD83 Zone 17

Perth County Groundwater Management Study

Legend

- County Boundaries
- Township Boundaries
- Study Area Boundary
- Rivers
- Roads
- Population Centres
- Bedrock Well Locations

Value

High : 415

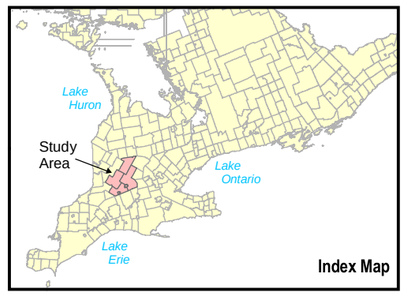
Low : 197

m asl

1:300,000

0 2 4 8 12

Kilometres



Disclaimer: This map is intended for illustrative purposes only. Figure is to be read in conjunction with the Perth County Groundwater Management Study.
Digital Mapping Sources: Base mapping features - Ministry of the Environment.
Water well information - Ministry of the Environment.

Date: April 2003

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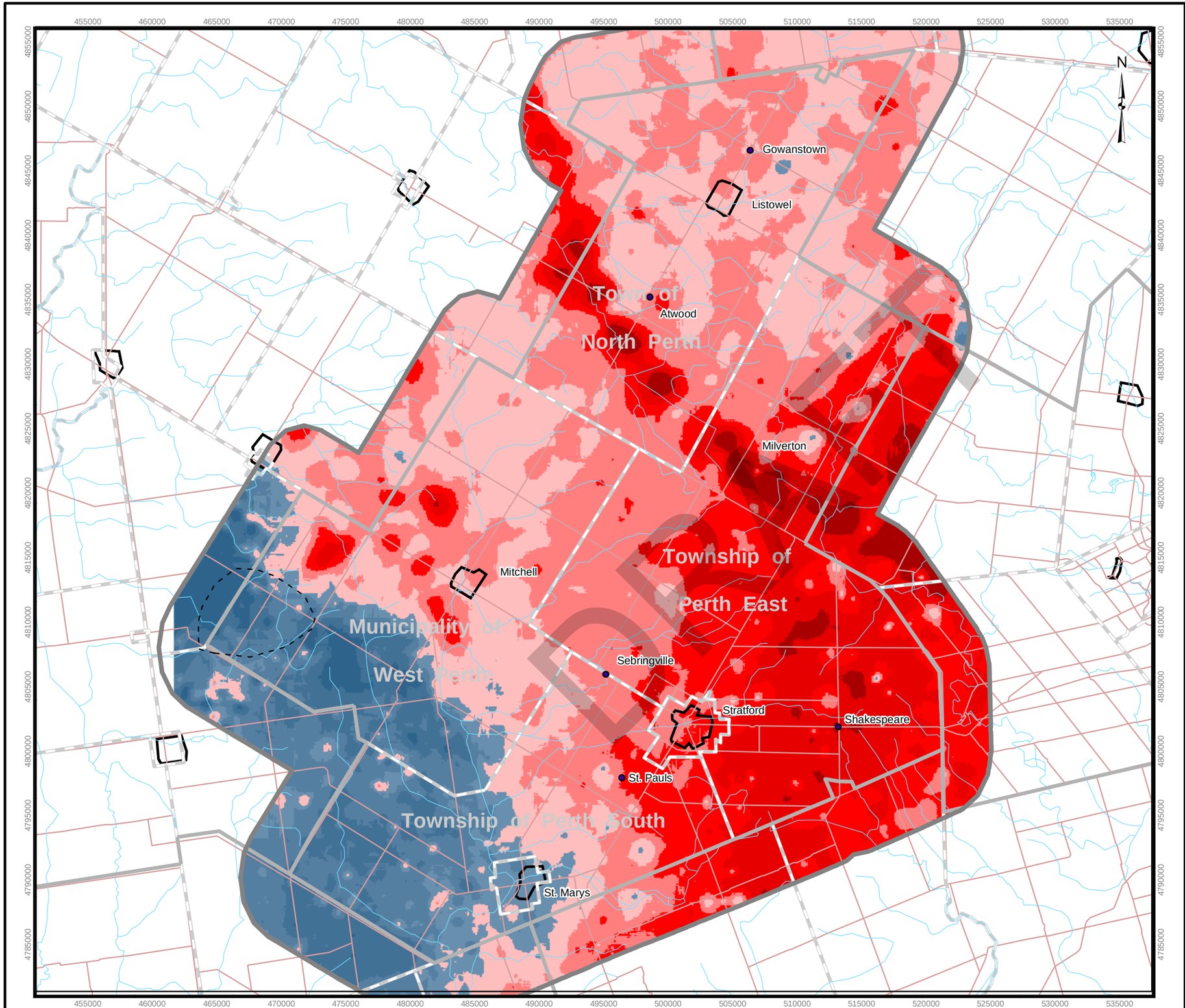
Perth Groundwater Study

Figure 2.22 : Bedrock Water Levels

Perth County Groundwater Management Study



Legend

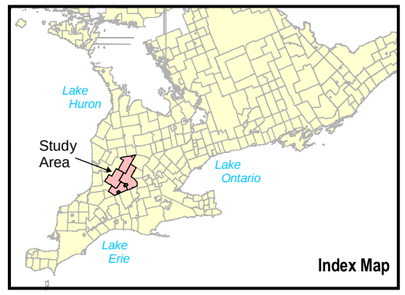
- Bedrock Well Locations
- County Boundaries
- Township Boundaries
- Study Area Boundary
- Rivers
- Roads
- Population Centres
- Karst Area

Water Level > Bedrock Surface
- 49.41 - 90.56
- 35.05 - 49.41
- 23.29 - 35.05
- 14.15 - 23.29
- 0 - 14.15

Water Level < Bedrock Surface
- 0 - -11.32
- -11.32 - -26.34
- -26.34 - -44.63
- -44.63 - -76.63

1:300,000

0 2 4 8 12
Kilometres



Disclaimer: This map is intended for illustrative purposes only. Figure is to be read in conjunction with the Perth County Groundwater Management Study.
Digital Mapping Sources: Base mapping features - Ministry of the Environment.
Water well information - Ministry of the Environment.
Sinkhole Area - Ministry of the Environment and R.Hopper.

Date: April 2003

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Perth Groundwater Study

Map Projection: UTM NAD83 Zone 17

Figure 2.23 : Bedrock Water Levels Relative to Bedrock Topography

BURNSIDE

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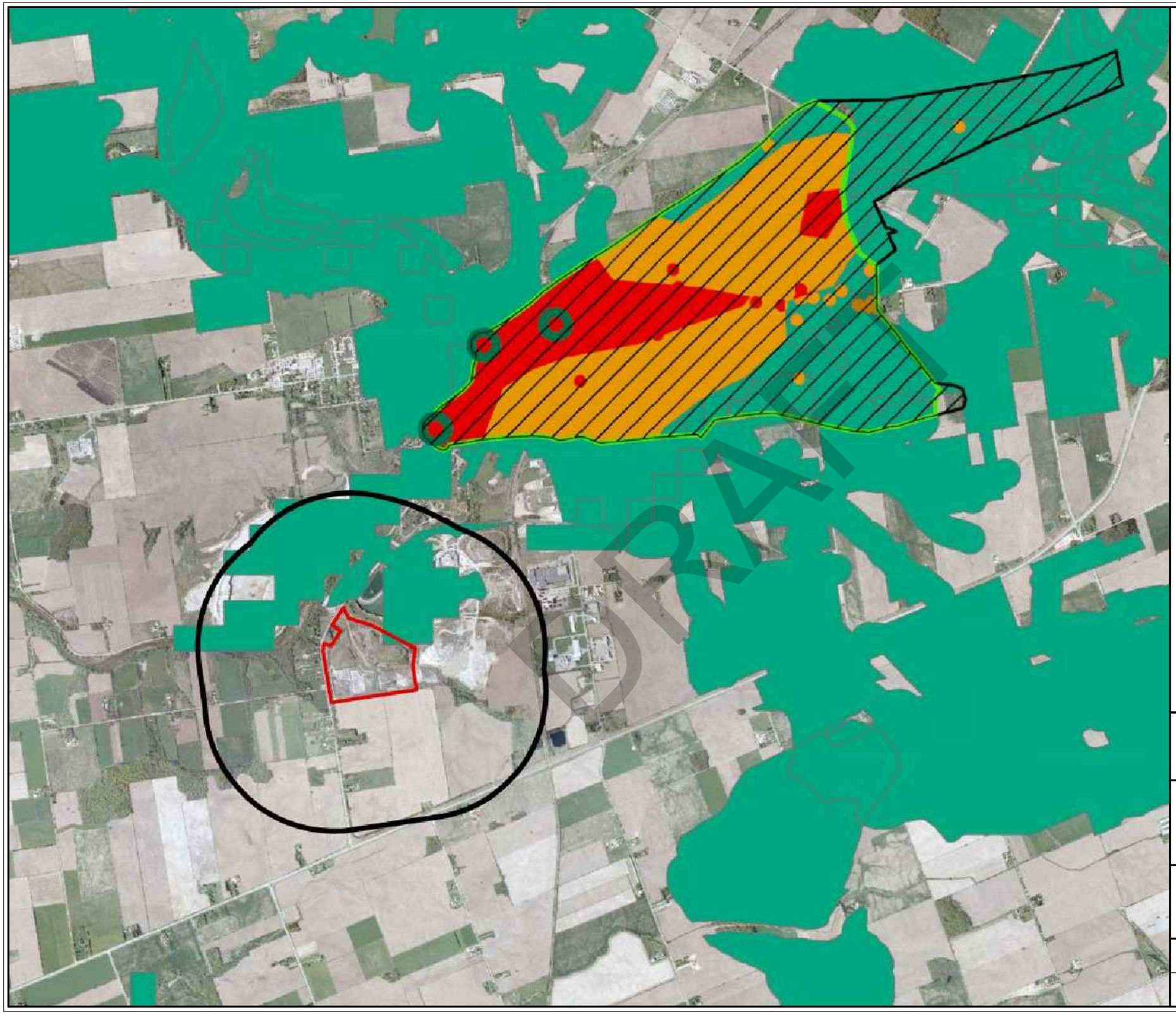
Appendix E

Source Protection Mapping



LEGEND

Significant Threat Policy Area Details - Approved
Significant Threat Policy Applicability

- WHPA-A
- WHPA-B
- WHPA-C
- Vulnerability Score of 10
- Vulnerability Score of 9
- Vulnerability Score of 8
- Issue Contributing Area
- DNAPL Policy Area WHPA-A,B,C
- Event Based Area
- See Essex SPA for Details
- Moderate and Low Threat Policy Area - Approved

Source: Mapping obtained from Upper Thames River Valley Conservation Authority. Upper Thames River Source Protection Area Assessment Report, September 16, 2015.

N

0 600 1,200 1,800 2,400
Metres

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Client / Report

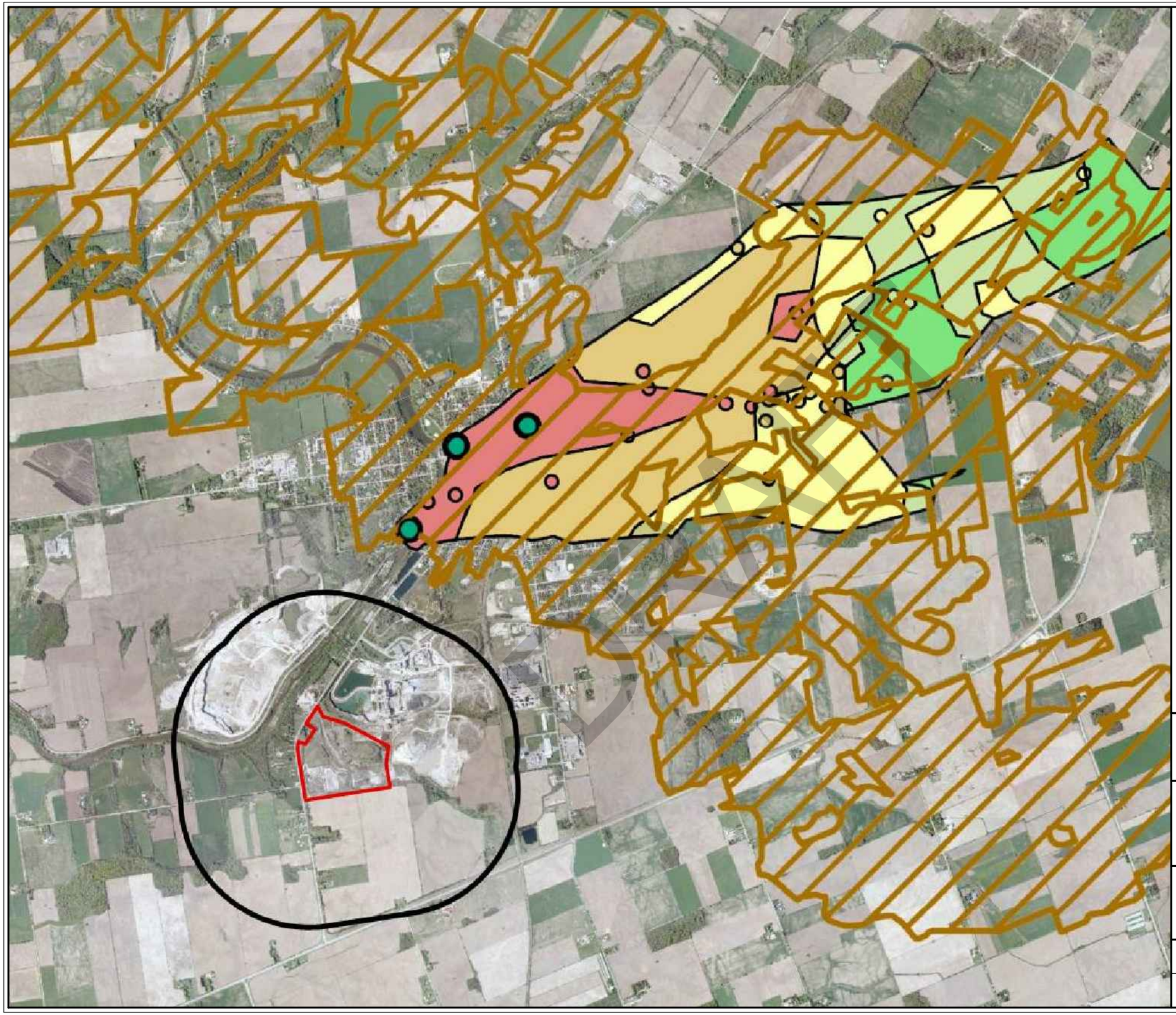
TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL ASSESSMENT

Figure Title

SIGNIFICANT THREAT POLICY AREAS

Drawn	Checked	Date	Figure No.
SK	CM	MARCH 2016	**E1**
Scale		Project No.	
1:30,000		300032339	



LEGEND

- Municipal Wells

Wellhead Protection Area Vulnerability - Approved

Vulnerability Score

- Vulnerability = 2
- Vulnerability = 4
- Vulnerability = 6
- Vulnerability = 8
- Vulnerability = 10
- Vulnerability = 6.3 (WHPA-E)
- Vulnerability = 7.0 (WHPA-E)
- Vulnerability = 7.2 (WHPA-E)
- Issue Contributing Area

Intake Protection Zone/Vulnerability - Approved

IPZ_Zone

- IPZ-1
- IPZ-2
- IPZ-3
- EBA
- See Essex SPA

Source: Mapping obtained from Upper Thames River Valley Conservation Authority. Upper Thames River Source Protection Area Assessment Report, September 16, 2015.

N

0 600 1,200 1,800 2,400

Metres

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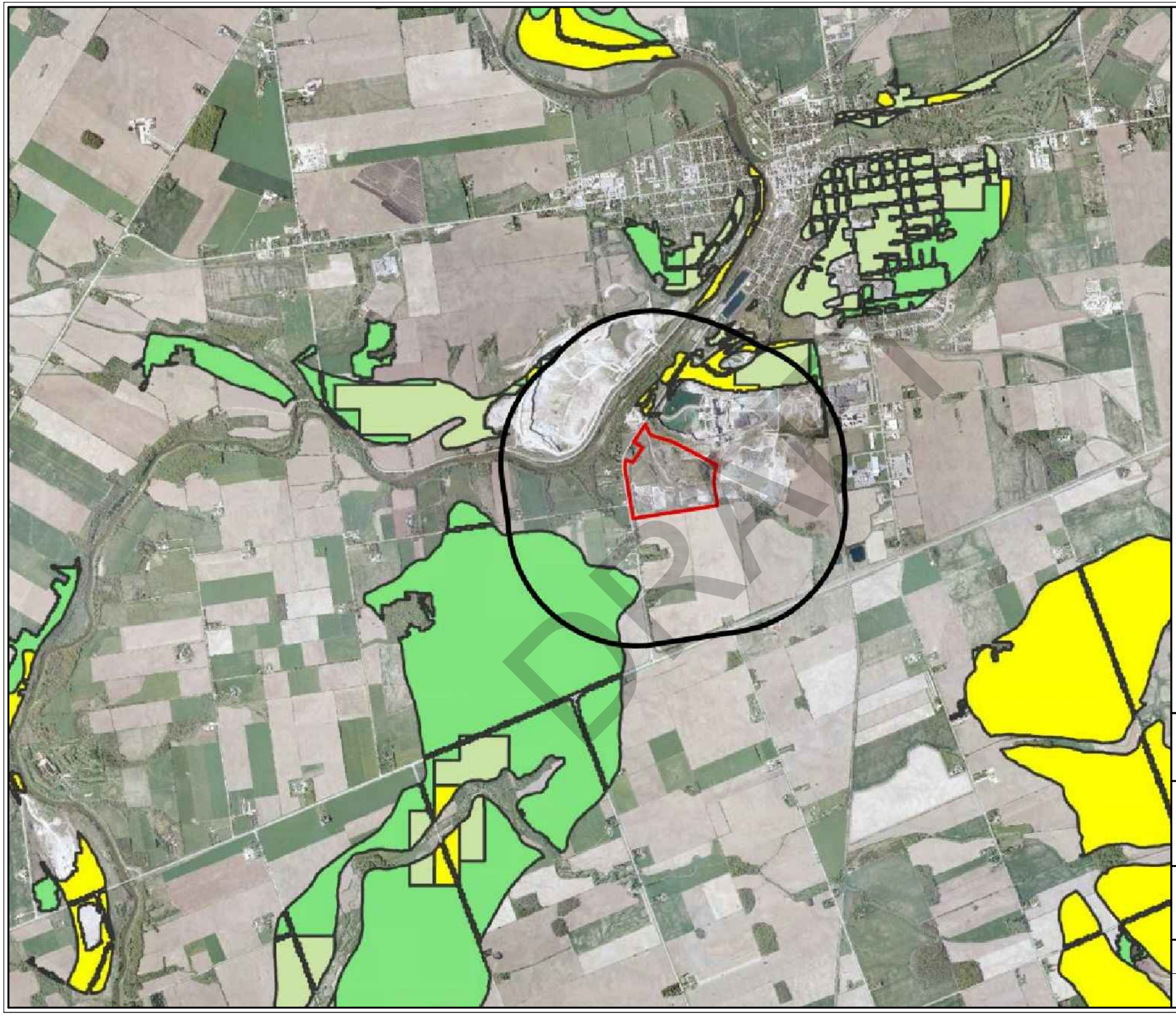
TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL ASSESSMENT

Figure Title

WELLHEAD PROTECTION AREAS

Drawn	Checked	Date	Figure No.
SK	CM	MARCH 2016	**E2**
Scale		Project No.	
1:30,000		300032339	



LEGEND

Significant Groundwater Recharge Area - Approved

Vulnerabilty Score

- Vulnerability = 2
- Vulnerability = 4
- Vulnerability = 6

Source: Mapping obtained from Upper Thames River Valley Conservation Authority. Upper Thames River Source Protection Area Assessment Report, September 16, 2015.

N

0 600 1,200 1,800 2,400

Metres

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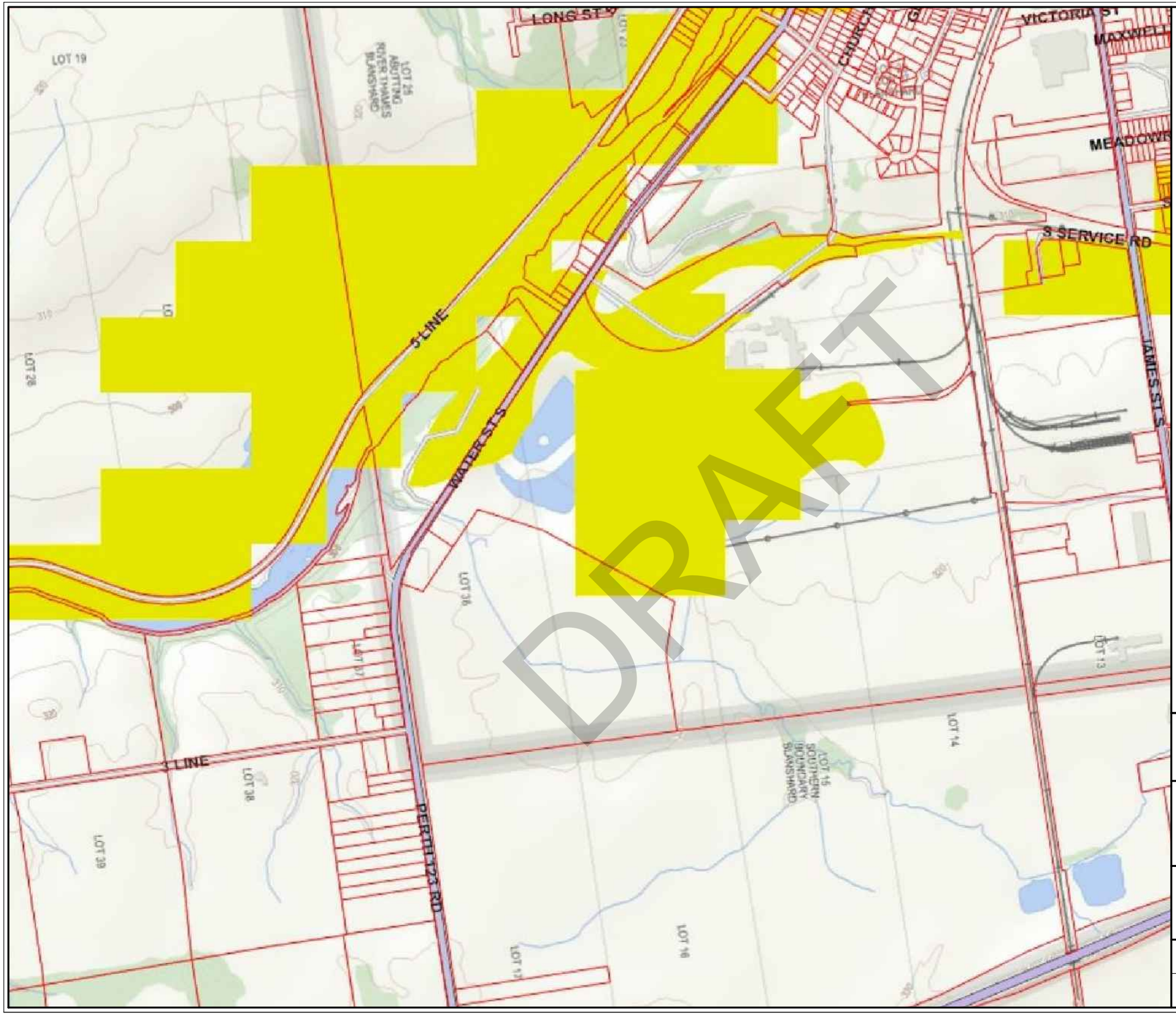
TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL ASSESSMENT

Figure Title

SIGNIFICANT GROUNDWATER RECHARGE AREAS

Drawn	Checked	Date	Figure No.
SK	CM	MARCH 2016	**E3**
Scale		Project No.	
1:30,000		300032339	



LEGEND

- Source Protection Region
- Assessment Parcel (MPAC)
- Highly Vulnerable Aquifer - Approved

Source: Mapping obtained from Upper Thames River Valley Conservation Authority. Upper Thames River Source Protection Area Assessment Report, September 16, 2015.

N

0 600 1,200 1,800 2,400

Metres

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TOWN OF ST MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL ASSESSMENT

Figure Title

HIGHLY VULNERABLE AQUIFERS

Drawn	Checked	Date	Figure No.
SK	CM	MARCH 2016	**E4**
Scale		Project No.	
1:30,000		300032339	

BURNSIDE

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Appendix F

Water Level Monitoring

Table F1.1
Groundwater Elevations
St. Marys Landfill

Elevations	OW2-84	OW3-84	OW4-84	OW5-84	OW6-84	OW7-91	OW8A-91	OW8B-91	OW8B-10	OW9A-91	OW9B-91	OW15-91	OW17-91	OW21-91	OW25-91	OW32-96	OW32A-02	OW33-96	OW34-96	OW35	DP1	WL at DP1	DP2	WL at DP2	DP3	WL at DP3	MW04-01	MW04-02	MW04-03	MW04-04
Measuring Point	322.86	314.87	314.89	314.42	314.79	315.27	315.19	314.90	315.35	318.49	318.58	318.67	318.39	320.76	323.35	323.48	322.63	321.57	321.64	313.52	311.18	311.18	310.73	310.14	310.01	309.12	333.55	330.12	330.07	314.98
Ground Surface	322.25	313.91	313.91	313.97	313.97	313.94	314.00	313.72	314.39	318.26	318.33	318.34	317.39	319.99	322.81	322.62	322.07	320.66	320.77	312.95	310.06		309.57		308.86		332.90	329.41	329.33	314.21
Screen Top	313.42	301.47	312.23	299.91	311.49	277.01	283.42		308.90	278.89	312.56	313.25	-	313.82	314.02	312.63	281.85	308.77	314.83		309.65		309.20		308.48					
Screen Bottom	312.66	300.71	311.47	299.15	310.73	275.49	281.89		307.99	277.36	311.64	312.33	311.59	312.29	313.11	311.11	278.81	307.25	311.78	270.87	309.35		308.90		308.18		317.83	317.44	313.51	282.64
Groundwater Elevation (metres above mean sea level)																														
3-Oct-84	318.17	Dry	312.81	301.55	Dry																									
18-Oct-84	317.96	Dry	312.83	301.36	Dry																									
29-Oct-84	317.91	Dry	312.80	301.31	Dry																									
31-Oct-84	317.86	Dry	312.77	301.22	Dry																									
4-Feb-85	318.48	Dry	312.85	301.24	Dry																									
8-May-85	318.45	Dry	312.46	301.42	Dry																									
14-Aug-85	317.17	Dry	312.06	301.33	Dry																									
18-Feb-86	318.52	Dry	312.80	301.58	Dry																									
8-May-86	318.62	Dry		301.39	Dry																									
12-Aug-86	317.54	Dry	312.18	301.24	Dry																									
3-Nov-86	318.76	Dry	312.84	301.41	Dry																									
10-Feb-87	318.32	Dry	312.87	301.70	Dry																									
12-May-87	318.42	Dry	312.16	301.40	Dry																									
13-Aug-87	317.09	Dry	311.71	301.30	Dry																									
3-Nov-87	316.66	Dry	312.83	301.27	Dry																									
28-Jan-88	317.81	Dry	312.76	301.15	Dry																									
24-May-88	318.18	Dry	313.04	301.38	Dry																									
18-Aug-88	317.50	Dry	312.53	301.34	Dry																									
8-Nov-88	318.12	Dry	313.09	301.35	Dry																									
2-Feb-89	318.51		313.10	301.35																										
9-May-89	317.85	Dry	312.79	301.41	Dry																									
28-Aug-89	317.46	Dry	312.14	301.34	Dry																									
30-Nov-89	317.26	Dry	312.88	301.38	Dry																									
22-Feb-90	318.58	Dry	312.88	301.38																										
28-May-90	318.65	Dry	313.01	301.27																										
14-Aug-90	318.60	Dry	312.94	301.53	Dry																									
5-Nov-90	319.08	Dry	312.97	301.78	Dry																									
4-Feb-91	318.66	Dry	312.88	301.69	Dry																									
14-May-91	318.75	Dry	313.02	301.88	Dry																									
26-Aug-91	317.80	Dry	312.69	301.62	Dry																									
21-Sep-91			312.83	301.65		286.15	286.41	Dry		285.62	314.10																			
26-Sep-91	317.19		312.86	301.61		285.99	286.22	Dry		285.54	314.13	314.13																		
11-Nov-91	317.26	Dry	312.44	301.55	Dry	285.78	286.06	Dry		285.33	314.13	314.13																		
22-Nov-91										285.42	314.25	314.26																		
3-Dec-91	317.47	Dry	312.87	301.83		286.27	286.47	Dry		285.66	314.36	314.37																		
12-Dec-91	317.65	Dry	313.04	301.61		286.79	287.04			285.88	314.38	314.38		317.53																
13-Dec-91		Dry								285.99	314.35				314.35															
14-Dec-91		Dry								286.11	314.45	314.44		316.26	314.41															
26-Dec-91	317.91	Dry	313.06	301.63		287.53	287.78			286.31	314.42	314.42		316.60	314.37															
23-Jan-92	318.35		313.09	301.88		288.30	288.67			286.97	314.61	314.61		316.26	314.54															
3-Feb-92	318.46		312.89	301.67		288.37	288.76			285.95	314.49	314.48			314.47															
7-Feb-92	318.53		312.93	301.63		288.46	288.73			287.07	314.53	314.51		316.57	314.46															
13-Mar-92	318.96		312.98	301.82		289.43	289.68	Dry		287.74	314.59	314.53		316.68	314.53															
25-May-92	318.54		312.93	301.80		288.49	288.61	Dry		286.95	314.45	313.84		315.08	314.39															
6-Aug-92	318.65		312.64	301.73		287.01	287.35	Dry		286.41	314.47	314.43		315.79	314.40															
2-Nov-92	319.01		313.00	301.98		288.90	289.38	Dry		287.56	314.70	314.61		316.11	314.72															
6-Feb-93	318.84		312.92	301.98		289.98	290.58	Dry		288.52	314.48	314.51		316.12	314.50															
25-May-93	318.63		Dry	301.99		288.10	288.55	Dry		287.61	314.53	314.43		316.49	314.41															
23-Aug-93	317.90		Dry	301.60		286.30	286.67	Dry		286.22	313.97	313.95		316.12	314.02															
13-Apr-94	318.92	Dry	313.10	302.14	310.89	289.17	289.75	307.84		288.08	315.04	315.04		316.50	315.10															
7-Sep-94	318.26	Dry	Dry	301.92	Dry	285.74	286.14	308.00		285.80	314.70	314.69		314.58	314.77															
28-Apr-95	319.10	Dry	313.11	301.98	Dry	288.00	288.39	308.08		286.99	315.21	315.17		313.23	315.77															
14-Sep-95	317.84	Dry	Dry	301.85	Dry	285.21	285.47	308.28		285.10	314.54	314.53		313.23	314.59															
2-Apr-96	318.62	Dry	312.30	301.86	Dry	288.43	289.07	308.01		287.18	314.97	314.91		316.59	315.19															
5-Sep-96	318.04	Dry	Dry	301.56	Dry	285.97	286.40	308.07		285.75	314.63	314.64		316.06	314.75	316.77		309.12	316.23											
9-Apr-97	318.87	Dry	313.14	302.07	Dry	289.09	289.72	308.36		287.68	315.12	315.07		316.93	315.40	314.53		309.26	317.52											
15-Sep-97	318.01	Dry	Dry	301.90	Dry	285.56	285.97	308.32		285.53	313.69	313.56		315.40	314.32	316.70		309.04	316.04											
7-Apr-98	318.86	Dry	312.08	302.17	Dry	285.56	288.58	308.24		286.87	315.23	315.17		315.36	318.19	317.34		309.32	317.59											
8-Sep-98	317.26	Dry	Dry	301.92	Dry	284.57	284.92	308.25		284.69	314.62	314.58		314.85	315.98	315.56		308.81	315.07											
21-Apr-99	318.37	Dry	Dry	301.94	Dry	286.43	286.93	308.16		285.62	315.37	315.34		316.24	317.63	317.02		309.16	317.39											
1-Sep-99	317.35	Dry	Dry	301.85	Dry	284.74	285.07	308.16		284.56	315.02	314.91		315.19	315.92	315.75		308.81	314.99											
19-Apr-00	318.51	Dry	Dry	302.12	Dry	285.83	286.19	307.89		285.19	315.41	315.27	315.38	316.02	317.84	317.23		309.27	317.56											
6-Sep-00	318.58	Dry	Dry	302.14	Dry	286.18	286.61	308.21		285.64	315.33	315.27	315.32	316.10	317.36	317.29		309.21	317.12											
11-Apr-01	318.75	Dry	312.31	302.07	Dry	288.34	288.92	308.56		287.04	315.57	315.44	315.46	316.22	318.37	317.42		309.42	317.64											
18-Sep-01	317.34	Dry	Dry	301.97	Dry	285.53	285.87	308.42		285.02	314.77	314.70	314.75	315.07	316.07	315.83		308.85	315.06											
2-Apr-02	318.68	Dry	312.35	302.24	Dry	287.13	287.72	308.35		286.08	315.41	315.36	315.39	316.32	318.11	317.41		309.40	317.63											
24-Sep-02	317.60	Dry	Dry	301.98	Dry	285.83	286.23	308.39		285.09	314.86	314.82	314.83	315.56	316.20	315.97		308.93	315.32											

Table F1.1
Groundwater Elevations
St. Marys Landfill

Elevations	OW2-84	OW3-84	OW4-84	OW5-84	OW6-84	OW7-91	OW8A-91	OW8B-91	OW8B-10	OW9A-91	OW9B-91	OW15-91	OW17-91	OW21-91	OW25-91	OW32-96	OW32A-02	OW33-96	OW34-96	OW35	DP1	WL at DP1	DP2	WL at DP2	DP3	WL at DP3	MW04-01	MW04-02	MW04-03	MW04-04
Measuring Point	322.86	314.87	314.89	314.42	314.79	315.27	315.19	314.90	315.35	318.49	318.58	318.67	318.39	320.76	323.35	323.48	322.63	321.57	321.64	313.52	311.18	311.18	310.73	310.14	310.01	309.12	333.55	330.12	330.07	314.98
Ground Surface	322.25	313.91	313.91	313.97	313.97	313.94	314.00	313.72	314.39	318.26	318.33	318.34	317.39	319.99	322.81	322.62	322.07	320.66	320.77	312.95	310.06		309.57		308.86		332.90	329.41	329.33	314.21
Screen Top	313.42	301.47	312.23	299.91	311.49	277.01	283.42		308.90	278.89	312.56	313.25	-	313.82	314.02	312.63	281.85	308.77	314.83		309.65		309.20		308.48					
Screen Bottom	312.66	300.71	311.47	299.15	310.73	275.49	281.89		307.99	277.36	311.64	312.33	311.59	312.29	313.11	311.11	278.81	307.25	311.78	270.87	309.35		308.90		308.18		317.83	317.44	313.51	282.64
Groundwater Elevation (metres above mean sea level)																														
16-Apr-03	318.74	Dry	312.26	301.87	Dry	287.25	287.71	308.28		286.12	315.40	315.36	315.36	316.61	318.21	317.27	285.65	309.27	317.65											
10-Sep-03	317.52	Dry	Dry	301.96	Dry	285.66	286.11	308.31		285.10	315.03	314.97	314.99	315.23	316.27	316.09	284.57	308.94	315.26											
12-May-04	318.73	Dry	312.57	301.86	Dry	287.95	288.57	308.38		286.78	315.45	315.37	315.38	317.16	318.43	317.44	286.22	309.38	317.69											
1-Sep-04	317.84	Dry	Dry	301.78	Dry	285.59	286.14	308.13		285.33	315.28	315.21	315.26	315.53	316.49	316.51	284.75	309.03	315.80											
6-Apr-05	318.74	Dry	312.60	301.92	Dry	286.71	287.06	308.05		285.76	315.38	315.31	315.37	317.43	318.28	317.31	285.29	309.28	317.66											
23-Nov-05	318.02	Dry	Dry	302.22	Dry	284.24	284.80	308.20		284.13	315.35	315.28	315.66	316.85	317.20	316.87	283.70	309.09	315.50											
19-Apr-06	318.76	Dry	312.28	301.96	Dry	287.39	287.95	308.20		286.27	315.38	315.25	315.57	317.61	318.04	317.43	285.77	309.34	317.63											
22-Nov-06	318.98	Dry	312.28	301.87	Dry	286.86	287.27	308.40		285.88	315.40	315.36	Decom	318.08	318.15	317.57	285.39	309.25	317.66											
18-Apr-07	318.78	Dry	312.34	302.20	Dry	287.49	288.25	308.21		286.58	315.38	315.32		317.68	317.97	317.45	285.96	309.46	317.64											
30-Nov-07	317.19	Dry	311.47	301.73	Dry	284.42	284.88	308.38		284.29	315.12	315.04		318.24	316.18	315.65	283.85	308.62	314.46											
9-Apr-08	319.08	Dry	312.31	302.02	Dry	288.43	289.05	308.21		287.08	315.43	315.35		318.22	318.42	317.31	286.54	309.35	317.74											
26-Nov-08	318.77	Dry	313.23	301.94	Dry	286.31	287.25	308.50		285.53	315.35	315.27		319.06	318.14	317.39	285.09	309.37	317.31											
27-Apr-09	318.64	Dry	313.12	302.12	Dry	288.35	289.26	313.80		287.22	315.35	315.29		318.91	318.28	317.34	286.63	309.40	317.58											
29-Nov-09	318.21	Dry	Dry	301.92	Dry	285.61	286.94	313.59		285.60	315.28	315.19		317.97	317.00	317.12	285.10	309.08	316.26											
25-Mar-10	318.66	Dry	311.97	302.18	Dry	286.76	287.53	313.77		285.91	315.36	315.28		318.30	317.80	317.29	285.34	309.37	317.57											
23-Nov-10	318.42	Dry	312.88	302.12	Dry	285.58	286.18			285.38	315.35	315.27		318.99	317.25	317.26	284.74	309.28	316.54											
31-Mar-11	318.90	Dry	Dry	302.33	Dry	287.59	288.43		Dry	286.77	315.41	315.32		318.55	318.00	317.48	286.12	309.44	317.72											
2-Dec-11	319.13	Dry	313.07	302.15	Dry	286.81	287.44		308.33	286.08	315.37	315.27		319.16	318.44	317.57	285.38	309.30	317.77											
26-Apr-12	318.39	Dry	Dry	302.52	Dry	286.48	287.30		308.56	286.04	315.38	315.27		317.81	317.54	317.27	285.32	309.53	317.30											
21-Nov-12	317.86	Dry	Dry	301.91	Dry	285.65	286.14		308.71	286.11	315.33	315.25		317.96	316.93	316.41	284.51	308.80	315.47											
1-May-13	318.76	Dry	312.27	302.23	Dry	287.90	288.85		308.83	286.76	315.36	315.28		318.34	318.08	317.37	NA	309.34	317.68											
28-Oct-13	318.91	Dry	313.16	302.07	Dry	286.61	287.19		309.04	285.77	315.32	315.24		318.88	318.28	317.41	285.22	309.23	317.66											
25-Jun-14	318.34	Dry	Dry	302.45	Dry	286.53	287.38		309.26	285.84	315.34	315.27		316.73	317.14	317.10	285.16	309.46	317.10											
5-Nov-14	318.64	Dry	Dry	302.23	Dry	285.70	286.35		309.15	285.27	315.37	315.29		317.21	317.50	317.39	284.48	309.27	317.00											
27-May-15	318.32	Dry	Dry	302.48	Dry	286.24	286.92		309.18	285.64	315.36	315.28		316.81	317.19	317.15	284.95	309.45	317.23											
29-Sep-15	318.01	Dry	Dry	302.25	Dry	285.26	285.85		308.82	285.03	315.36	315.28		316.58	316.67	316.88	284.32	309.23	315.82											
14-Dec-15	318.46		Dry	302.40		285.35	285.92		308.68	285.08	315.46	315.39		317.09	317.37	317.30	284.39	309.40	316.66		309.86	309.96	309.54	309.55	308.80	308.78	321.57	317.59	317.08	285.84
8-Mar-16	318.81		313.29	302.40		286.61	287.24		308.82	285.87	315.38	315.30		317.73	317.97	317.45	285.18	309.39	317.67	286.67	310.28	310.30	309.59	309.74	309.09	309.13	322.36	317.59	317.10	287.12
29-Mar-16	318.84		313.45	302.35		286.75	287.33		309.06	285.91	315.28	315.20		317.92	318.31	317.44	285.29	309.29	317.71	287.07	310.32	310.33	309.76	309.74	309.10	309.05	322.52	317.58	317.19	287.20

Notes:
NA - Not Available
All elevations measured in meters above mean sea level (m amsl).
Elevations previously reported relative to a local datum. Conversion: geodetic-198.86 m=local datum
Elevations for ground, reference, bottom and groundwater (1980-2012) provided by Conestoga-Rovers & Associates
Observation wells OW1-84, OW2-84, OW3-80, OW4-80, OW3-84, OW4-84, OW5-84, OW6-84 were resurveyed (reference & ground elevation) October 1994.
Observation wells OW25-91 and OW32-96 were resurveyed (reference & ground elevation) November 1999.
Observation wells OW1-80 and OW2-80 were sealed and abandoned in February 1993.
Observation wells OW3-80, OW4-80 and OW1-84 were sealed and abandoned in August 1996.
Observation well OW17-91 was sealed and abandoned in September 2006.
Observation wells OW8A-91 and OW8B-91 were repaired in August and resurveyed in November 2008
Observation well OW8B-91 was abandoned and replaced by OW8B-10 in October 2010 and resurveyed in November of 2010

Table F1.2
Vertical Gradients
St. Marys Landfill

Vertical Gradients					
Shallow well	**OW4-84**	**OW8B-10**	**OW9B-91**	**OW32-96**	**OW34-96**
Top of screen	312.77	308.89	313.64	316.61	316.48
Bottom of screen	311.47	307.99	311.64	311.11	311.78
Mid-point	312.12	308.44	312.64	313.86	314.13
Deep well	**OW7-91**	**OW8A-91**	**OW9A-91**	**OW32A-02**	**OW33-96**
Top of screen	280.89	287.59	280.56	281.86	310.95
Bottom of screen	275.49	281.89	277.36	278.81	307.25
Mid-point	278.19	284.74	278.96	280.34	309.10
Sep-91	-0.79		-0.85		
Sep-91	-0.79		-0.85		
Nov-91	-0.79		-0.86		
Nov-91			-0.86		
Dec-91	-0.78		-0.85		
Dec-91	-0.77		-0.85		
Dec-91			-0.84		
Dec-91			-0.84		
Dec-91	-0.75		-0.83		
Jan-92	-0.73		-0.82		
Feb-92	-0.72		-0.85		
Feb-92	-0.72		-0.82		
Mar-92	-0.69		-0.80		
May-92	-0.72		-0.82		
Aug-92	-0.76		-0.83		
Nov-92	-0.71		-0.81		
Feb-93	-0.68		-0.77		
May-93			-0.80		
Aug-93			-0.82		
Apr-94	-0.71		-0.80		
Sep-94			-0.86		
Apr-95	-0.74		-0.84		
Sep-95			-0.87		
Apr-96	-0.70		-0.83		
Sep-96			-0.86		-1.41
Apr-97	-0.71		-0.81		-1.64
Sep-97			-0.84		-1.39
Apr-98	-0.78		-0.84		-1.64
Sep-98			-0.89		-1.24
Apr-99			-0.88		-1.64
Sep-99			-0.90		-1.23
Apr-00			-0.90		-1.65
Sep-00			-0.88		-1.57
Apr-01	-0.71		-0.85		-1.63
Sep-01			-0.88		-1.23
Apr-02	-0.74		-0.87		-1.64
Sep-02			-0.88		-1.27
Apr-03	-0.74		-0.87	-0.94	-1.67
Sep-03			-0.89	-0.94	-1.26
May-04	-0.73		-0.85	-0.93	-1.65
Sep-04			-0.89	-0.95	-1.35
Apr-05	-0.76		-0.88	-0.96	-1.67
Nov-05			-0.93	-0.99	-1.27
Apr-06	-0.73		-0.86	-0.94	-1.65
Nov-06	-0.75		-0.88	-0.96	-1.67
Apr-07	-0.73		-0.86	-0.94	-1.63
Nov-07	-0.80		-0.92	-0.95	-1.16
Apr-08	-0.70		-0.84	-0.92	-1.67
Nov-08	-0.79		-0.89	-0.96	-1.58
Apr-09	-0.73		-0.84	-0.92	-1.63
Nov-09			-0.88	-0.96	-1.43
Mar-10	-0.74		-0.87	-0.95	-1.63
Nov-10	-0.80		-0.89	-0.97	-1.44
Mar-11			-0.85	-0.94	-1.65
Dec-11	-0.77	-0.88	-0.87	-0.96	-1.68
Apr-12		-0.90	-0.87	-0.95	-1.54
Nov-12		-0.95	-0.87	-0.95	-1.33
May-13	-0.72	-0.84	-0.85		-1.66
Oct-13	-0.78	-0.92	-0.88	-0.96	-1.68
Jun-14		-0.92	-0.88	-0.95	-1.52
Nov-14		-0.96	-0.89	-0.98	-1.54
May-15		-0.94	-0.88	-0.96	-1.55
Sep-15		-0.97	-0.90	-0.97	-1.31
Dec-15		-0.96	-0.90	-0.98	-1.44
Mar-16	-0.79	-0.91	-0.88	-0.96	-1.65
Mar-16	-0.79	-0.92	-0.87	-0.96	-1.67

Notes:

- downward gradient + upward gradient

Table F1.3
Surface Water Measurements
St. Marys Landfill

Location		Upstream		Basin B		Midstream	Basin A			Downstream	
		SP1-10*		SP1B-94 (Inlet)	SP2B-94 (Outlet)	SP2-93	SP3A-94 (South Inlet)	SP5A-94 (North Inlet)	SP4A-94 (Outlet)	SP3-93	
Reference Elevation		311.240	Flow (4)	314.63	(2)	310.190	314.42	314.62	(2)	310.32 (Shallow) 309.38 (Deep)	Flow Measurement (4)
Feb-93		310.01				309.2				308.44	
Aug-93		Dry				Dry				Dry	
Apr-94		310.3		313.1		309.7	313.19	313.19		309.22	167 L/s
Sep-94		310.06		312.45	Dry	309.39	Dry	Dry	Dry	308.9	12.7 L/s
Apr-95		310.25		313.56	Flowing	309.64	313.81	313.48	Flowing	309.23	170 L/s
Sep-95		310.06		312.49	Dry	309.33	Dry	Dry	Dry	309.25	28 L/s
Oct-95	3	310.17		NA	Flowing	309.48	--	313.08	Flowing	309.13	130 L/s
Apr-96		310.19		NA	Flowing	309.49	Dry	Dry	Flowing	309.04	160 L/s
Sep-96		310.08		312.57	Dry	309.32	Dry	Dry	Dry	308.87	9 L/s
Oct-96	3	310.23		NA	Flowing	309.52	313.54	313.03	Flowing	309.11	230 L/s
Apr-97		310.11		313.37	Flowing	309.35	313.63	313.02	Flowing	308.96	58.6 L/s
Sep-97		309.95		NA	Flowing	309.19	Dry	Dry	Flowing	NA	4.7 L/s
Apr-98	3	310.11		NA	Flowing	309.42	313.51	313.06	Flowing	309.06	118 L/s
Apr-98		310.01		312.64	Flowing	309.29	Dry	313.01	Flowing	309.03	220 L/s
Sep-98		309.91		312.1	Flowing	309.22	Dry	Dry	Dry	NA	10 L/s
Apr-99		310.05		312.60	Flowing	309.37	Dry	Flowing	Flowing	309.07	60 L/s
Jun-99	3	310.12		313.33	Flowing	309.41	Dry	Flowing	Flowing	309.06	35 L/s
Sep-99		310.00		313.01	Flowing	309.28	Dry	Dry	Dry	309.01	41 L/s
Apr-00		310.05		313.54	Flowing	309.44	Dry	313.23	Flowing	309.04	146 L/s
Jun-00	3	310.46		313.74	Flowing	310.05	313.69	313.54	Flowing	>309.38	4012 L/s
Sep-00		310.03		313.59	Flowing	309.44	313.77	313.62	Flowing	309.01	98 L/s
Apr-01		310.02		313.39	Flowing	309.70	314.03	313.81	Flowing	309.05	89 L/s
Jun-01	3	310.01		313.49	Dry	309.73	Dry	312.54	Dry	309.08	784 L/s
Sep-01		309.92		Dry	Dry	309.54	Dry	Dry	Dry	308.99	17 L/s
Apr-02		309.96		313.58	Dry	309.61	314.14	313.92	Flowing	Dry	143.62 L/s
Sep-02		309.88		Dry	Dry	309.45	Dry	Dry	Dry	Dry	31.16 L/s
Apr-03		309.93		313.43	Flowing	309.69	Dry	Dry	Dry	309.06	118.52 L/s
Jun-03	3	309.93		313.6	Flowing	309.65	Flowing	Flowing	Flowing	309.06	42.08 L/s
Sep-03		309.82		Dry	Dry	309.50	Dry	Dry	Dry	Dry	28.15 L/s
May-04		309.86		NA		309.81	314.21	NA	Dry	NA	504 L/s
Sep-04		309.78		No Flow	No Flow	309.51	Dry	Dry	Dry	Dry	3.54 L/s
Apr-05		309.89		Bent	No Flow	309.73	Too Deep/No Flow	Too Deep/Low flow	Flowing	309.07	168 L/s
Jul-05	3	309.83		313.41	Flowing	309.66	Dry	Dry	Flowing	NA	NA
Nov-05		309.83		313.51	Flowing	309.67	Dry	Dry	Flowing	NA	20 L/s
Apr-06		310.05		313.18	Flowing	309.70	Too Deep	Flowing	Flowing	309.03	66 L/s
Jul-06	3	310.62		313.48	Flowing	Too Deep	Too Deep	313.73	Flowing	NA	NA
Nov-06		309.98		313.19	Flowing	309.77	Too Deep/No Flow	Flowing	Flowing	309.05	51 L/s
Apr-07		310.00		Dry	Flowing	309.78	313.97	Too Deep/Flowing	Flowing	Dry	69.23 L/s
Nov-07		309.77		313.64	Flowing	Dry	Dry	Dry	Dry	Dry	9.01 L/s
Apr-08		309.98		313.70	Flowing	309.77	T-Bar Removed	Dry	NA	Dry	97.01 L/s
Aug-08		309.94		313.76	Flowing	309.74	Dry	Dry	Flowing	Dry	105.0 L/s
Nov-08		310.23		313.74	Flowing	309.97	Flowing	Flowing	Flowing	309.25	398.82 L/s
Apr-09		310.42		313.49	Flowing	309.85	Dry	Flowing	Flowing	309.15	324.72 L/s
Nov-09		NA		313.20	Flowing	309.36	Dry	Dry	Flowing	Dry	15.41 L/s
Mar-10		309.88		313.79	Flowing	309.69	Dry	Flowing	Flowing	Dry	49.34 L/s
Nov-10		NA		313.84	Flowing	309.78	Dry	Flowing	Flowing	309.255	310.50 L/s
Mar-11		310.39		313.73	Flowing	309.56	Dry	Dry	Flowing	308.88	528.48 L/s
Oct-11		310.08		313.83	Flowing	T-Bar Missing	Dry	Dry	Flowing	309.01	217.41 L/s
Dec-11		310.47		313.84	Flowing	T-Bar Missing	Dry	Dry	Flowing	Dry	639.20 L/s
Apr-12		310.35		313.73	Flowing	Dry	Dry	Dry	Flowing	Dry	48.0 L/s
Aug-12		310.08		313.83	Flowing	T-Bar Missing	Dry	Dry	Flowing	309.01	40.0 L/s
Nov-12		310.47		313.84	Flowing	T-Bar Missing	Dry	Dry	Flowing	Dry	11.12 L/s
May-13		310.83		313.82	Flowing	309.52	Ponded	Dry	Flowing	308.95	(6)
Oct-13		310.94		313.86	Flowing	NA	Ponded	Dry	Flowing	308.98	170.57 L/s
Jun-14		310.79		Trickle	Dry	309.43	Dry	Dry	Dry	308.95	3.13 L/s
Nov-14		310.83		313.87	Flowing	309.55	Ins	Dry	Flowing	309.07	13.61 L/s
May-15		310.80		Trickle	Dry	309.52	Ponded	Dry	Dry	308.91	1.49 L/s
Sep-15		310.75		Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
Mar-16		310.93	167.27 L/s			309.76				309.05	170.55 L/s

Notes:

Reference elevation refers to top of staff gauge (T-bar) elevation based on most recent survey information of top of staff gauge.

* SP1-10 replaced SP1-93 after the Town took ownership of the Site property in 2009

** Reference elevation - top of culvert - Surveyed October 12, 2006 used for SP1B as of July 2005.

(1) T -bar removed during reconstruction of Retention Pond.

(2) Water levels are not recorded. Dry or flowing conditions are noted.

(3) Water levels recorded after rainfall event.

Ins Insufficient water to obtain a sample

NA T-bar not accessible (area flooded, bent or missing T-bar, overgrowth of weeds)

(4) Rectangular channel cross section assumed

(5) T-Bar elevation not consistent with historical information; Resurveyed in 2009

(6) Flow meter did not work properly

Dry Dry at T-bar

Table F1.4
Phase I Leachate Elevations
St. Marys Landfill

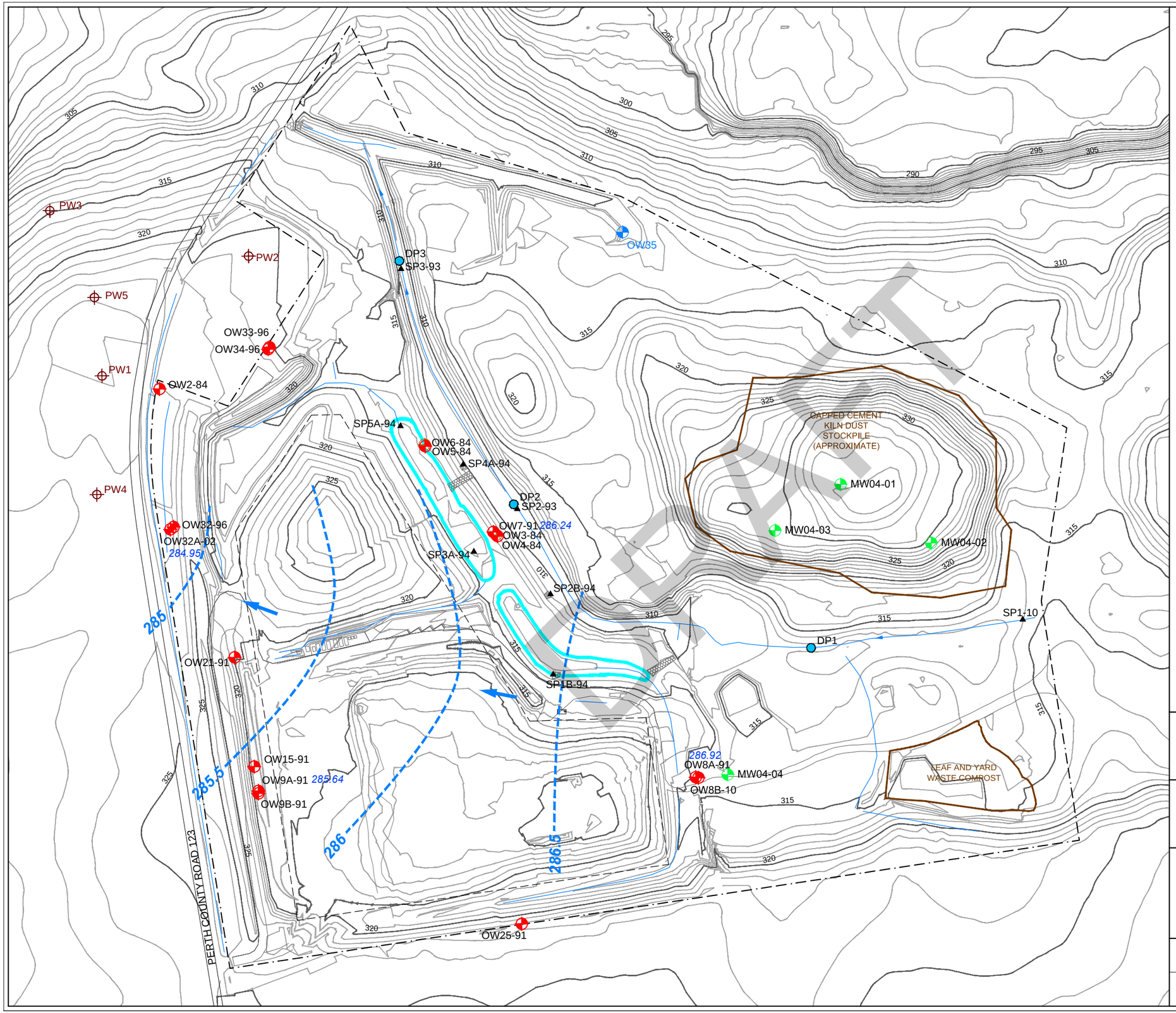
Manhole ID	MH-1	MH-2	MH-3	MH-4	MH-5	MH-6	MH-7	MH-8	MH-16A	MH-15A
Invert Elev.	314.199	314.928	316.04	316.767	316.366	315.966	315.532	315.147	313.91	313.536
Reference Elev.	320.47	319.88	319.08	319.91	319.49	319.31	319.36	319.55	319.02	316.65
May-89	318.57	317.53	317.57	319.50	319.21	318.91	319.25	319.21		
Aug-89	318.69	319.60	317.68	317.78	317.80	Buried	317.50	317.67		
Nov-89	318.70	317.91	317.75	318.00	317.81	317.87	317.64	317.87		
Feb-90	--	--	--	--	--	--	--	--		
Apr-90	317.50	--	317.85	318.15	--	--	--	--		
May-90	317.07	317.02	317.07	317.17	317.16	317.97	317.94	Buried		
May-90	316.86	318.14	316.20	318.73	318.26	319.25	318.07	317.85		
Aug-90	317.11	318.06	316.44	A	317.63	Buried	319.11	317.74		
Nov-90	315.06	Dry	Dry	Flooded	316.06	Buried	Flooded	Dry		
Feb-91	316.70	316.70	316.68	316.72	316.70	Buried	Buried	316.64		
May-91	316.08	316.21	316.18	316.71	316.56	Buried	317.87	316.22		
Aug-91	314.65	Dry	Dry	Dry	Dry	Dry	Dry	Dry		
Nov-91	314.62	Dry	Dry	Dry	Dry	Dry	Dry	Dry		
Feb-92	--	--	--	--	--	--	--	--		
May-92	314.88	315.37	Dry	Dry	Dry	Dry	*	*		
Aug-92	316.36	*	*	Dry	Dry	Dry	Dry	315.53		
Nov-92	316.44	316.45	316.43	Dry	316.44	316.44	316.43	316.44		
Feb-93	315.68	315.68	Dry	Dry	Dry	Dry	315.65	315.66		
May-93	316.79	316.78	316.81	316.8	316.8	316.81	316.79	316.8		
Aug-93	316.42	316.42	316.41	Dry	316.41	316.43	316.4	316.42		
Apr-94	316.52	316.54	316.51	Dry	316.52	316.53	316.52	316.53		
Sep-94	314.90	315.13	Dry	Dry	Dry	315.73	315.49	315.05		
Apr-95	316.35	316.36	316.35	Dry	316.35	316.36	316.34	316.35		
Nov-95	316.20	316.21	316.2	Dry	Dry	316.21	316.19	316.19		
Apr-96	316.61	316.67	316.67	Dry	316.67	316.68	316.66	316.66		
Sep-96	315.99	316.00	Dry	Dry	Dry	316	315.98	315.98		
Apr-97	316.93	316.93	316.93	316.91	317.12	316.94	316.92	316.93		
Sep-97	315.14	Dry	Dry	Dry	Dry	Dry	Dry	Dry		
Apr-98	314.27	315.14	Dry	Dry	Dry	315.83	315.5	315.08		
Sep-98	314.26	315.14	Dry	Dry	Dry	315.83	315.5	315.08		
Apr-99	314.26	315.12	Dry	Dry	316.12	315.83	315.5	315.08		
Sep-99	Wet	Wet	Dry	Dry	Wet	Wet	Wet	Wet		
Apr-00	Flowing	Flowing	Dry	Dry	Wet	Flowing	315.53	Flowing		
Sep-00	Flowing	Wet	Dry	Dry	Dry	Wet	315.53	Wet		
Apr-01	Flowing	Flowing	Dry	Dry	Wet	Flowing	315.55	Flowing		
Sep-01	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry		
Apr-02	Flowing	Flowing	Dry	Dry	Flowing	Flowing	Flowing	Flowing		
Sep-02	--	Wet	Dry	Dry	Dry	Wet	315.55	Wet		
Apr-03	314.63	Flowing	Wet	Dry	Flowing	Flowing	Flowing	Flowing		
Sep-03	Dry	Dry	Dry	Dry	Dry	Dry	Wet	Flowing		
May-04	315.89	315.96	Wet/No Flow	Dry	Wet/Flowing	315.98	315.93	315.96	Flowing	Flowing
Sep-04	Wet/Flowing	Dry	Dry	Dry	Dry	Dry	Wet/No Flow	Wet/No Flow	--	Wet/Flowing
Apr-05	315.89	315.93	Wet/No Flow	Dry	Wet/Flowing	316.11	315.90	315.90	Wet/Flowing	Wet/Flowing
Nov-05	314.58	Wet/Flowing	Dry	Dry	Dry	Wet/Flowing	Wet/Flowing	Wet/Flowing	Flowing	Flowing
Apr-06	315.62	315.65	Wet	Dry	Wet	Flowing	315.63	315.63	Flowing	Flowing
Nov-06	315.76	315.78	Wet/No Flow	Dry	Wet/No Flow	Wet/Flowing	315.77	315.77	Flowing	Flowing
Apr-07	Wet/Flowing	Wet/Flowing	Dry	Dry	Wet/No Flow	Wet/No Flow	Wet/No Flow	Wet/Flowing	--	--
Nov-07	Wet/Flowing	Dry	Dry	Dry	Dry	Wet/Flowing	Wet/No Flow	Wet/No Flow	Wet/Flowing	Wet/Flowing
Apr-08	Wet/Flowing	Wet/Flowing	Wet/Flowing	Dry	Wet/No Flow	Wet/No Flow	Wet/No Flow	Wet/Flowing	Wet/Flowing	Wet/Flowing
Nov-08	Wet/Flowing	Wet/Flowing	Wet/Flowing	Dry	Flowing	Flowing	Flowing	Wet/Flowing	Wet/Flowing	Wet/Flowing
Apr-09	Dry	Dry	Flowing	Dry	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing
Nov-09	Wet/Flowing	Wet	Dry	Dry	Wet	Wet	Wet	Wet	Flowing	Flowing
Mar-10	Flowing	Flowing	Wet	Dry	Wet	Flowing	Wet	Wet	Flowing	Flowing
Nov-10	Flowing	Flowing	Dry	Dry	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing
Mar-11	Flowing	Flowing	Wet	Dry	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing
Dec-11	Flowing	Flowing	Wet	Dry	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing
Apr-12	Flowing	Wet	Dry	Dry	Wet	Wet	Wet	Wet	Flowing	Flowing
Nov-12	Flowing	Flowing	Dry	Dry	Wet	Wet	Wet	Flowing	Flowing	Flowing
May-13	Flowing	Flowing	316.09	Dry	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing
Oct-13	Flowing	Flowing	317.43	Dry	316.45	Flowing	Flowing	Flowing	Flowing	Flowing
Jun-14	Flowing	Wet	317.42	Dry	Wet	Wet	Wet	Wet	Flowing	Flowing
Nov-14	Very Slow Flow	Very Slow Flow	317.42	Dry	Wet/No Flow	Wet/No Flow	Wet/No Flow	Very Slow Flow	Flowing	Very Slow Flow
May-15	Very Slow Flow	Very Slow Flow	317.52	Dry	Pond/No Flow	Pond/No Flow	Pond/No Flow	Pond/No Flow	Flowing	Very Slow Flow
Sep-15	Very Slow Flow	Pond/No Flow	317.42	Dry	Dry	Pond/No Flow	Pond/No Flow	Pond/No Flow	Slow Flow	Flowing

Notes:
All elevations in metres above mean sea level (m AMSL).
Reference elevation is elevation of top of steel frame and grate.
* Data obtained during monitoring is not consistent with other data.
Buried - MH covered by waste or interim cover material
-- No Data
A - Leachate running into manhole.
(1) - Leachate pumped from holding tank prior to measuring levels.
Wet - bottom of MH wet, but no leachate accumulation
Flowing - indicates leachate moving through the bottom of the MH

Table F1.5
Phase II/III Leachate Elevations
St. Marys Landfill

Manhole ID		MH1	MH2	MH3	MH4	MH5	MH6 [2]	MH7	MH8	MH9	MH10	MH11	MH12	MH13	MH14	MH15	MH16	MH17	MH18	MH19	MH20	MHA	MHB
Invert Elev.		313.25	312.81	312.12			314.79	315.07	315.42	315.81	316.13	317.60	317.45	317.13	316.79	316.28			313.93	314.397	314.871	311.76	310.79
Reference Elev.	1	317.24	318.27	318.26	319.31	318.13	320.00	320.29							321.82	321.75	319.77	319.13	319.11	318.57	318.13	318.33	315.72
May-93		NA	NA	NA																			
Aug-93		NA	NA	NA																			
Apr-94		NA	NA	NA																			
Sep-94		Dry	Dry	312.73																			
Apr-95		Dry	312.84	312.84															Dry	Dry			
Sep-95		Dry	Dry	312.55															Dry	Dry			
Apr-96		Dry	313.24	313.26															Dry	Dry			
Sep-96		Dry	313.3	313.3															Dry	Dry			
Apr-97		Dry	Dry	312.64															Dry	Dry			
Sep-97		Dry	313.06	313.06															Dry	314.28			
Apr-98		Dry	Dry	312.14															Dry	314.36			
Sep-98		Dry	Dry	312.15															Dry	Dry			
Apr-99		312.27	312.83	312.14															Dry	Dry			
Sep-99		Dry	Flowing	Flowing															Dry	No Flow			
Apr-00		Wet	Flowing	Flowing															Wet	Dry			
Sep-00		Dry	Wet	312.49															Dry	Wet			
Apr-01		Wet	Flowing	Flowing															Dry	Wet			
Sep-01		Dry	Dry	312.69															Dry	Dry			
Apr-02		Flowing	Flowing	312.29															Flowing	Flowing			
Sep-02		Dry	313.2	310.88															Wet	Dry	Dry		
Apr-03		Flowing	Flowing	Flowing															Flowing	Flowing	Wet		
Sep-03		Dry	Dry	Dry															Dry	Dry	Dry		
May-04		Wet/Flowing	Wet/Slight Flow	Wet/Slight Flow	Wet/Flowing													Dry	Wet/Flowing	Wet/Flowing	Wet/Flowing		Overflowing
Sep-04		Dry	Dry	308.25	Wet/Slight Flow													Dry	Dry	Dry	314.85	Dry	Top Flowing
Apr-05		Wet/No Flow	Wet/No Flow	Wet/Flowing	Flowing	Flowing											Wet/No Flow	Wet/No Flow	Wet/No Flow	Dry	Dry	315.34	Overflowing
Nov-05		Dry	Wet/No flow	Flowing	Wet/Flowing	Wet/Flowing	Wet/Flowing										Wet/Flowing	Wet	Flowing	314.74	Dry	315.33	Top Flowing
Apr-06		Wet	Wet	Flowing	Flowing	Flowing	Wet										Wet	Wet	Flowing	315.00	Dry	315.32	Top Flowing
Nov-06		Wet/No Flow	Wet/No Flow	Flowing	Flowing	Wet/Flowing	Wet/Flowing										Wet/Flowing	Wet/No Flow	Wet/Flowing	315.23	Dry	315.32	Top Flowing
Apr-07		Wet/No Flow	Wet/No Flow	Flowing	Wet/Flowing	Wet/Flowing	Wet/Flowing										Wet/Flowing	Dry	Wet/Flowing	315.19	Dry	315.32	Top Flowing
Nov-07		Dry	Dry	Wet/Flowing	Wet/No Flow	Wet/No Flow	Wet/Flowing	NA							NA		Wet/No Flow	Wet/No Flow	Wet/No Flow	314.91	Dry	315.12	315.12
Apr-08		Wet/No Flow	Wet/No Flow	312.59	Wet/No Flow	Wet/Flowing	Wet/Flowing	NA							NA	NA	NA	Wet/Flowing	Wet/No Flow	Wet/Flowing	Dry	315.35	315.37
Nov-08		Dry	Dry	Flowing	Flowing	Flowing	Flowing	NA							NA	Wet/Flowing	Wet/Flowing	Wet/Flowing	Wet/Flowing	315.38	Wet	315.14	Top Flowing
Apr-09		Dry	Dry	Flowing	Flowing	Flowing	Flowing	NA							NA	Flowing	Flowing	Wet	Flowing	315.05	Flowing	315.14	Top Flowing
Nov-09		Wet	Wet	Flowing	Flowing	Wet	Wet	315.11							NA	Wet	Dry	Wet	Wet	314.85	Wet	315.29	315.34
Mar-10	3	NA	NA	NA	NA	NA	NA	NA							NA	NA	NA	NA	NA	NA	NA	NA	Top Flowing
Nov-10		Wet	Flowing	Flowing	Flowing	Flowing	Flowing	NA	NA					NA	NA	Flowing	Flowing	Flowing	Flowing	314.87	Wet	315.11	Top Flowing
Mar-11		Wet	Flowing	Flowing	Flowing	313.38	Flowing	NA	NA					NA	NA	Flowing	Flowing	Wet	Flowing	315.04	Dry	315.13	Top Flowing
Dec-11		Wet	Flowing	Flowing	Flowing	Flowing	Flowing	Flowing	NA					NA	NA	Flowing	Flowing	Flowing	Flowing	315.27	Wet	315.08	Top Flowing
Apr-12		Dry	Flowing	Flowing	312.84	Flowing	Flowing	Flowing	NA					Dry	Wet	Flowing	Flowing	Wet	Flowing	314.95	Dry	315.12	Top Flowing
Nov-12		Wet	Wet	Flowing	Flowing	Wet	Flowing	Wet	NA					Wet	Wet	Wet	Wet	Wet	Wet	314.96	Wet	315.12	Top Flowing
May-13		Dry	Flowing	Flowing	Dry	Flowing	Flowing	315.23	NA					Flowing	316.66	Flowing	Flowing	Flowing	Flowing	315.11	Dry	315.11	Top Flowing
Oct-13		Dry	Dry	Flowing	313.75	Flowing	Flowing	315.24	Flowing					Flowing	316.65	Flowing	Flowing	Flowing	Flowing	315.29	Dry	315.09	Top Flowing
Jun-14		Wet	Wet	Trickle	314.48	314.52	Flowing	315.16	Wet					Trickle	316.65	Trickle	Wet	Wet	Trickle	315.05	314.9	315.12	315.36
Nov-14		Dry	Dry	Trickle	NA	314.52	Flowing	315.22	Trickle					Trickle	316.66	Wet/No Flow	Wet/No Flow	Dry	Wet/No Flow	315.08	Dry	315.14	315.37
May-15		Pond/No Flow	Pond/No Flow	Trickle	NA	314.55	Flowing	315.23	Trickle	NA	Trickle	Dry	Trickle	Pond/No Flow	316.65	Pond/No Flow	Trickle	Pond/No Flow	Trickle	314.77	Dry	315.11	315.35
Sep-15		Dry	Dry	Trickle	NA	314.43	Trickle	315.29	NA	NA	NA	Wet	Dry	Dry	316.57	Dry	Dry	Dry	Pond/No Flow	314.82	Pond/No Flow	315.13	315.36

Notes:
All elevations in metres above mean sea level (m amsl).
Reference elevation of manholes is elevation of top of steel frame and grate.
1. Reference elevations resurveyed November 23, 2009
2. 1.46 m spacer added to MH 6 in 2008 to bring MH cover elevation above grade.
3. Phase II/III Manholes were not inspected during the March 2010 event due to the disposal of ACM at the site on the day of the inspection.
NA - not accessible
Wet - bottom of MH wet, but no leachate accumulation
Flowing - indicates leachate moving through the bottom of the MH
Overflowing - indicates that groundwater was flowing out the top of the MH cover.
Top Flowing - indicates that groundwater was flowing out of the manhole riser.
Invert elevations MH8 to MH13 from 2013 Cell 8 Construction documents



LEGEND

- PROPERTY BOUNDARY
- LIMIT OF REFUSE DISPOSAL
- WATERCOURSE
- STORM WATER MANAGEMENT BASIN
- OBSERVATION WELL
- SURFACE WATER MONITORING LOCATION
- PRIVATE DOMESTIC WELL (APPROXIMATE LOCATION)
- MONITORING WELL (NOT SAMPLED)
- MONITORING WELL (REMOVED FROM MONITORING PROGRAM)
- MONITORING WELL (SOURCE UNKNOWN)
- DRIVE POINT PIEZOMETER
- INTERPRETED GROUNDWATER CONTOUR (masl)
- *287.90* MEASURED WATER LEVEL (MAY, 2015)
- INTERPRETED GROUNDWATER FLOW DIRECTION

N

0 60 120 180 240

Metres

BURNSIDE

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TOWN OF ST. MARYS

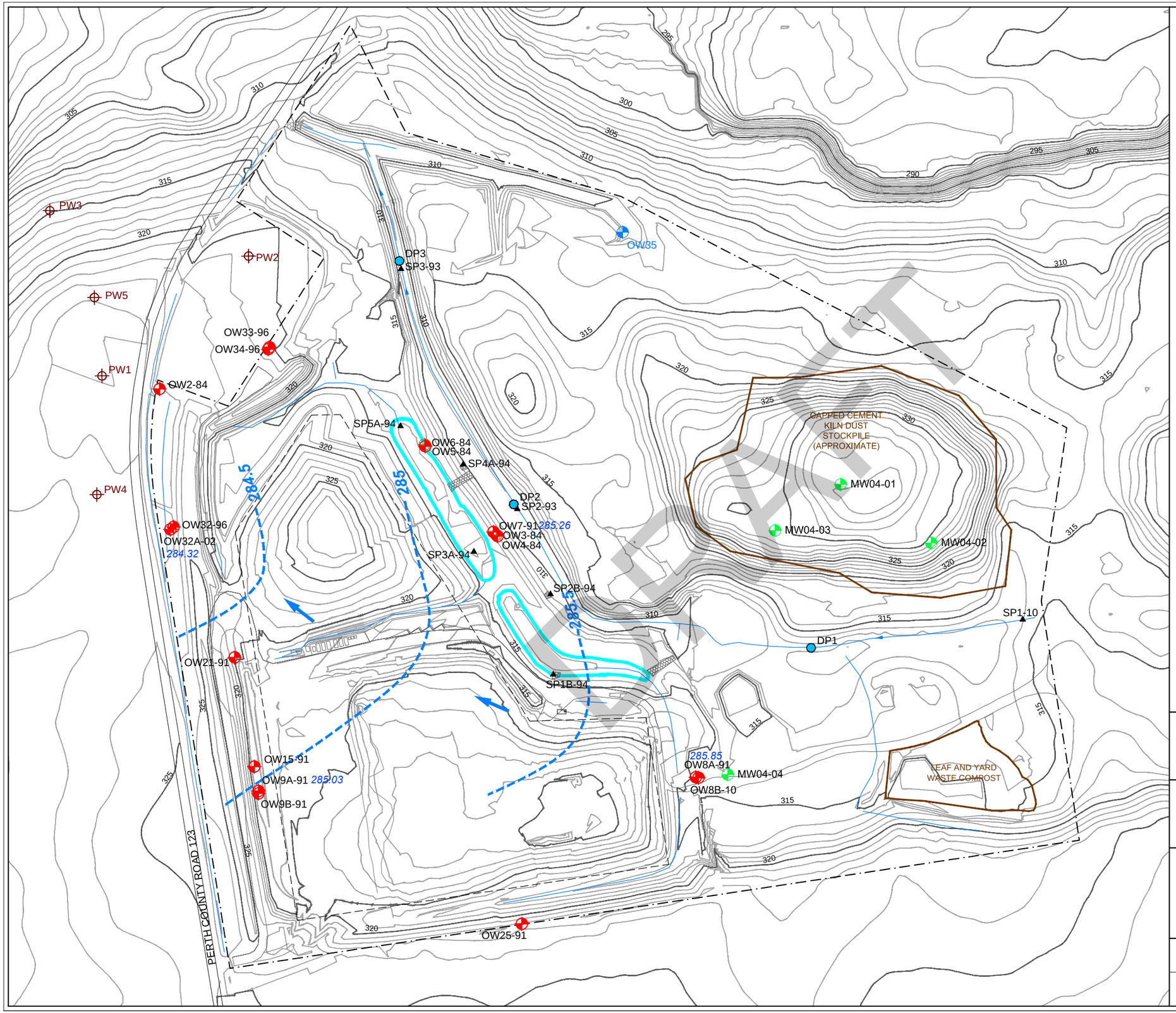
ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

GROUNDWATER FLOW IN BEDROCK (MAY, 2015)

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**F2.1**
Scale		Project No.	
1:3,000		300032339	

File Name: 032339 2016 EA HG STUDY APPENDIX F2.dwg Date Plotted: April 12, 2016 - 1:35 PM



LEGEND

- PROPERTY BOUNDARY
- LIMIT OF REFUSE DISPOSAL
- WATERCOURSE
- STORM WATER MANAGEMENT BASIN
- OBSERVATION WELL
- SURFACE WATER MONITORING LOCATION
- PRIVATE DOMESTIC WELL (APPROXIMATE LOCATION)
- MONITORING WELL (NOT SAMPLED)
- MONITORING WELL (REMOVED FROM MONITORING PROGRAM)
- MONITORING WELL (SOURCE UNKNOWN)
- DRIVE POINT PIEZOMETER
- INTERPRETED GROUNDWATER CONTOUR (masl)
- *287.90* MEASURED WATER LEVEL (SEPTEMBER, 2015)
- INTERPRETED GROUNDWATER FLOW DIRECTION

BURNSIDE

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TOWN OF ST. MARYS

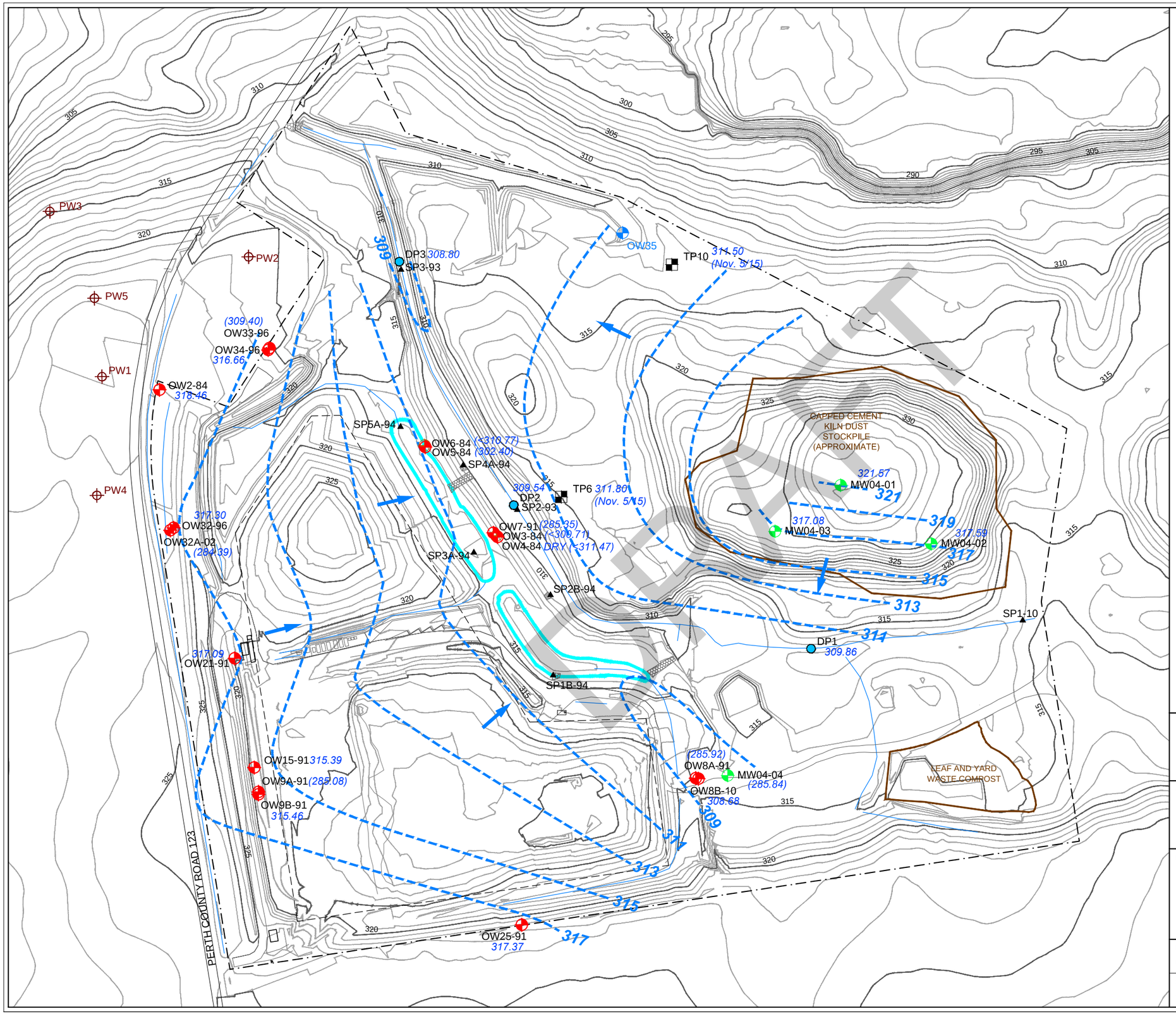
ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

GROUNDWATER FLOW IN BEDROCK (SEPTEMBER, 2015)

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**F2.2**
Scale		Project No.	
1:3,000		300032339	

File Name: 032339 2016 EA HG STUDY APPENDIX F2.dwg Date Plotted: April 12, 2016 - 1:36 PM



LEGEND

- PROPERTY BOUNDARY
- LIMIT OF REFUSE DISPOSAL
- WATERCOURSE
- STORM WATER MANAGEMENT BASIN
- OBSERVATION WELL
- SURFACE WATER MONITORING LOCATION
- PRIVATE DOMESTIC WELL (APPROXIMATE LOCATION)
- MONITORING WELL (NOT SAMPLED)
- MONITORING WELL (REMOVED FROM MONITORING PROGRAM)
- MONITORING WELL (SOURCE UNKNOWN)
- DRIVE POINT PIEZOMETER
- INTERPRETED GROUNDWATER CONTOUR (masl)
- 287.90 MEASURED WATER LEVEL (DECEMBER, 2015)
- (309.40) MEASURED WATER LEVEL (DECEMBER, 2015) NOT USED FOR INTERPRETING GROUNDWATER CONTOURS
- INTERPRETED GROUNDWATER FLOW DIRECTION

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Client / Report

TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

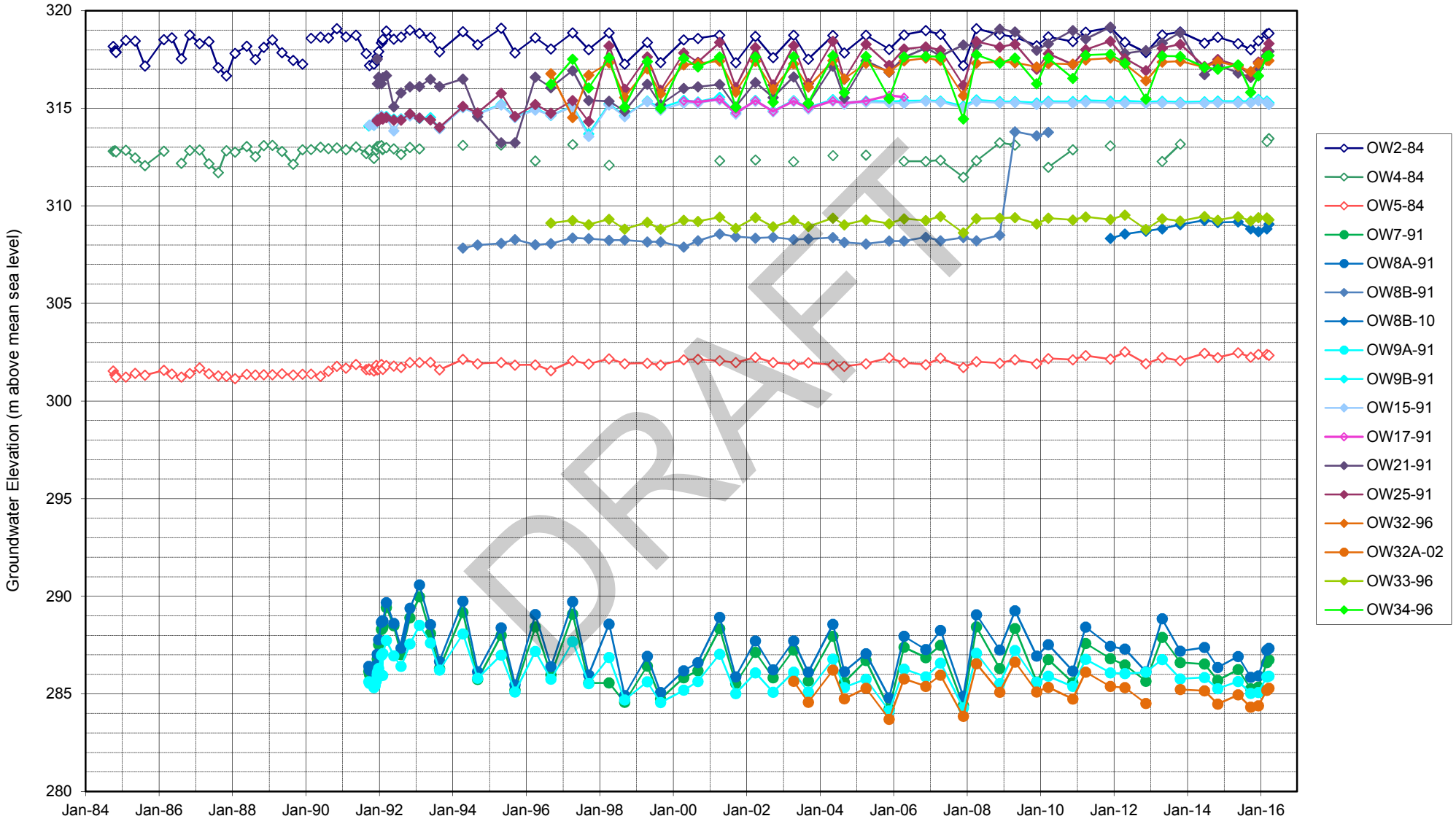
Figure Title

GROUNDWATER FLOW IN OVERBURDEN (DECEMBER, 2015)

Drawn	Checked	Date	Figure No.
SK	CM	March 2016	**F2.3**
Scale		Project No.	
1:3,000		300032339	

File Name: 032339 2016 EA HG STUDY APPENDIX F2.dwg Date Plotted: April 12, 2016 - 1:36 PM

Figure F2.4
Groundwater Hydrograph



R.J. Burnside & Associates Limited
File: 032339 St. Marys 2016 EA HG Study Tables
Date: 4/12/2016

Town of St. Marys Landfill
Environmental Assessment Hydrogeology Study
300032339.0000

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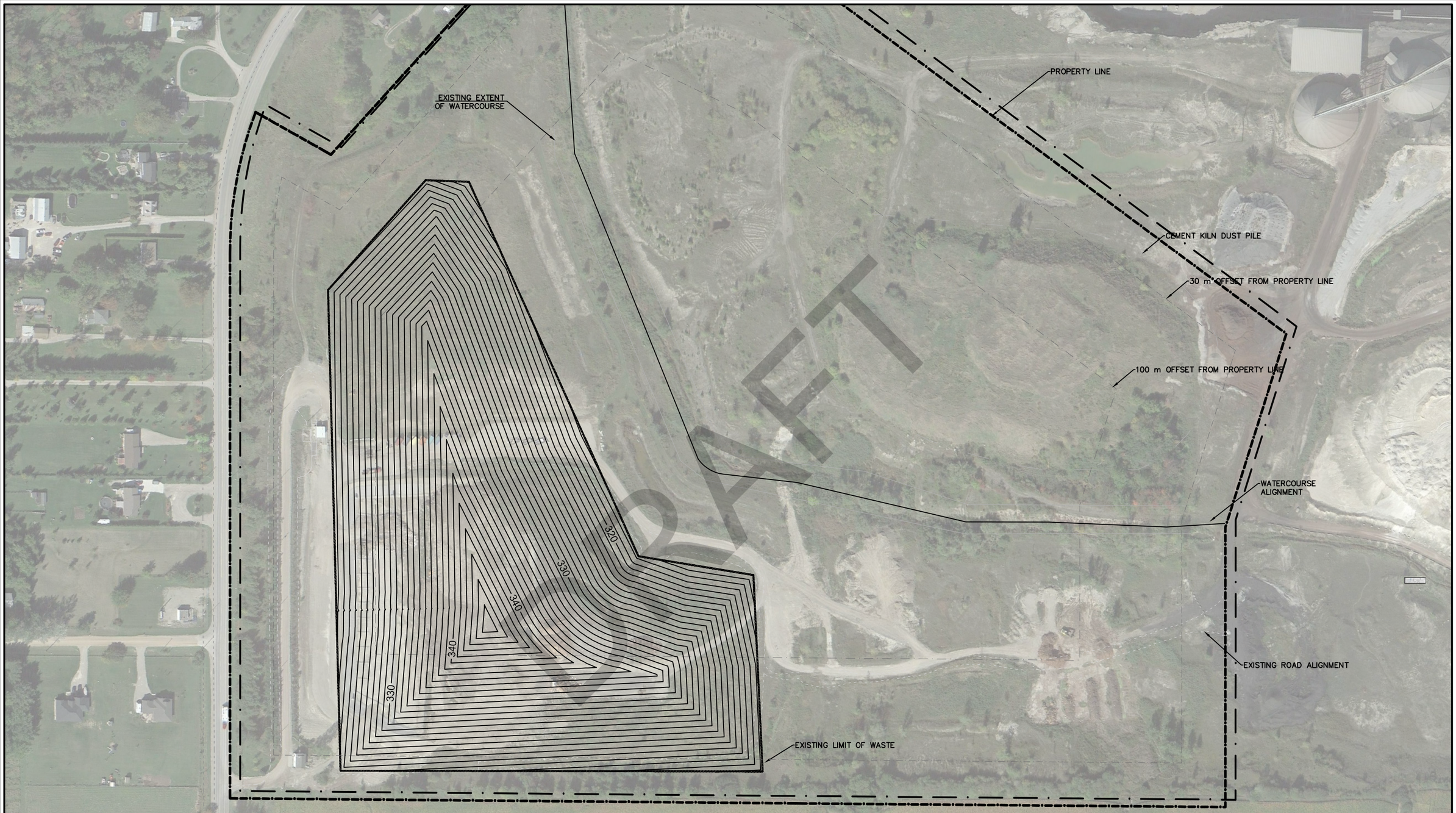
Appendix G

Alternative Methods Conceptual Drawings



OBTAINED CAPACITY - 577,000 m³

N

0 50 100 150 200

Metres

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TOWN OF ST. MARYS

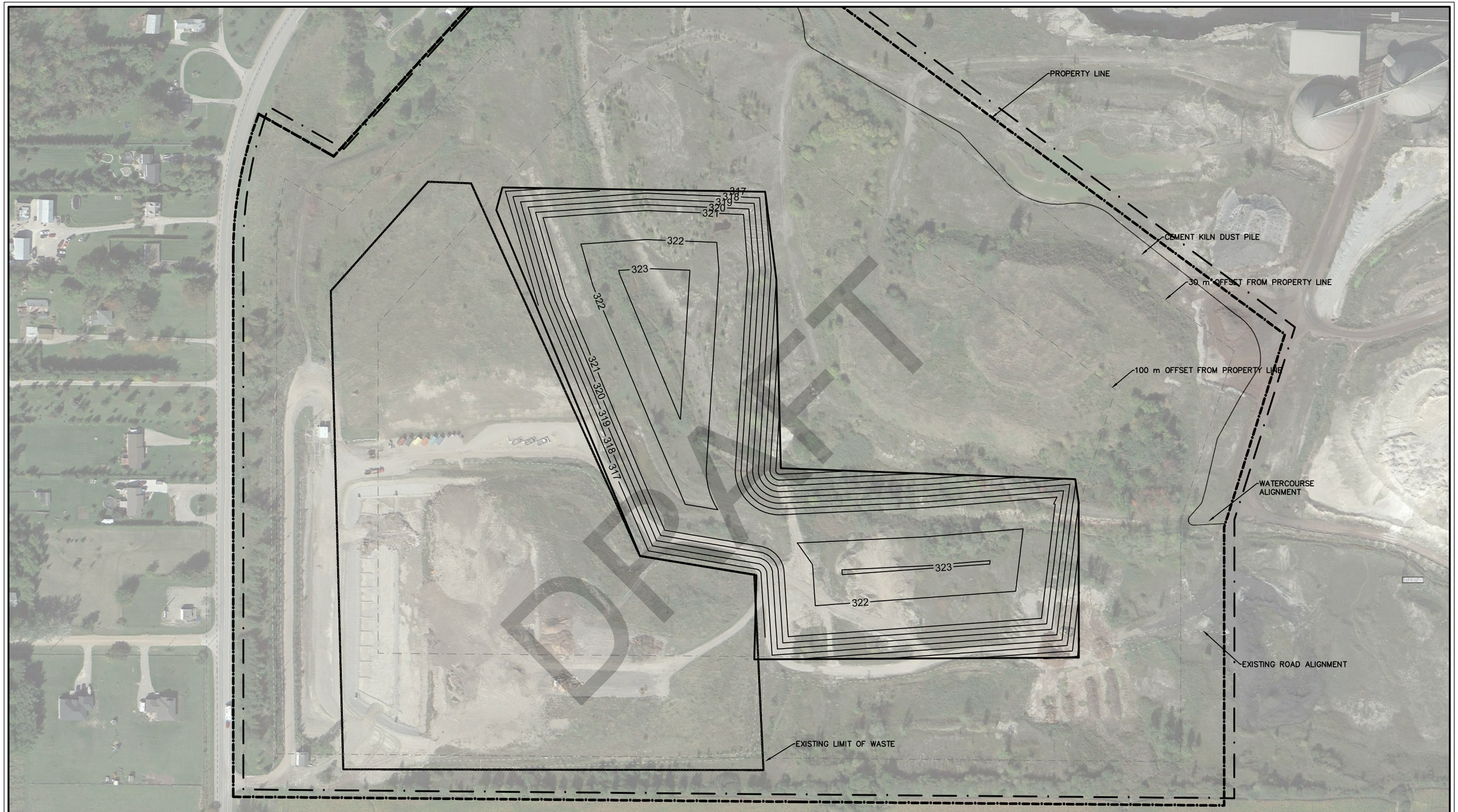
Figure Title

SOLID WASTE CAPACITY DEVELOPMENT

ALTERNATIVE METHOD 1 - VERTICAL EXPANSION

Drawn	Checked	Date	Figure No.
AE	JRH	APRIL 2016	1
Scale		Project No.	
1:2500		300032339	

File: A:\032339 - St. Marys Waste\CIVIL\02_ProductionDwg\Alternative Method 1.dwg Date Plotted: March 29, 2016 - 5:04 PM



N

0 50 100 150 200

Metres

OBTAINED CAPACITY -	733,000 m³
ABOVE GRADE -	403,000 m³
BELOW GRADE-	330,000 m³

EXPANSION VOLUME IS ATTAINED FROM A 4:1 SIDESLOPE FROM THE EDGE OF WASTE TO m ELEVLATION 321 m. FOLLOWED BY A 20:1 GRADE TO THE PEAK AT 323m. COMBINED WITH A 5 m VERTICAL EXCAVATION (CKD PILE EXCLUDED).

MINIMUM MOECC SETBACK FROM PROPERTY BOUNDARY = 30 m
GUIDELINE SETBACK = 100 m

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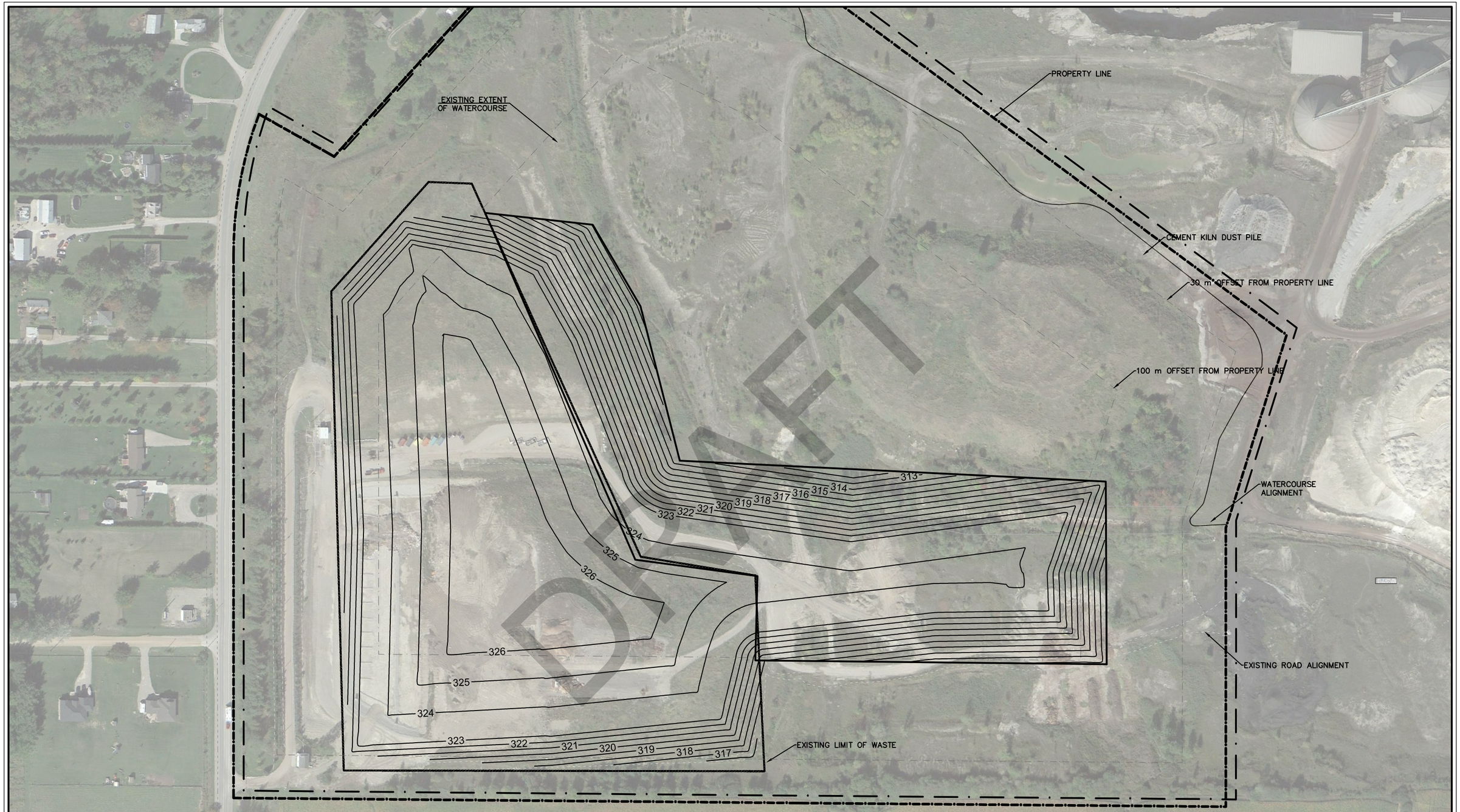
Figure Title

SOLID WASTE CAPACITY DEVELOPMENT

METHOD 2 - HORIZONTAL EXPANSION OF THE EXISTING LANDFILL

Drawn	Checked	Date	Figure No.
AE	JRH	APRIL 2016	**2**
Scale		Project No.	
1:2500		300032339	

File: A:\032339 - St. Marys Waste\CIVIL\02_Production\Dwg\Alternative Method 2.dwg Date Plotted: March 29, 2016 - 5:02 PM



N

0 50 100 150 200

Metres

OBTAINED CAPACITY - 756,000 m³
ABOVE GRADE - 506,000 m³
BELOW GRADE- 250,000 m³

EXPANSION VOLUME IS ATTAINED FROM A 4:1 SIDESLOPE FROM THE EDGE OF THE WASTE TO ELEVATION OF 323m, FOLLOWED BY A 20:1 SLOPE ON THE PEAK. COMBINED WITH A 5m VERTICAL EXCAVATION (CKD PILE EXCLUDED).

MINIMUM MOECC SETBACK FROM PROPERTY BOUNDARY = 30 m
GUIDELINE SETBACK = 100 m

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TOWN OF ST. MARYS

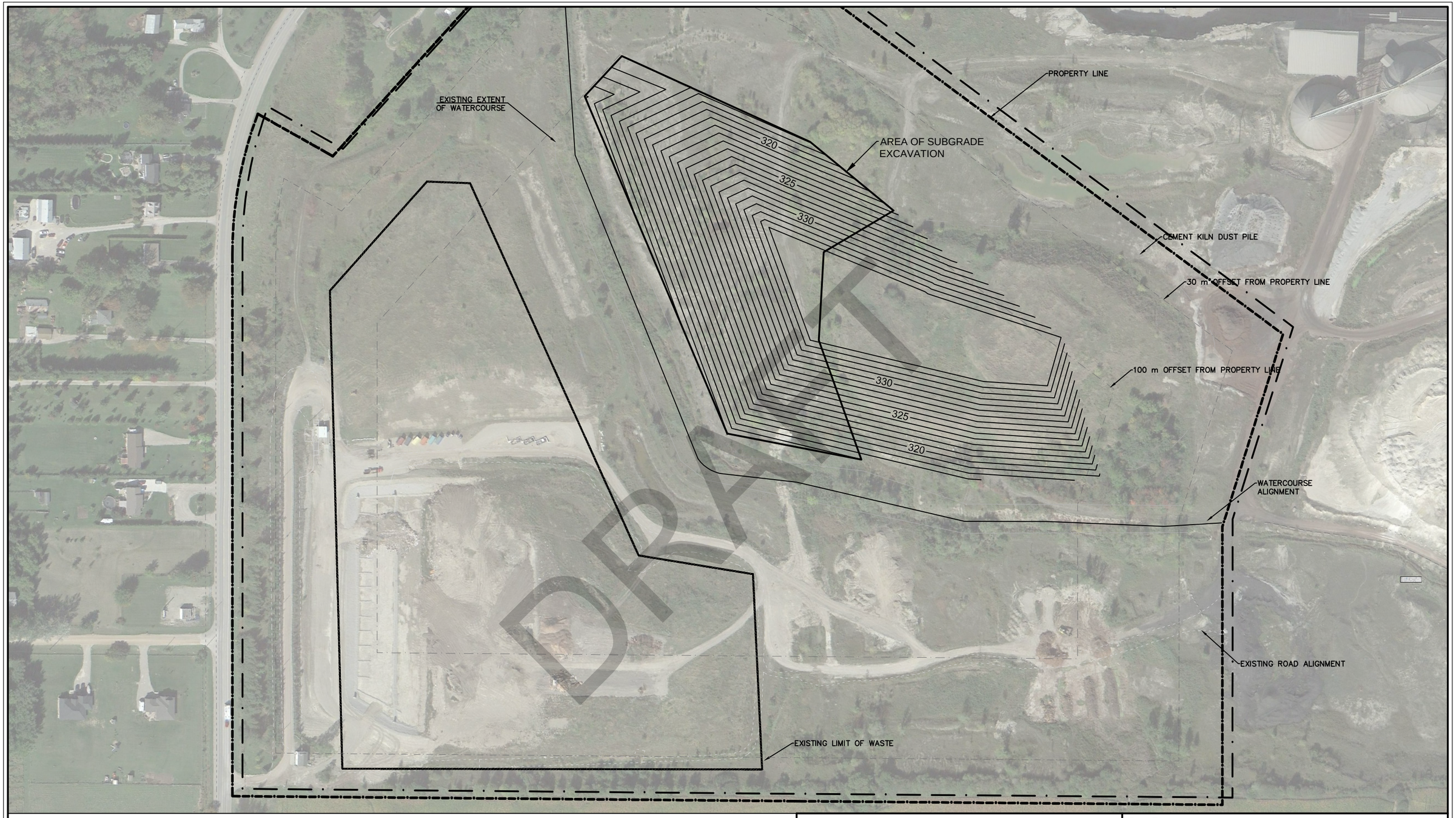
Figure Title

SOLID WASTE CAPACITY DEVELOPMENT

METHOD 3 - COMBINATION OF VERTICAL AND HORIZONTAL EXPANSION

Drawn	Checked	Date	Figure No.
AE	JRH	APRIL 2016	3
Scale		Project No.	
1:2500		300032339	

File: A:\032339 - St. Marys Waste\CIVIL\02_Production\Dwg\Alternative Method 3.dwg Date Plotted: March 29, 2016 - 5:03 PM



N

0 50 100 150 200

Metres

OBTAINED CAPACITY -	397,000 m³
ABOVE GRADE -	252,000 m³
BELOW GRADE-	145,000 m³

EXPANSION VOLUME IS ATTAINED FROM A 4:1 SIDESLOPE FROM THE EDGE OF THE WATERCOURSE BANK TO THE ELEVATION OF THE EXISTING TOPOGRAPHY. COMBINED WITH A 5 m VERTICAL EXCAVATION (CKD PILE EXCLUDED).

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TOWN OF ST. MARYS

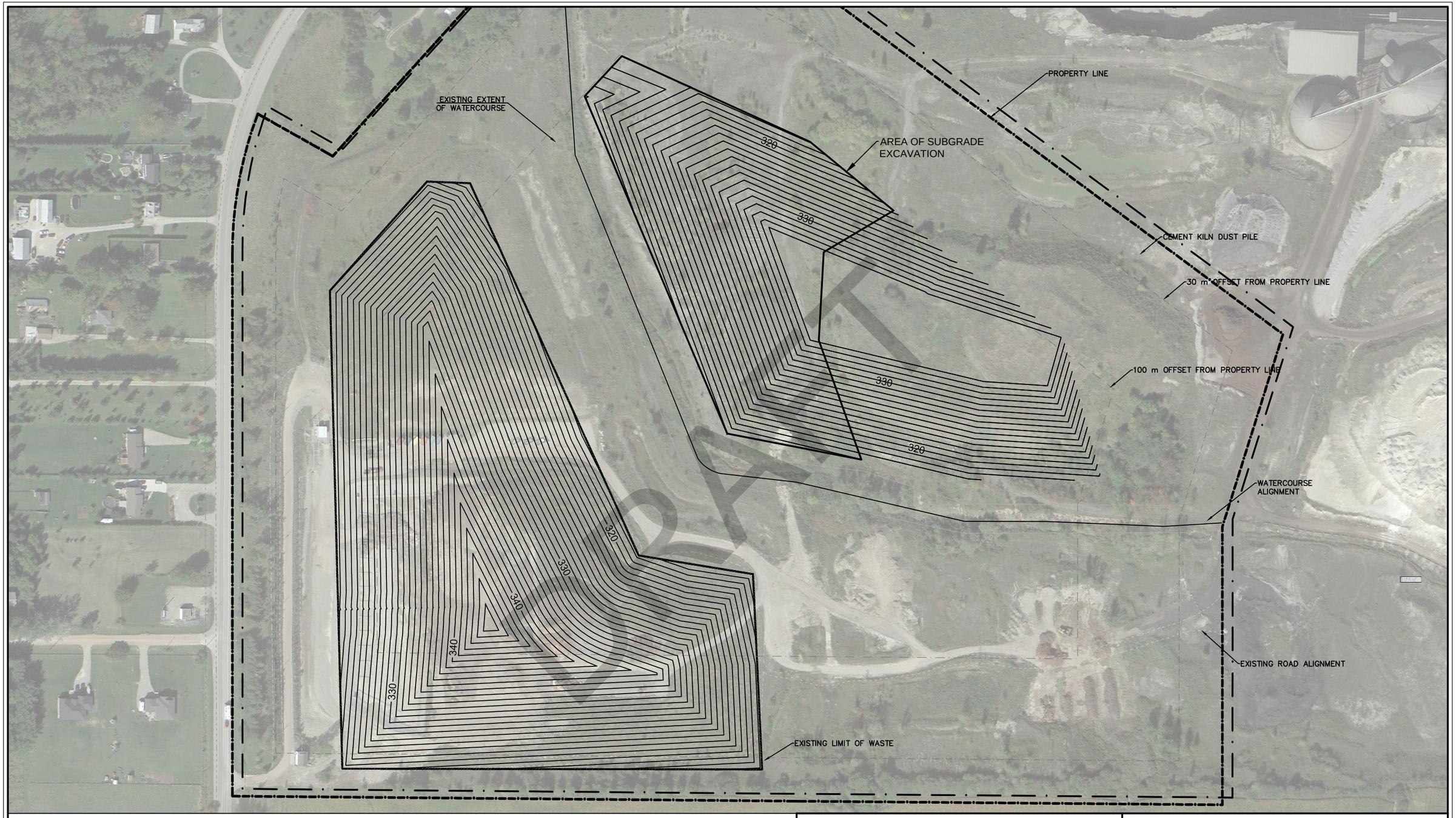
Figure Title

SOLID WASTE CAPACITY DEVELOPMENT

ALTERNATIVE METHOD 4 - NEW LANDFILL FOOTPRINT

Drawn	Checked	Date	Figure No.
AE	JRH	APRIL 2016	4
Scale		Project No.	
1:2500		300032339	

File: A:\032339 - St. Marys Waste\C\VIL\02_Production\Dwg\Alternative Method 4.dwg Date Plotted: March 29, 2016 - 5:04 PM



N

0 50 100 150 200

Metres

OBTAINED CAPACITY -	974,000 m³
ABOVE GRADE -	827,000 m³
BELOW GRADE-	145,000 m³

EXPANSION VOLUME IS ATTAINED FROM A 4:1 SIDESLOPE FROM THE EDGE OF THE WATERCOURSE BANK TO THE ELEVATION OF THE EXISTING TOPOGRAPHY. COMBINED WITH A 5 m VERTICAL EXCAVATION (CKD PILE EXCLUDED). ADDITIONALLY WASTES WILL BE PLACED OVERTOP OF THE EXISTING PHASES.

MINIMUM MOECC SETBACK FROM PROPERTY BOUNDARY = 30 m
GUIDELINE SETBACK = 100 m

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TOWN OF ST. MARYS

Figure Title

SOLID WASTE CAPACITY DEVELOPMENT

METHOD 5 - COMBINATION OF VERTICAL EXPANSION AND SEPARATE DEVELOPMENT OF A NEW LANDFILL FOOTPRINT

Drawn	Checked	Date	Figure No.
AE	JRH	APRIL 2016	5
Scale		Project No.	
1:2500		300032339.0000	

File: A:\032339 - St. Marys Waste\CIVIL\02_Production\Dwg\Alternative Method 5.dwg Date Plotted: March 29, 2016 - 5:05 PM

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Appendix H

Impacts and Mitigation

Table H1
Potential Impacts

Description of Site Alteration	Leachate Generation		Groundwater				Surface Water			
			Quantity		Quality		Quantity		Quality	
Method 1 Vertical Expansion of Existing Landfill (577,000 m3)										
Added height to Phase I and Phase II/III during operation	N1	Increased leachate strength	o		N2	Potential for increased leachate elevation - increased head could drive leachate into sand/silt seam and into till	o		N3	Potential for contaminated runoff from footprint during filling
Added height to Phase I and Phase II/III when closed	P	Decreased generation - increased runoff on longer side slopes	o		N2	Potential for increased leachate elevation - increased head could drive leachate into sand/silt seam and into till	N4	Increased runoff from footprint - longer side slopes No change outside footprint	N5	Potential for leachate breakout on final side slope
Filled between Phase I and Phase II/III - increased waste footprint	N6	Increased infiltration into waste	o	Potential decreased infiltration (increased runoff) - minor	N7	Potential for migration of leachate downward into sand/silt seam	o	Decreased runoff during filling Increased runoff from finished slopes	N8	Potential for contaminated runoff from fill area
Footprint does not encroach on stormwater basins	o		o		P	No alterations to stormwater basin with regard to sand/silt seam	P	No alterations to stormwater basin location	o	
Footprint does not encroach on watercourse	o		o		o		P	No alterations to water course location	o	
Method 2 Horizontal Expansion of Existing Landfill (733,000 m3)										
Height slighlty less than current Phase I and Phase II/III	o		o		o		o		o	
Increased waste footprint	N6	Increased infiltration into waste	o	Potential decreased infiltration (increased runoff) - minor	N7	Potential for migration of leachate downward into sand/silt seam	o	Decreased runoff during filling Increased runoff from finished slopes	N8	Potential for contaminated runoff from fill area
New waste footprint in centre of property - farther from boundary	o		o		P	Creates large buffer between fill and property boundary	o		P	Creates large buffer between fill and property boundary
Create long narrow depressions between footprint expansion and existing Phases	N9	could cause surface ponding and increased infiltration	o		N2	Potential for increased leachate elevation - increased head could drive leachate into sand/silt seam	P	Decreased stormwater runoff	N5	Potential for leachate breakout on final side slope
5 metre excavation	o		N10	Could intersect saturated soil or sand/silt seam	N10	Could intersect saturated soil or sand/silt seam	o		o	
Bottom of waste may be closer to bedrock surface	o		o		N11	Shorter travel distance between bottom of waste and bedrock	o		o	
Displaces stormwater basins - requires relocation	o		o		N12	Potential for migration of stormwater downward into sand/silt seam	o		o	
Displaces watercourse - requires relocation	o		N13	Potential to change flow direction in shallow groundwater	N14	Potential for migration of leachate laterally into sand/silt seam (exposed on bank of watercourse)	N15	Will require alterations of surface water movement to reach new watercourse	P	Increase waste to watercourse distance
									N16	Decrease CKD to watercourse distance

Legend

o	No net impact or neutral when compared to the existing site
P	Positive Impact
N2	Negative impact - numbered in order in which they appear on table Follow number to mitigation tables

Table H1
Potential Impacts

Description of Site Alteration	Leachate Generation		Groundwater				Surface Water			
			Quantity		Quality		Quantity		Quality	
Method 3 Combionation of Vertical and Horizontal Expansion of Existing Landfill (Method 1 and Method 2) (756,000 m3)										
Filled between Phase I and Phase II/III - increased waste footprint	N6	Increased infiltration into waste	o	Potential decreased infiltration (increased runoff) - minor	N7	Potential for migration of leachate downward into sand/silt seam	o	Decreased runoff during filling Increased runoff from finished slopes	N8	Potential for contaminated runoff from fill area
Increased waste footprint but less area than Method 2	N6	Increased infiltration into waste	o	Potential decreased infiltration (increased runoff) - minor	N7	Potential for migration of leachate downward into sand/silt seam	o	Decreased runoff during filling Increased runoff from finished slopes	N8	Potential for contaminated runoff from fill area
New waste footprint in centre of property - farther from boundary	o		o		P	Creates large buffer between fill and property boundary	o		P	Creates large buffer between fill and property boundary
Eliminates long narrow depressions between footprint expansion and existing Phases created by Method 2	o		o		o		o		o	
5 metre excavation	o		N10	Could intersect saturated soil or sand/silt seam	N10	Could intersect saturated soil or sand/silt seam	o		o	
Displaces stormwater basins - requires relocation	o		o		N12	Potential for migration of stormwater downward into sand/silt seam	o		o	
Displaces watercourse - requires relocation	o		N13	Potential to change flow direction in shallow groundwater	N14	Potential for migration of leachate laterally into sand/silt seam (exposed on bank of watercourse)	N15	Will require alterations of surface water movement to reach new watercourse	P	Increase waste to watercourse distance
									N16	Decrease CKD to watercourse distance
Method 4 Development of a New Landfill Footprint (397,000 m3)										
Adds height to currently flat area			N13	Potential to change flow direction in shallow groundwater	N2	Potential for increased leachate elevation - increased head could drive leachate into sand/silt seam	o		N8	Potential for contaminated runoff from fill area
Adds slopes to currently flat area	o		o	Potential decreased infiltration (increased runoff) - minor	o		N17	Increased runoff from western side slopes into watercourse		
Increases waste footprint	N6	Increased infiltration into waste	o	Potential decreased infiltration (increased runoff) - minor	N7	Potential for migration of leachate downward into sand/silt seam	o	Decreased runoff during filling Increased runoff from finished slopes	N8	Potential for contaminated runoff from fill area
New waste footprint closer to eastern property boundary	o		o		N11	Shorter travel distance between bottom of waste and bedrock	o		o	
5 metre excavation	o		N10	Could intersect saturated soil or sand/silt seam	N10	Could intersect saturated soil or sand/silt seam	o		o	
Bottom of waste may be closer to bedrock surface	o		o		N11	Shorter travel distance between bottom of waste and bedrock	o		o	
Footprint does not encroach on stormwater basins	o		o		P	No alterations to stormwater basin with regard to sand/silt seam	P	No alterations to stormwater basin location	o	
Footprint does not encroach on watercourse but is close to top of bank	o		o		P	No alterations to water course with regard to sand/silt seam	N17	Increased runoff from western side slopes into watercourse	N8	Potential for contaminated runoff from fill area
Overlaps part of cement kiln dust stockpile	N18	CKD leachate unknown Combination unknown	N19	Potential to change current mounding in CKD stockpile and change shallow flow direction	o		o		o	

Table H1
Potential Impacts

Description of Site Alteration	Leachate Generation		Groundwater				Surface Water			
			Quantity		Quality		Quantity		Quality	
Method 5 Vertical Expansion of Existing plus Development of a New Landfill Footprint (Method 1 and Method 4) (974,000 m3)										
Added height to Phase I and Phase II/III during operation	N1	Increased leachate strength	o		N2	Potential for increased leachate elevation - increased head could drive leachate into sand/silt seam and into till	o		N3	Potential for contaminated runoff from footprint during filling
Added height to Phase I and Phase II/III when closed	P	Decreased generation - increased runoff on longer side slopes	o		N2	Potential for increased leachate elevation - increased head could drive leachate into sand/silt seam and into till	N4	Increased runoff from footprint - longer side slopes No change outside footprint	N5	Potential for leachate breakout on final side slope
Added height to currently flat area	o		N13	Potential to change flow direction in shallow groundwater	N2	Potential for increased leachate elevation - increased head could drive leachate into sand/silt seam	o		N8	Potential for contaminated runoff from fill area
Added slopes to currently flat area	o		o	Potential decreased infiltration (increased runoff) - minor	o		N17	Increased runoff from western side slopes into watercourse	o	
Increased waste footprint	N6	Increased infiltration into waste	o	Potential decreased infiltration (increased runoff) - minor	N7	Potential for migration of leachate downward into sand/silt seam	o	Decreased runoff during filling Increased runoff from finished slopes	N8	Potential for contaminated runoff from fill area
Filled between Phase I and Phase II/III - increases waste footprint	N6	Increased infiltration into waste	o	Potential decreased infiltration (increased runoff) - minor	N7	Potential for migration of leachate downward into sand/silt seam	o	Decreased runoff during filling Increased runoff from finished slopes	N8	Potential for contaminated runoff from fill area
New waste footprint closer to eastern property boundary	o		o		N11	Shorter travel distance between bottom of waste and bedrock	o		o	
5 metre excavation east of watercourse	o		N10	Could intersect saturated soil or sand/silt seam	N10	Could intersect saturated soil or sand/silt seam	o		o	
Bottom of waste may be closer to bedrock surface	o		o		N11	Shorter travel distance between bottom of waste and bedrock	o		o	
Footprint does not encroach on stormwater basins	o		o		P	No alterations to stormwater basin with regard to sand/silt seam	P	No alterations to stormwater basin location	o	
Footprint does not encroach on watercourse but is close to top of bank	o		o		P	No alterations to water course with regard to sand/silt seam	N17	Increased runoff from western side slopes into watercourse	N8	Potential for contaminated runoff from fill area
Overlaps part of cement kiln dust stockpile	N18	CKD leachate unknown Combination unknown	N19	Potential to change current mounding in CKD stockpile and change shallow flow direction	o		o		o	

Legend

o	No net impact or neutral when compared to the existing site
P	Positive Impact
N2	Negative impact - numbered in order in which they appear on table Follow number to mitigation tables

Table H2
Groundwater Mitigation Measures and Ranking

	Alternative Methods								
	1	2	3	4	5				
Impact No						Impact	Site Alteration Leading to Impact	Impacted Feature	Possible Mitigation
N1	◕				◕	Increased leachate strength	Added height to Phase I and Phase II/III	Leachate	• Monitor leachate quality and quantity in leachate collection system • Review capacity of sewage treatment plant
N2	○				○	Potential for increased leachate elevation - increased head could drive leachate into sand/silt seam	Added height to Phase I and Phase II/III	GW	• Monitor flow rate from leachate collection system • Leachate head control by enchanced or modified leachate collection system
		◑					Create long narrow depressions between footprint expansion and existing Phases	Leachate	• Design stormwater control between existing and expansion footprints for operation and closed stages to prevent ponding and infiltration into waste
				◔	◔		Added height to currently flat area	GW	• Map presence and remove sand/silt seams • Install a leachate collection system of similar design to current system
N6	◑		◑		◑	Increased infiltration into waste (increased leachate generation)	Filled between Phase I and Phase II/III - increased waste footprint	Leachate	• Design and operations to reduce work area & interim cover to promote clean runoff • Evaluate leachate generation potential against sewage treatment plant capacity
		◑	◑	◑	◑		Increased footprint area	Leachate	• Design and operations to reduce work area & interim cover to promote clean runoff • Evaluate leachate generation potential against sewage treatment plant capacity
N7	◔		◔		◔	Potential for migration of leachate downward into sand/silt seam	Filled between Phase I and Phase II/III - increased waste footprint	GW	• Map presence and remove sand/silt seams • Extend leachate collection system between Phase I and Phase II/III
		◔	◔	◔	◔		Increased footprint area	GW	• Map presence and remove sand/silt seams • Install a leachate collection system of similar design to current system
N9		◑				Could cause surface ponding and increased infiltration	Create long narrow depressions between footprint expansion and existing Phases	Leachate	• Design stormwater control between existing and expansion footprints for to prevent ponding and infiltration into waste
N10		○	○	○	○	Could intersect saturated soil or sand/silt seam	5 metre excavation	GW	• Map presence and remove sand/silt seam • Map depth to water table and maintain landfill base above water table • Liner designed to separate groundwater in the seam from the waste • Induce groundwater from sand/silt seam toward leachate collection system
N11		○		○	○	Reduced separation distance between bottom of waste and bedrock	Bottom of waste may be closer to bedrock surface	GW	• Confirm depth to bedrock and soil characteristic between waste and bedrock • Enhance leachate collection system (e.g. liner)
				○	○		New waste footprint closer to eastern property boundary	GW	• Confirm depth to bedrock and soil characteristic between waste and bedrock • Confirm groundwater flow direction in bedrock at northeast corner • Enhance leachate collection system (e.g. liner)
N12		◑	◑			Potential for migration of stormwater downward into sand/silt seam	Displaces stormwater basins - requires relocation	GW	• Determine presence and depth of sand/silt seam in new basin location • Remove seam or maintain separation distance from basin bottom to seam
N13		○	○			Potential to change flow direction in shallow groundwater	Displaces watercourse - requires relocation	GW	• Create conceptual model of new flow direction • Design leachate collection system to induce flow from CKD stockpile toward former watercouse location
				◔	◔		Added height to currently flat area	GW	• Create conceptual model of new flow direction • Install a leachate collection system of similar design to current system

Table H2
Groundwater Mitigation Measures and Ranking

	Alternative Methods							
	1	2	3	4	5			
Impact No						Impact	Site Alteration Leading to Impact	Impacted Feature	Possible Mitigation
N14		○	○			Potential for migration of leachate laterally into sand/silt seam (exposed on bank of watercourse)	Displaces watercourse - requires relocation	GW	• Map presence and remove sand/silt seams • Design leachate collection system to induce flow toward former watercouse location
N18				◕	◕	CKD leachate unknown Combination unknown	Overlaps part of cement kiln dust stockpile	Leachate	• Monitoring samples from wells in CKD
N19				◕	◕	Potential to change current mounding in CKD stockpile and change shallow flow direction	Overlaps part of cement kiln dust stockpile	GW	• Monitor water levels in wells in CKD

Negative Impacts for Each Method

	1	2	3	4	5
◕	1	-	-	2	3
◑	1	4	3	1	2
◔	1	1	2	3	4
○	1	4	3	3	4

Legend
Minor Impact - monitoring with potential mitigation (e.g. monitoring of groundwater around CKD stockpile)
Low Impact - feature alteration with monitoring (e.g. stormwater controls)
Medium Impact - enhanced engineering with monitoring (e.g. extension of current leachate control system)
Major Impact - major mitigation engineering required (e.g. liner, redesigned leachate control system)

Positive Impacts	2	1	1	2	3

Overall Impact Ranking

Least	▨				
⇩			▨	▨	
⇩		▨			
Most					▨

Table H3
Surface Water Mitigation Measures and Ranking

	Alternative Methods								
	1	2	3	4	5				
Impact No						Impact	Site Alteration Leading to Impact	Impacted Feature	Possible Mitigation
N3	◑				◑	Potential for contaminated runoff from footprint during filling	Added height to Phase I and Phase II/III	SW	• Storm water diversion and sedimentation control away from fill area • Leachate containment within footprint to LCS
N4	◑				◑	Increased runoff from footprint - longer side slopes	Added height to Phase I and Phase II/III	SW	• Design storm water and erosion control for side slopes and toe
N5	○				○	Potential for leachate breakout on final side slopes	Added height to Phase I and Phase II/III	SW	• Leachate head control by enhanced or modified leachate collection system
		◑					Create long narrow depressions between footprint expansion and existing Phases	SW	• Design stormwater control between existing and expansion footprints for closed stage to prevent ponding and infiltration into waste
N8	◑		◑		◑	Potential for contaminated runoff from fill area	Filled between Phase I and Phase II/III - increased waste footprint	SW	• Design and operations to reduce work area & interim cover to promote clean runoff
		◑	◑	◑	◑		Increased footprint area	SW	• Design and operations to reduce work area & interim cover to promote clean runoff
				◑	◑		Added height to currently flat area	SW	• Create soil berm along watercourse to contain water within waste area
				◑	◑		Footprint does not encroach on watercourse but is close to top of bank	SW	• Create soil berm along watercourse to contain water within waste area
N15		◑	◑			Will require alterations of surface water movement to reach new watercourse	Displaces watercourse - requires relocation	SW	• Grading, storm water and erosion control to redirect, slow or hold runoff
N16		◕	◕			Decrease CKD to watercourse distance	Displaces watercourse - requires relocation	SW	• Monitoring samples from wells in CKD and new watercourse
N17				◑	◑	Increased runoff from western side slopes into watercourse	Added slopes to currently flat area	SW	• Create vegetated water control buffer strip between landfill toe and watercourse
				◑	◑		Footprint does not encroach on watercourse but is close to top of bank	SW	• Create vegetated water control buffer strip between landfill toe and watercourse

Negative Impacts for Each Method

	1	2	3	4	5
◕	-	1	1	-	-
◑	3	3	3	5	8
◔	-	-	-	-	-
○	1	-	-	-	1

Legend
Minor Impact - monitoring with potential mitigation (e.g. monitoring of groundwater around CKD stockpile)
Low Impact - feature alteration with monitoring (e.g. stormwater controls)
Medium Impact - enhanced engineering with monitoring (e.g. extension of current leachate control system)
Major Impact - major mitigation engineering required (e.g. liner, redesigned leachate control system)

Positive Impacts	2	3	2	1	1

Overall Impact Ranking

Least
⇩
Most