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SUMMARY REPORT ON

GROUND INVESTIGATIONS AT WALSHESTOWN PIT CO. KILDARE

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EXECUTIVE SUMMARY

Cemex (ROI) Ltd (Cemex) has retained Golder Associates Ireland (Golder) to assess the possible risks posed to the groundwater and surface water environment by a proposed facility for disposal/recovery of inert materials at a worked-out sand and gravel site, at Walshestown, Co Kildare.

There are three large ponds on the Site, two along the western boundary (Ponds A1/A2 and A3) and one in the southern part of the Site (Pond B). The worked-out pit area has been restored to agricultural land-use (grazing) in the southern and eastern parts of the Site. The northern part of the Site is, for the most part exposed silts, with glacial till along part of the western boundary. The central area of the Site, almost as far south as Pond B, comprises made ground.

The field investigation comprised eight rotary boreholes, one shell & auger borehole, nine window sample probes and one line of geophysics. A programme of laboratory testing was undertaken, which included classification testing of materials encountered. A piezometer was installed in each of the eight rotary boreholes to collect information on groundwater both up-gradient and down-gradient of the proposed development.

From interpretation of the site investigation data a number of observations can be made about the on-Site sub-surface:

(a) Recorded soil thickness ranges from ca.15 m to ca.38 m, and is typically greater than ca.22 m;

(b) The mineral soils generally consisted of sandy gravelly silts (sometimes clays);

(c) A zone of ‘heavily weathered’ ‘bedrock’, ranging from between 2.5 m to 7.5 m thickness is interpreted to occur below the mineral soils; and

(d) Thinly bedded grey-green siltstones lie below the ‘heavily weathered’ zone.

Groundwater flow direction is interpreted, from water level monitoring and contouring, to be towards west- northwest.

1.0 INTRODUCTION

1.1 General

Cemex (ROI) Ltd (Cemex) has retained Golder Associates Ireland (Golder) to assess the possible risks posed to the groundwater and surface water environment by a proposed facility for disposal/recovery of inert materials at a worked-out sand and gravel site, at Walshestown, Co Kildare.

The Walshestown Pit is located at Irish National Grid co-ordinate 2932 2157; c. 5 km southeast of Naas, Co. Kildare (approximately halfway between Naas and Blessington), and c. 0.5 km due east of Punchestown racecourse.

The Site covers an area of c. 70 hectares. The southern and eastern parts of the Site have been restored to agricultural grazing land. The central and northern parts consist of bare made ground and a former silt lagoon area respectively (Figure GI/01) There are currently three large ponds on the Site, two along the western boundary (Ponds A1/A2 and A3) and one in the southern part of the Site (Pond B). The water level in the ponds fluctuates seasonally. The ground just south of Pond B is wet underfoot with scattered clumps of rushes, and remains damp throughout the year; in very wet weather the pond overflows at the southwestern corner.

Golder carried out ground investigations to provide information on the geology, hydrogeological and geotechnical properties of the mineral soils and rock underlying the Site, in order to assist with the design of the proposed facility. The field investigations comprised eight rotary boreholes, one shell & auger borehole, nine window samples and one line of geophysics. A short programme of laboratory testing was undertaken that included classification testing on silts.

Seven rotary boreholes were drilled on the expected upgradient and downgradient perimeters of the Site with respect to groundwater flow. One rotary borehole was drilled in a central location.

The silt-lagoon area in the north of the Site was investigated by means of nine window sample probes and one shell & auger borehole. Further information was obtained through one line of geophysics (2D resistivity), the results of which were correlated with the information obtained from the borehole and window samples.

2.0 SCOPE OF INVESTIGATIONS

The scope of the investigation was to investigate the ground and subsurface conditions by means of walk over surveys, rotary drilling, window sampling probes, shell & auger drilling and geophysics to record information on groundwater and surface water levels, and depths of strata encountered.

3.0 METHOD OF INVESTIGATION

3.1 General

All boreholes and window sample probes were drilled between 11 October and 14 December 2007 by two drilling contractors, Drilling 2000 and Glover Site Investigations Limited. All field investigation activities were supervised, on a full time basis, by technical staff from Golder.

Table 1 identifies which contractor drilled each hole and which investigation/drilling technique was used. The locations of the boreholes and probes are indicated on Figure GI/01. Borehole logs and window sample logs are presented in Attachment A of this report.

Table 1: Record of borehole contractors and drilling methods

Borehole Reference	Drilling Contractor	Drilling Method Used	
		Soils	Rock
BH1-07	Drilling 2000	Rotary Percussion, air flush	Rock Not Drilled
BH2-07	Drilling 2000	Rotary Percussion, air flush (water flush from 28.15 m)	Rotary Coring, water flush
BH3-07	Drilling 2000	Rotary Percussion, air flush	Rotary Percussion, air flush
BH4-07	Drilling 2000	Rotary Percussion, air flush (water flush from 17.65 m)	Rock Not Drilled
BH5-07	Drilling 2000	Rotary Percussion, air flush (water flush from 17.75 m)	Rotary Coring, water flush
BH6-07	Drilling 2000	Rotary Percussion, air flush	Rock Not Drilled
BH7-07	Glover Site Investigations Ltd	Rotary Percussion, air flush	Rotary Percussion, air flush
BH8-07	Glover Site Investigations Ltd	Rotary Percussion, air flush	Rock Not Drilled
SA1-07	Glover Site Investigations Ltd	Cable Percussion	Rock Not Drilled
WS1-07	Glover Site Investigations Ltd	Window Sampling Probe	Rock Not Drilled
WS2-07	Glover Site Investigations Ltd	Window Sampling Probe	Rock Not Drilled
WS3-07	Glover Site Investigations Ltd	Window Sampling Probe	Rock Not Drilled
WS4-07	Glover Site Investigations Ltd	Window Sampling Probe	Rock Not Drilled
WS5-07	Glover Site Investigations Ltd	Window Sampling Probe	Rock Not Drilled
WS6-07	Glover Site Investigations Ltd	Window Sampling Probe	Rock Not Drilled
WS7-07	Glover Site Investigations Ltd	Window Sampling Probe	Rock Not Drilled
WS8-07	Glover Site Investigations Ltd	Window Sampling Probe	Rock Not Drilled
WS9-07	Glover Site Investigations Ltd	Window Sampling Probe	Rock Not Drilled

3.2 Drilling in Soils

3.2.1 Rotary Percussion

During October, early November and early December 2007 Golder managed the drilling of rotary boreholes, followed by installation of standpipe piezometers for water monitoring. All locations were set out on site by Golder in advance of the investigation and the boreholes were drilled as close as practicable to the designated locations.

The initial strategy was to drill two boreholes at each designated location wherever practical, the first being drilled to water level in bedrock (observing unconsolidated strata encountered), and the second being drilled to the depth of water-bearing strata in the mineral soils, and then to install a piezometer in each borehole. This was in fact only practical at two locations, at the other locations either bedrock was encountered below dry mineral soils, or bedrock was not encountered, making it unnecessary to drill a second borehole at this location. In total eight rotary boreholes were drilled, BH1-07 to BH8-07, with BH1-07 and BH2-07 being a pair, and BH7-07 and BH8-07 being a pair (Figure GI/01).

All drilling operations on site were directed, and stratigraphy logged, by a qualified field technician from Golder staff, who also retrieved and labelled any recovered samples. Rotary percussion does not allow retrieval of undisturbed samples: the material which is being drilled through is forced by the flushing medium up the annulus between the drill string and the side of the hole. All material recovered is therefore highly disturbed. Table 1 identifies which boreholes were advanced through the soils using rotary percussive drilling, and using air or water as the flushing medium.

Groundwater conditions were observed and recorded in the open boreholes during drilling. Detailed borehole logs, including groundwater observations, are provided in Attachment A of this report, and a summary of findings is given in Section 4.0.

3.2.2 Window Sampling

On 27 November 2007 window sampling was carried out in the former silt lagoon area in an effort to estimate the thickness of the silts (Figure GI/01). The strategy was to penetrate the silts to refusal at fourteen locations. Of the fourteen planned probes only nine were completed due to unfavourable ground conditions and refusals at shallow depths.

Table 1 identifies which holes were probed using the window sampling technique; one bulk disturbed sample was taken from each probe location. All window sample probes were conducted using a Dando Terrier rig with coring attachment of approximately 100 mm nominal diameter. All sampling operations on site were directed, and stratigraphy logged, by a qualified field technician from Golder staff, who also retrieved and labelled the recovered samples. Of the proposed fourteen locations only nine probes were completed. The remaining five proposed probes were omitted because the ground proved too soft to sample

by this method, the samples not staying in the coring attachment as it was lifted. Detailed logs are provided in Attachment A.

3.2.3 Cable Percussion

Following on from the window sampling, during mid-December 2007 two shell & auger boreholes (cable percussion) were scheduled to extend through the silts to the natural ground below, in order to estimate the thickness of the silts in the former silt lagoon. In fact only one shell & auger borehole (SA1-07) was drilled, to refusal, due to the unfavourable surface conditions (Figure GI/01). The second proposed borehole was omitted as the proposed location proved too soft to support the weight of the cable percussion drilling rig during transportation, and it was not possible to find an alternative location which could support the rig.

Cable percussion boring and sampling were carried out in general accordance with BS 5930: 1999, casing of 200mm nominal diameter was used. Small disturbed samples and bulk samples were collected at regular intervals for inspection and laboratory testing. All drilling and sampling operations on site were directed, and stratigraphy logged, by a qualified field technician from Golder staff, who also retrieved and labelled the recovered samples.

Groundwater conditions were observed and recorded in the open borehole during drilling and sampling. A detailed borehole log, including groundwater observations, is provided in Attachment A.

3.3 Drilling in Rock

Table 1 identifies which of the rotary boreholes were advanced through to bedrock. Drilling 2000 started rotary coring at HQ size in the boreholes in which they used water flush, yielding a core diameter of 61.0 mm; where necessary (in order to drive the long drill-string) the hole size was reduced to NQ size, yielding a core diameter of 47.5 mm. Glover Site Investigations Ltd drilled their sole rock borehole using rotary percussion and air flush; this method was also used by Drilling2000 in BH3-07. No core was obtained from either of these boreholes

3.4 Geophysics (Resistivity)

To obtain further information on the depth and extent of the silts in the northern part of the Site, one 400 m line of 2D resistivity geophysics was conducted on 30 April 2008 (Figure GI/01).

3.5 Survey of Borehole Locations and Geophysics Lines

Following completion of the field investigation, a topographical survey was undertaken using differential GPS to obtain geographic co-ordinates (Irish National Grid) and ground level

elevations for the boreholes and the geophysics line. All elevations are relative to Ordnance Datum (Malin Head).

3.6 Laboratory Testing

All the recovered soil samples were transported to and stored at the Golder's INAB accredited laboratory, GeoTesting Ltd, in Naas, Co. Kildare for further examination and for selective classification testing. A programme of laboratory testing was carried out on a selection of these samples. The suite of soil testing carried out included basic classification testing on mineral soils i.e. particle size distribution analysis, determination of moisture content, and liquid and plastic limits (on one sample only). A number of permeability tests were also carried out using the triaxial cell method. All of the laboratory testing was carried out in accordance with the relevant sections of BS 1377: 1990. Results of laboratory testing are included in Attachment B.

3.7 Slug Testing

In order to assess permeability of the rock and mineral soils, on the 1st, 2nd, 12th and 13th May 2008 a Golder scientist undertook site visits to visually inspect the groundwater monitoring piezometers and carry out hydraulic conductivity evaluation using the slug test method. In total slug tests (both falling and rising head) were carried out on seven of the rotary-drilled boreholes/groundwater monitoring wells (BH1-07, BH3-07, BH4-07, BH5-07, BH6-07, BH7-07 and BH8-07).

Slug tests were carried out in accordance with the Golder Field Procedure *(CP 725 Well Response Testing 2008*, included in Attachment C). For each borehole a pressure transducer, 'diver', was first placed in the piezometer pipe, this was followed by inserting the slug to create a falling head test with change in water level being recorded by the 'diver'. After allowing sufficient time for equilibrium to be reached the slug was withdrawn, to create a rising head test, and the 'diver' left in the borehole overnight to record the rising water level.

The results of the slug tests were used to calculate hydraulic conductivities using the General and Simple methods (BS 5930:1981, Section 21.4.6.1) for calculating hydraulic conductivities in an unconfined aquifer under steady state flow conditions.

4.0 SUMMARY OF SUBSURFACE CONDITIONS

4.1 General

The following is a summary of the main subsurface soil and groundwater conditions encountered, based on the field testing and laboratory-testing performed as described in this report. The locations of all exploratory holes and the geophysics line are shown on Figure GI/01.

4.2 Soils

Rotary boreholes were drilled to a maximum depth of 52.8 m below ground level (mbgl). Table 2 gives a summary of depth of the rotary boreholes, thickness of soils encountered and depth to waterstrike. The maximum recorded thickness of soils was found to be ca. 38 m (BH2-07, BH4-07, BH5-07).

Table 2: Thickness of soils at Site & depth to waterstrike in rotary boreholes

Borehole Reference	Total Depth (m)	Ground Level Elev (mAOD)	Thickness of Soils (m)	Depth to Weathered Bedrock (m bgl)	Depth to Waterstrike (m bgl)
BH1-07	19.5	147.58	19.5+	-	12.4
BH2-07	46.0	147.54	37.5	37.5	16.2
BH3-07	35.85	157.54	15.1	15.1	29.9
BH4-07	38.0	169.12	38.0+	-	-
BH5-07	52.8	146.91	37.9	37.9	-
BH6-07	22.15	154.09	22.15+	-	17.0
BH7-07	37.0	155.07	31.5	31.5	29.0
BH8-07	22.0	154.90	22.0+	-	17.5

Notes: 1) All measurements were taken from ground level, not from stickup level

2) – indicates a measurement was not obtained (due to water flush being used)

The ground conditions encountered in the boreholes located around the perimeters of the site are summarised in Table 3. Mineral soils consist mainly of sandy gravelly silts (sometimes clayey). Recorded soil thickness ranges from ca.15 m to ca.38 m, and is typically greater than ca.22 m.

Approximately 12 m thickness of running sands were encountered in BH1-07 and BH2-07 starting at a depth of ca. 12.5 or 13 m below ground level. Similar running sands were encountered in BH5-07 (15.6 – 16.7 mbgl). One disturbed bulk sample of this material was collected during rotary percussion drilling (from BH1-07 at 19 m depth). The laboratory particle size distribution (PSD) classification test of this sample describes the material as a loose dark brown grey silty SAND (as described in accordance with BS5930).

Table 3: Summary of ground conditions encountered in rotary boreholes

Stratum	Description	Depth to top of Stratum (m)	Stratum Thickness (m)	Comments
Agricultural soils		0	ca. 2.6 – 4.1	Only present in southern part of Site, restored agricultural land, & BH5-07
Fluvioglacial deposits	Sands gravels & silts (varying composition)	2.6 – 3.0	ca. 6 – 31	BH3-07 (6 m) thickening to BH4-07, BH5-07 (ca. 15 m), and to BH2-07 (25 m) & BH7-07 (31 m)
	Includes: *1) CLAY horizon (thickness ca. 1.75 – 5.35 m)* **Note 1** *2) Running SAND (loose dark brown grey silty SAND) (thickness ca 1 – 12.15 m)* **Note 2**			
Till	Yellow-brown sandy gravelly CLAY (occasional limestone boulders)	10.15 – 28.1	ca. 5 – 21	BH3-07 (ca. 5 m), thickening to BH2-07 (9.3 m), and to BH4-07 & BH5-07 (ca. 20 m); highest elevation in BH3-07, deepest in BH2-07. Not present in BH8-07.
Weathered rock	weathered rock, occasional fracture with brown clay infill	15.1 – 37.9	ca. 2.5 – 7.5	Encountered only in BH2-07, BH3-07, BH5-07 & BH7-07; highest elevation in BH3-07; most weathered in BH3-07 & BH5-07.
Bedrock	Thinly bedded grey-green SILTSTONES	ca. 20 – 45.4	unknown	Encountered only in BH2-07, BH3-07, BH5-07 &, BH7-07; elevation rising to BH3-07

Notes: 1: Not present in BH3-07. BH2-07 (1.75 m), thickening to BH5-07 and BH4-07 (ca. 5 m), thinning again to BH7-07 (ca. 3 m).
2: Only present along western boundary: BH5-07, thickening to BH1-07/ BH2-07

The formation screened in each piezometer/borehole is indicated in Table 4. The estimated hydraulic conductivity of the mineral soils and bedrock units as calculated from slug tests in piezometers is also presented in that table. Calculated hydraulic conductivity values (often referred to as coefficient of permeability) in the mineral soils ranged from 1.0E-3 m/s to 5.6E-6 m/s.

The data presented suggest the drift material has a greater hydraulic conductivity than the bedrock. Published values of hydraulic conductivity for unconsolidated silty sand range from approximately 1E-3 m/s to 1E-7 m/s (Freeze and Cherry 1979, Table 2.2). Published values for sandstone and fractured rock range from 5E-4 m/s to 1E-10 m/s. The data derived for the Walshestown Site are considered to be fairly consistent with these ranges.

Table 4: Estimated hydraulic conductivity of mineral soils and bedrock in the field

Borehole Ref.	Screen Depth (mbgl)	Mineral soils/ Bedrock	Geological Strata Screened	Test & Interpretation Method	Hydraulic Conductivity Kv (m/s)
BH1-07	13.4 – 17.4	Mineral soils.	Fine running sands	General rising head method	1.8E-4 – 9.6E-4
BH3-07	32.6 – 35.6	Bedrock	Siltstone	General rising head method	3.8E-4
BH4-07	31.6 – 37.6	Mineral soils	Sandy very gravelly clay /gravel	General rising head method	7.6E-5
BH5-07	35.4 – 38.4	Mineral soils	Gravel & cobbles/weathered bedrock (siltstone)	General rising head method	1.3E-5 – 6.9E-7
BH6-07	19 – 22	Mineral soils	Sand & gravel / sandy, gravelly clay	Simple rising head method	1.0E-3
BH7-07	34 – 37	Bedrock	Siltstone	General rising head method	5.0E-5 – 8.7E-6
BH8-07	19 – 22	Mineral soils	Gravelly sand	Simple rising head method	5.6E-6

4.2.1 Silt Lagoon

A summary of the window sampling and shell & auger borehole investigation in the former silt lagoon is given in Table 5.

The results of the laboratory testing on the window samples, and shell & auger and rotary borehole samples, are summarised in Table 6 and Table 7 respectively. Laboratory certificates relating to particle size distribution (PSD), moisture contents, Atterberg Limits and hydraulic conductivity are included in Attachment B.

The maximum depth penetrated by window sampling was 4 m. Window samples from the former silt lagoon were found to be relatively consistent, the material being predominantly a silt with varying quantities of sand (Table 6). Laminations of sand were observed in the field, and no gravel was encountered in the samples analysed for particle size distribution (PSD), supporting evidence that the area where window sampling was carried out was historically used as a siltation lagoon. The sand fraction present is in the form of fine sand bordering the coarse-silt fraction. The laboratory classification tests and the visual examination of samples taken from the window sample probes suggests the material in the former silt lagoon is a compact greyish-brown sandy SILT, as described in accordance with BS5930.

The shell & auger borehole located on the former silt lagoon (SA1-07) was terminated at ca. 12 m depth. Sample no. 3 (taken at a depth of 1.5 – 2 m) had a fines fraction of 87%, and PSD analysis returned a high clay content with representation of all fractions (see Table 7). Samples 10 and 13, taken from below 8.6 m depth, had a coarse fraction of > 65%. Reporting

on the deeper samples, GeoTesting Ltd. states "These samples appear to be taken in natural/unprocessed ground in an area where a sand/gravel bar is located. The presence of defined profiles indicates that this area is natural/unprocessed ground. The soil matrix also contains varying degrees of gravel and clay indicating that this is natural ground."

Table 5: Summary of window sample probes, shell & auger borehole and bulk samples

Probe/Borehole Reference	Depth Penetrated (m bgl)	Bulk Sample ID & Location (m bgl)		Sample Description (BS5930)
WS1-07	3.9	1	1.0 – 2.0	Compact, greyish-brown very sandy SILT
WS2-07	4.0	1	1.0 – 2.0	Cohesive greyish-brown slightly sandy SILT/CLAY
WS3-07	2.0	1	1.0 – 2.0	Compact, greyish-brown sandy SILT
WS4-07	2.0	1	1.0 – 2.0	Compact, greyish-brown very silty clayey fine SAND
WS5-07	2.0	1	No sample	Sample slipped from rod when pulled
WS6-07	0.3	1	No sample	Sample slipped from rod when pulled
WS7-07	0.5	1	No sample	Sample slipped from rod when pulled
WS8-07	3.0	1	2.0 – 3.0	Compact, greyish-brown sandy SILT
WS9-07	0.2	1	No sample	Sample slipped from rod when pulled
SA1-07	12.0	2	1.0 – 1.5	Soft light brown slightly sandy SILT
		3	1.5 – 2.0	Soft brown slightly gravelly slightly sandy SILT
		4	2.5 – 3.0	Firm light brown slightly sandy slightly gravelly CLAY/SILT. Sands and gravels well graded.
		6	4.0 – 4.5	
		7	4.5 – 5.0	
		10	8.5 – 9.0	Soft brown gravelly sandy SILT
		11	9.0 – 9.5	
		13	10.4 – 10.5	
		14	10.5 – 10.7	
		17	11.5 – 12.0	

Table 6: Summary of results of laboratory tests on window samples

Probe	Sample ID	Depth (m)	% Gravel	% Sand	% Coarse	% Silt	% Clay	% Fines	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Perm. (Triaxial) Kv (m/s)	Sample Description (BS5930)	Comments
WS1-07	1	1.0 – 2.0	0	35	35	55	10	65	18	-	Not Plastic	-	1.03E-07	Compact, greyish-brown very sandy SILT	The material taken from the window samples is similar for all samples taken between 0.0 -4.0m. The material is predominantly a SILT matrix with varying amounts of sand. Sand Laminations were observed in the field. No gravels were encountered in these samples for PSD. The sand fraction present is fine, indicating that this portion of the sand fraction is from a washing process. The clay size fraction is >10% for all samples. The absence of gravel and the presence of thin laminations of sand indicate that the area where these samples were taken was likely to be where a siltation pond was located.
WS2-07	1	1.0 – 2.0	0	8	8	67	25	92	24	-	Not Plastic	-	4.00E-09	Cohesive greyish-brown slightly sandy SILT/CLAY	
WS3-07	1	1.0 – 2.0	0	37	37	49	14	63	-	-	Not Plastic	-	-	Compact, greyish-brown sandy SILT	
WS4-07	1	1.0 – 2.0	0	51	51	36	13	49	29	-	Not Plastic	-	6.07E-08	Compact, greyish-brown very silty clayey fine SAND	
WS8-07	1	2.0 – 3.0	0	14	14	60	26	86	-	-	-	-	-	Compact, greyish-brown sandy SILT	

Table 7: Summary of results of laboratory tests on shell & auger and rotary borehole samples

Borehole	Sample ID	Depth (m)	% Gravel	% Sand	% Coarse	% Silt	% Clay	% Fines	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Perm. (Triaxial) Kv (m/s)	Sample Description (BS5930)	Comments
SA1-07	3	1.5 – 2.0	6	7	13	42	45	87	39	35	18	17	7.99E-10	Soft brown slightly gravelly slightly sandy SILT/CLAY	
SA1-07	7	4.5 – 5.0								-		-	2.23E-07	Medium dense brown sandy SILT	These samples appear to be taken in natural/unprocessed ground in an area where a sand/gravel bar is located. The presence of defined profiles indicates that this area is natural/unprocessed ground. The soil matrix also contains varying degrees of gravel and clay indicating that this is natural ground. The structure and texture of the soil matrix varies also, indicating natural or unprocessed ground
SA1-07	10	8.6 – 9.0	33	33	66	24	10	34	14	-	Not Plastic	-	2.27E-07	Soft brown gravelly sandy SILT	
SA1-07	13	10.4 – 10.5	34	38	72	22	6	28	14	-	Not Plastic	-	-	Soft brown very silty very gravelly SAND	
SA1-07	17	11.5 – 12.0	22	30	52	38	10	48	13	-	Not Plastic	-	-	Soft brown gravelly sandy SILT	
BH1-07	1	ca. 19.0	0	97	97	3	0	3	-	-	-	-	-	Loose dark brown grey silty SAND	

One 400 m line of 2D resistivity geophysics was conducted on the former silt lagoon 30 April 2008. A conceptual cross-section, based on the results of the geophysics, is shown in Figure GI/02, and a summary of the ground conditions encountered is given in Table 8. It can be seen that the soft silts of the former lagoon range in thickness from ca 1.5 m to 8.0 m, and they overlie natural ground (fine, sandy silts) which extend up to 30 m in depth below the former lagoon area. In the location of the shell & auger borehole the 2D resistivity geophysics indicates that approximately 4 m of soft silts overlie fine sandy silts (natural ground), which is broadly-speaking in agreement with the sample descriptions. The geophysics line also passed close to window sample probe locations WS5-07 and WS7-07. The former encountered sand and gravel at 1.2 m depth before collapsing, the latter collapsed at 0.5 m depth.

Table 8: Summary of ground conditions encountered in former silt lagoon area

Stratum	Depth to top of Stratum (m)	Stratum Thickness (m)	Comments
Soft SILT	0	ca. 1.5 – 8	
Fine sandy SILT	ca. 1.5 – 8.0	ca. 10.5 – 30	
Till	ca. 1.5 – 15	ca 5 – 27	Thickness varies considerably
Bedrock elevation	ca. 33	unknown	

Atterberg Limits (liquid and plastic limits) were obtained for only one of the samples (sample 3 from the shell & auger borehole, SA1-07). Results indicated that this SILT/CLAY material falls in the CL sector of the Casagrande Classification system. Bulk samples from the window samples were described by Geotesting as not being plastic.

The co-efficient of permeability of remoulded bulk samples of silt was determined using the triaxial cell method. The results of these tests are presented in Table 6 and Table 7. Test results indicated hydraulic conductivity/permeability values ranging from 1.03 x 10^{-7} m/s to 7.99 x 10^{-10} m/s.

4.3 Bedrock

All of the boreholes drilled into the bedrock encountered thinly bedded grey-green siltstones, which are likely to belong to the Carrighill Formation as suggested by the GSI (GSI, 1994). A zone of ‘heavily weathered’ ‘bedrock’, ranging from between 2.5 m to 7.5 m thickness is interpreted to occur below the mineral soils.

In BH4-07 no water was struck while drilling to 17.65 mbgl (on 22 October 2007), only damp clays were encountered at approximately 16 mbgl. Waterlevel was measured at 18 mbgl in the borehole before drilling resumed on the morning of 23 October 2007.

BH5-07 was drilled to a depth of ca. 53 mbgl into strong bedrock. The borehole was backfilled from to 42.7 mbgl, prior to installing the piezometer, and sealed with bentonite

grout from 42.7 mbgl to 38.7 mbgl. The installation monitors peizometric water level in the weathered rock with a screened section between 35.4 mbgl-38.4 mbgl.

The bedrock is a fine-grained rock which is likely to have a negligible inter-granular (or matrix) permeability. However, it appears to have fine joints and fractures through which water may be able to flow, increasing the permeability of the unit as a whole to some small extent. Calculated hydraulic conductivity values in the bedrock ranged from 3.8E-4 m/s to 8.7E-6 m/s. A published range for fractured igneous and metamorphic bedrock varies between approximately 8E-9 m/s to 2E-4 m/s respectively (Freeze and Cherry 1979). The data derived for Walshestown are considered to be fairly consistent with this range.

4.4 Groundwater

Table 2 summarises the groundwater strike levels encountered in the boreholes during drilling. Table 9 shows the groundwater levels recorded in the borehole installations, and in Ponds A1/A2, A3 and B, for the period since drilling up to and including 31 August 2008.

4.4.1 Bedrock

Confirmed groundwater elevations in the bedrock on Site are available for BH2-07, BH3-07, and BH7-07 (BH5-07 is installed across the soil/weathered rock horizon). Elevations in BH3-07 towards the south of the site suggest the bedrock is not fully saturated and it therefore forms a concealed aquifer beneath the overlying soils (which are 15.1 m thick). Groundwater elevations in BH2-07 towards the west of the Site and BH7-07 toward the northeast indicate that the bedrock is perennially saturated at these locations and that hydraulic heads are elevated within the overlying soils. Hydraulic head elevations in the bedrock vary across the Site from approximately 132 mAOD at BH2-07 to about 145 mAOD at BH7-07, with ranges in individual holes being less than 5 m.

A groundwater contour plot has been generated from the three piezometers that are installed in the bedrock only, for water levels monitored on 15 February 2008 (Figure GI/03). This plot indicates that drainage in the bedrock beneath the site footprint is towards the west northwest, and down a gradient of approximately 0.016. The flow direction, towards west-northwest, is in agreement with the topography across the site. Groundwater elevations recorded in BH5-07, which is installed across the bedrock/soil interface, are considered to be not inconsistent with the water table contour plot for the bedrock.

4.4.2 Soils

Confirmed groundwater elevations in the soils are available for BH1-07, BH4-07, BH6-07, and BH8-07. These provide for a variation of between ca. 137 mAOD towards the west of the site (BH1-07) to ca. 151 mAOD to the northeast (BH4-07).

Table 9: Monitored groundwater levels (m AOD)

Borehole Reference	Screen Formation	Top of casing reference level (mAOD)	01/11/07	29/11/07	20/12/07	14/01/08	15/02/08	27/03/08	09/04/08	13/05/08	23/06/08	28/07/08	31/08/08
BH1-07	Soils	148.276	136.84	136.89	-	137.53	137.97	137.76	137.86	137.62	137.21	137.03	137.54
BH2-07	Bedrock	148.080	132.68	132.54	-	133.14	133.93	133.72	133.72	133.32	132.89	132.43	132.90
BH3-07	Bedrock	158.121	134.40	134.12	-	135.72	138.40	136.70	136.66	135.84	134.52	133.69	134.73
BH4-07	Soils	169.705	150.82	150.86	-	151.78	151.94	151.45	-	151.09	150.67	150.47	151.45
BH5-07	Soils	147.515	133.31	133.30	-	133.88	134.55	134.29	134.29	133.76	133.49	132.90	133.55
BH6-07	Soils	154.900	138.26	138.12	-	138.75	139.45	139.20	139.14	138.86	138.32	137.97	138.46
BH7-07	Bedrock	155.710	-	-	144.09	144.30	144.82	144.13	143.98	143.94	143.65	143.49	144.26
BH8-07	Soils	155.500	-	-	144.09	144.32	144.83	144.17	144.03	143.97	143.69	143.53	144.28
Pond A1/A2	n/a	139.409	-	137.49	-	-	138.48	138.25	-	137.97	137.64	137.37	137.70
Pond A3	n/a	-	-	137.89	-	-	138.95	-	-	-	-	-	-
Pond B	n/a	142.89	-	141.80	-	-	142.64	-	-	142.22	141.92	141.80	142.24

Notes: - indicates a measurement was not obtained

A water strike was not reported in the soils during the drilling of BH3-07 towards the south of the site. This, together with the fact that the bedrock at this location is not fully saturated, suggests that the overlying soils are dry at this location and do not support a water table.

Neighbouring boreholes BH1-07 and BH2-07, installed in the soils and bedrock respectively, indicate significantly different groundwater elevation, with piezometric level in bedrock being consistently lower in bedrock by ca 4 to 5 m. These data suggest that the groundwater in the soils at BH1-07 is perched above a significant till layer recorded at the base of the fluvioglacial deposits in the log of the neighbouring borehole, BH2-07 (see Attachment A).

A similar pair of installations is provided by BH7-07 (bedrock) and BH08-07 (soils) towards the north-eastern end of the site. However, at this location the boreholes in both the bedrock and soils report very similar hydraulic heads (always less than 5 cm difference between the boreholes even though the hydraulic head elevation has ranged by ca. 1.3 m since monitoring began). The data suggests that at this location there is a strong degree of hydraulic continuity between the soils and bedrock, probably due to the absence of any basal till unit below the fluvioglacial deposits. Values in the order of 144 mAOD are representative of groundwater elevation in this location.

Pond B in the southern half of the site is considered likely to be perched above any groundwater table in the bedrock, since it is to the northwest and technically down-gradient of BH3-07 (installed in the bedrock), yet its elevation is greater than water elevations recorded at BH3-07. It is considered possible that Pond B is perched above clay units observed in the top half of the logs from BH1-07 and BH2-07, or it may represent a ‘silted up’ depression allowing for some surface water collection in the floor of the former quarry. Either way, it is concluded that a conventional groundwater table does not exist in the soils across the southern half of the site, and development of any such water table would occur only locally.

The northern part of the site contains two ponds, A1/A2 and A3, which are at an elevation of about 3 – 4 m above the groundwater elevation reported for BH5-07 (located about 120 m to the south-southeast of these ponds), and about 3 – 4 m below groundwater elevations reported for Pond B towards the south of the site. It has been suggested above that in the vicinity of BH7-07/BH8-07 a single groundwater elevation (in the order of 144 mAOD) is representative of both the soils and bedrock. Given that groundwater in the bedrock drains to the west (or slightly north of west), it is plausible and indeed expected that the Ponds at A1/A2 and A3 are an expression on the surface of this groundwater table.

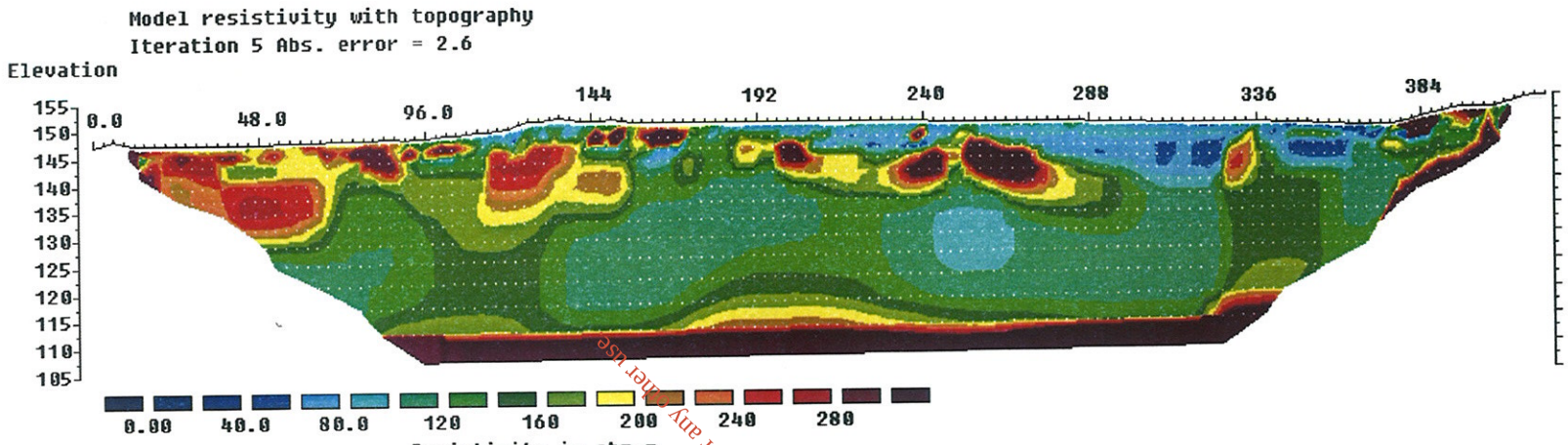
In summary, the groundwater table across the site is expected to drain to the west-northwest. Towards the south the soils are unsaturated, and towards the north and west of the site where the soils are thicker and the bedrock surface elevation drops, the groundwater table lies within the soils. Ponds to the northwest of the site (A1/A2 and A3) are expected to be a surface expression of this groundwater table, whereas the pond towards the south of the site (Pond B) is considered more likely to be perched on a clay horizon within the glacial deposits and not part of any main water table. In other areas where clays occur within the glacial deposits localised water tables may also be present.

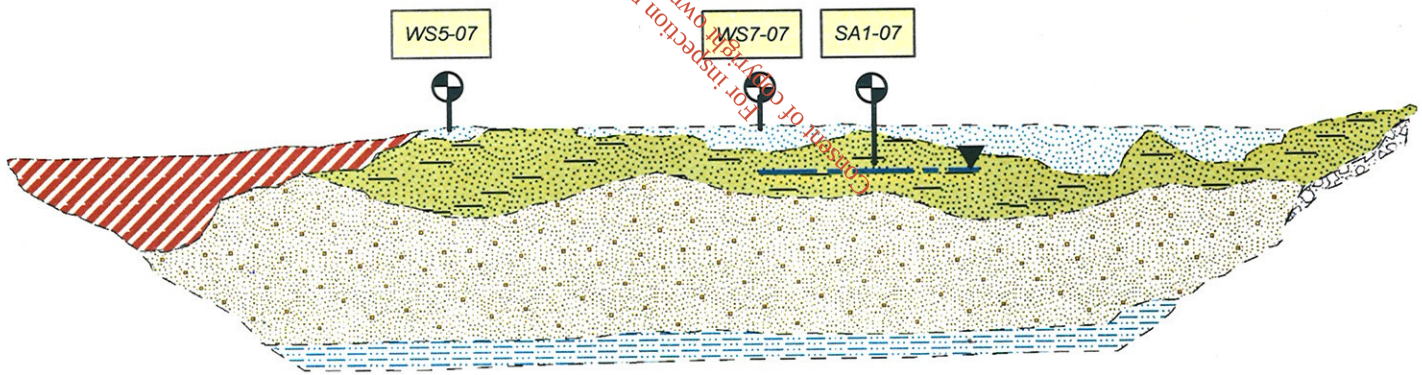
5.0 REFERENCES

Freeze R.A. & Cherry J.A. (1979). Groundwater. Prentice Hall.

GSI (1994). Geology of Kildare-Wicklow: A Geological Description, with accompanying Bedrock Geology 1:100,000 Scale Map, Sheet 16, Kildare-Wicklow. GSI Publications.

Resistivity Line R1





Inferred Material Types

- Borehole
- Inferred Water Table
- Boulder Clay
- Made Ground
- Till/Boulder Clay
- Fine Sandy Silt (native ground)
- Possible Bedrock (Siltstones)
- Soft Silt (from aggregate processing)

Golder Associates
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Client: CEMEX (ROI) Ltd.	Project number: 07507150231	Created by: JH	Issue to: Client	Date: Dec '08	Revision: A	Title: 2D Resistivity Conceptual Cross Section
Location: Walshestown, Co. Kildare	File Location: GIS\WALSHESTOWN\GI 02	Checked by: PK				Figure No. GI 02
Project: GROUND INVESTIGATION	ORDNANCE SURVEY OF IRELAND LICENCE NUMBER AR0056008	Approved by: BB				Scale: As Shown

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 1-07

SHEET 1 OF 1

LOCATION: Western boundary (see Fig. GI/01)

BORING DATE: 11-12 Oct 2007

DATUM: Malin Head
EASTING: 292609
NORTHING: 215283

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE									lockable cover (100 mm diameter)
0	Symmetrix (rotary percussion) 6" casing, Air flush	Firm, medium-brown, sandy, gravelly, CLAY		0.00							cement cap
2				144.98			146				
2		Loose, gravelly SAND		2.60							
4							144				
6				140.88			142				50 mm plain riser backfilled with local sand
6		Boulder		140.53							
6		Loose, gravelly SAND		7.05							
8				139.58			140				
8		Loose, dark-grey, silty, very gravelly, SAND		8.00							
8				138.93							
8		Loose, brown SAND		8.65			138				
10				137.43							before installation 12/10/07
10		Loose, silty, very gravelly, SAND		10.15							01/11/07
12				135.13			136				bentonite seal
12		Loose, brown-grey, fine SAND (running)		12.45							silica sand
12											water strike 11/10/07
14							134				natural sands caved in
16							132				50 mm slotted screen with geosock, natural sands caved in around screen
16											piezometer silted-up to 15.4 m during installation
18							130				hole caved in
18					1	B				PSD	EOH
18				128.08							
20		EOH		19.50							

DEPTH SCALE
1 : 100

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LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 2-07

SHEET 1 OF 3

LOCATION: Western boundary (see Fig. GI/01)

BORING DATE: 12-17 Oct 2007

DATUM: Malin Head
EASTING: 292611
NORTHING: 215299

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE									lockable cover (100 mm diameter)
0	Symmetrix (rotary percussion) 6" casing, Air flush	Firm, medium-brown, sandy, gravelly, CLAY		0.00			146				cement cap
2				145.04							bentonite seal
2		Loose, gravelly, SAND, with occasional cobble		2.50			144				
4											
6							142				
8				139.04							
8		Loose, brown, SAND		8.50			140				
10				136.14			138				50 mm plain riser backfilled with local sand
10		Brown, sandy, gravelly CLAY		11.40							
12				134.39			136				
12		Loose, brown-grey, fine SAND (running)		13.15							
14							134				before installation 17/10/07
14											01/11/07
16							132				water strike 15/10/07
18							130				
20							128				
20		--- CONTINUED NEXT PAGE ---									

DEPTH SCALE
1 : 100

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CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 2-07

SHEET 2 OF 3

LOCATION: Western boundary (see Fig. GI/01)

BORING DATE: 12-17 Oct 2007

DATUM: Malin Head
EASTING: 292611
NORTHING: 215299

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (25 50 75 100); nat V. +, rem V. ⊕, Q - ●, U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Symmetrix (rotary percussion) 6" casing, Air flush	Loose, brown-grey, fine SAND (running)					126				
22											
24				122.24			124				
26		Brown, sandy, clayey, GRAVEL		25.30			122				
28				119.39			120				
30	Rotary percussion HQ casing, Water flush	Yellow-brown, sandy, gravelly, CLAY with limestone boulders (casing held tightly)		28.15			118				50 mm plain riser backfilled with local sand
32							116				
34							114				
36							112				
38		Grey-green SILTSTONE (3.5m weathered zone)		110.04 37.50			110				
40		*--- CONTINUED NEXT PAGE ---*					108				bentonite seal

DEPTH SCALE
1 : 100

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CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 2-07

SHEET 3 OF 3

LOCATION: Western boundary (see Fig. GI/01)

BORING DATE: 12-17 Oct 2007

DATUM: Malin Head
EASTING: 292611
NORTHING: 215299

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---									
40	Rotary percussion HQ casing / Water flush	Grey-green SILTSTONE (3.5m weathered zone)					106				silica sand
42							104				
44											50 mm slotted screen with geosock, backfilled with silica sand & caved-in natural sands
46		EOH		101.54 46.00			102				EOH
48											
50											
52											
54											
56											
58											
60											

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

DEPTH SCALE
1 : 100

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LOGGED: PK
CHECKED: BB

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 3-07

SHEET 1 OF 2

LOCATION: Eastern boundary (see Fig. GI/01)

BORING DATE: 18-19 Oct 2007

DATUM: Malin Head
EASTING: 292791
NORTHING: 214827

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (25 50 75 100); nat V. + Q - ●; rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE									lockable cover (100 mm diameter)
0	Rotary percussion Air flush cased	Firm, medium-brown, sandy, gravelly, CLAY		0.00			156				cement cap
2											
4				153.39			154				
		GRAVEL, with some cobbles/boulders		4.15							
				151.89			152				
6		Gravelly SAND, with minor clay		5.65							
				150.39							
		Light-brown, fine SAND, with occasional gravel		7.15			150				
8				148.89							
		Brown, clayey, coarse SAND		8.65			148				
10				147.39							50 mm plain riser backfilled with local sand
		Yellow-brown, sandy, gravelly, CLAY		10.15							
				146.84			146				
		Light-brown, fine, SAND and GRAVEL, some clay (casing very tight)		10.70							
12											
14				142.44			144				
		Grey SILTSTONE (5m slightly weathered zone: very occasional fracture with brown clay infill)		15.10							
16							142				
18							140				
20		--- CONTINUED NEXT PAGE ---					138				

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 3-07

SHEET 2 OF 2

LOCATION: Eastern boundary (see Fig. GI/01)

BORING DATE: 18-19 Oct 2007

DATUM: Malin Head
EASTING: 292791
NORTHING: 214827

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
20		--- *CONTINUED FROM PREVIOUS PAGE* ---									
20	Rotary percussion Air flush cased	Grey SILTSTONE (5m slightly weathered zone: very occasional fracture with brown clay infill)					136				*01/11/07* ▽ 50 mm plain riser backfilled with local sand
22											
24							134				
26							132				
28							130				
30							128				*water strike 18/10/07* ▽ bentonite seal
32							126				silica sand
34							124				50 mm slotted screen with geosock, backfilled with silica sand
36		EOH		121.69 35.85			122				EOH
38											
40											

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 4-07

SHEET 1 OF 2

LOCATION: Eastern boundary (see Fig. GI/01)

BORING DATE: 19-23 Oct 2007

DATUM: Malin Head
EASTING: 293196
NORTHING: 215360

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (25 50 75 100); nat V. + Q - ●; rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE									lockable cover (100 mm diameter)
0	Symmetrix (rotary percussion) 6" casing, Air flush	Firm, medium-brown, sandy, gravelly, CLAY		0.00			168				cement cap
2				166.62							
		Loose, grey-brown, GRAVEL, some sand		2.50			166				
4											
							164				
6											
							162				50 mm plain riser backfilled with local sand
8											
							160				
10											
							158				
12				156.82							
		Damp, sandy CLAY (no boulders)		12.30			156				
14											
							154				bentonite seal
16											
							152				
				151.47							
18	Rotary percussion HQ casing, Water flush	Cohesive sandy, very gravelly CLAY		17.65							level in am before drilling 23/10/07; 01/11/07
							150				
20		--- CONTINUED NEXT PAGE ---									50 mm plain riser, backfilled with local sand

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 4-07

SHEET 2 OF 2

LOCATION: Eastern boundary (see Fig. GI/01)

BORING DATE: 19-23 Oct 2007

DATUM: Malin Head
EASTING: 293196
NORTHING: 215360

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Rotary percussion HQ casing Water flush	Cohesive sandy, very gravelly CLAY					148				50 mm plain riser, backfilled with local sand
22							146				
24							144				
26							142				
28							140				
30							138				
32							136				50 mm slotted screen with geosock, backfilled with local sand
34							134				
36				132.92			132				
		Limestone gravel/boulders		36.20							
38				131.12							hole caved in
		EOH		38.00							EOH
40											

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 5-07

SHEET 1 OF 3

LOCATION: Western boundary (see Fig. GI/01)

BORING DATE: 25-31 Oct 2007

DATUM: Malin Head
EASTING: 292659
NORTHING: 215654

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE									lockable cover (100 mm diameter)
		CLAY (topsoil?)		0.00							cement cap
							146				bentonite seal
2											
							144				
4				142.76							
		Slightly damp CLAY		4.15							
							142				
6											
							140				
8	Symmetrix (rotary percussion) 6" casing / Air flush			138.21							*before installation 30/10/07*
		Clayey, sandy, GRAVEL		8.70			138				
10											50 mm plain riser backfilled with local sand
							136				
12											
							134				*01/11/07*
14											
				131.31			132				
		Loose, brown-grey, fine SAND (running)		15.60							
16				130.21							
		Yellow-brown, clayey, sandy, GRAVEL (very slow progress: 3m/hr)		16.70			130				
18	Rotary percussion HQ casing / Water flush										
							128				
20		*--- CONTINUED NEXT PAGE ---*									

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 5-07

SHEET 2 OF 3

LOCATION: Western boundary (see Fig. GI/01)

BORING DATE: 25-31 Oct 2007

DATUM: Malin Head
EASTING: 292659
NORTHING: 215654

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	Rotary percussion HQ casing Water flush	Yellow-brown, clayey, sandy, GRAVEL (very slow progress: 3m/hr)					126				
22							124				
24							122				
26							120				50 mm plain riser backfilled with local sand
28							118				
30							116				
32							114				
34							112				
36							110				50 mm slotted screen with geosock, backfilled with local washed sand & fine gravel
38		Limestone boulder/cobbles Grey-green SILTSTONE (ca. 7.5m heavily weathered zone)		109.91 37.00 109.01 37.90			108				bentonite seal
40		*--- CONTINUED NEXT PAGE ---*									

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 5-07

SHEET 3 OF 3

LOCATION: Western boundary (see Fig. GI/01)

BORING DATE: 25-31 Oct 2007

DATUM: Malin Head
EASTING: 292659
NORTHING: 215654

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- *CONTINUED FROM PREVIOUS PAGE* ---									
40	Rotary percussion HQ casing Water flush	Grey-green SILTSTONE (ca. 7.5m heavily weathered zone)					106				bentonite seal
42							104				
44							102				
46							100				hole infilled with local sand
48							98				
50							96				
52				94.11							EOH
		EOH		52.80							
54											
56											
58											
60											

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 6-07

SHEET 1 OF 2

LOCATION: Central, beside access track (see Fig. GI/01)

BORING DATE: 31 Oct - 1 Nov 2007

DATUM: Malin Head
EASTING: 292904
NORTHING: 215579

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE					154				lockable cover (100 mm diameter)
		GRAVEL (likely Made Ground)		0.00							cement cap
				151.89							bentonite seal
2		Slightly sandy CLAY		2.20			152				
				149.69							
4		GRAVEL		4.40			150				
				149.09							
		SAND, occasional gravel lenses		5.00							
6							148				
8							146				50 mm plain riser, backfilled with local sand
10	Symmetrix (rotary percussion) 6" casing Air flush						144				
12							142				
14							140				
16							138				bentonite seal 1/11/07 water strike 31/10/07
18							136				50 mm plain riser, backfilled with local sand
20		--- CONTINUED NEXT PAGE ---									

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 6-07

SHEET 2 OF 2

LOCATION: Central, beside access track (see Fig. GI/01)

BORING DATE: 31 Oct - 1 Nov 2007

DATUM: Malin Head
EASTING: 292904
NORTHING: 215579

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
20		*--- CONTINUED FROM PREVIOUS PAGE ---*					134				
	Air flush	SAND, occasional gravel lenses		133.69							
		Sandy, gravelly, CLAY		20.40							50 mm slotted screen with geosock, backfilled with local sand
22				131.94			132				
		EOH		22.15							EOH
24											
26											
28											
30											
32											
34											
36											
38											
40											

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 7-07

SHEET 1 OF 2

LOCATION: Just inside entrance (see Fig. GI/01)

BORING DATE: 11-12 Dec 2007

DATUM: Malin Head
EASTING: 293319
NORTHING: 215790

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE									lockable cover (150 mm diameter)
		Made Ground (gravel)									
		Loose, brown SAND and GRAVEL		0.20			154				bentonite seal
2							152				
4							150				
6							148				
				147.27							
8	Symmetrix (rotary percussion) 6" casing / Air flush	Grey-brown, gravelly CLAY		7.80			146				
10				144.67							water strike 11/12/07
		Loose, grey-brown SAND and GRAVEL		10.40			144				50 mm plain riser, backfilled with local sand
12											
				142.47			142				
		Grey-black CLAY/SILT		12.60							
14				140.97							
		Compact, light-brown, gravelly, fine SAND		14.10			140				
16											
							138				
18											
							136				
20		--- CONTINUED NEXT PAGE ---									

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 7-07

SHEET 2 OF 2

LOCATION: Just inside entrance (see Fig. GI/01)

BORING DATE: 11-12 Dec 2007

DATUM: Malin Head
EASTING: 293319
NORTHING: 215790

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
20		*--- CONTINUED FROM PREVIOUS PAGE ---*									
20	Symmetrix (rotary percussion) 6" casing, Air flush	Compact, light-brown, gravelly, fine SAND					134				water strike 12/12/07
22											
24							132				
26							130				50 mm plain riser, backfilled with local sand
28							128				
30							126				water strike 12/12/07
32				123.57			124				bentonite seal
34		SILTSTONE (2.5m weathered zone: clay infill)		31.50			122				
36							120				50 mm slotted screen with geosock, backfilled with local sand
38				118.07							EOH
40		EOH		37.00							

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 8-07

SHEET 1 OF 2

LOCATION: Just inside entrance (see Fig. GI/01)

BORING DATE: 13-14 Dec 2007

DATUM: Malin Head
EASTING: 293315
NORTHING: 215797

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE									lockable cover (150 mm diameter)
0		Made Ground (gravel)									
		Brown, gravelly CLAY		0.20			154				bentonite seal
				153.00							
2		SAND and GRAVEL		1.90			152				
4							150				
6							148				
8							146				
10	Symmetrix (rotary percussion) 6" casing / Air flush			144.30							water strike 13/12/07
		Grey-black CLAY/SILT, with some gravel		10.60			144				
				143.50							50 mm plain riser, backfilled with local sand
12		Stiff, grey, sandy, gravelly CLAY		11.40			142				
14				140.80							
		Compact, light-brown, gravelly SAND (more gravelly below 20 m)		14.10			140				
16							138				water strike 14/12/07
18											
20		--- CONTINUED NEXT PAGE ---					136				

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: 07507150230 Walshestown

RECORD OF MONITORING WELL BH 8-07

SHEET 2 OF 2

LOCATION: Just inside entrance (see Fig. GI/01)

BORING DATE: 13-14 Dec 2007

DATUM: Malin Head
EASTING: 293315
NORTHING: 215797

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
20		--- *CONTINUED FROM PREVIOUS PAGE* ---									
	Air flush	Compact, light-brown, gravelly SAND (more gravelly below 20 m)					134				50 mm slotted screen with geosock, backfilled with local sand
22		EOH		132.90 22.00							EOH
24											
26											
28											
30											
32											
34											
36											
38											
40											

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: PK
CHECKED: BB

GOLDER-IRELAND WALSHESTOWN MONITORING WELLS 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: PK

PROJECT: Walshestown 07507150296

RECORD OF AUGER HOLE SA1-07

SHEET 1 OF 2

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 13/12/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE									
0	Light Cable Precussion Shell & Auger	Soft light brown slightly sandy SILT.		0.00	1	SDS					
1					2	B					
		Firm light brown slighty sandy CLAY.		1.50	3	B					
2		Firm light brown slightly sandy slighty fine gravelly CLAY. Sand is well graded.		2.00							
		Firm light brown slightly sandy slighty gravelly CLAY/SILT. Sands and gravels are well graded.		2.60	4	B					
3					5	SDS					
4					6	B					
					7	B					Hole backfilled with cuttings and original ground
5											
6											
7					8	B					
		Firm light brown to grey slightly sandy gravelly SILT. Gravel is medium and coarse in size.		7.30							
8		Firm light brown to grey slightly sandy gravelly CLAY/SILT with occasional cobbles. Gravel is medium and coarse in size.		8.00	9	SDS					
					10	B					
9					11	B					
					12	SDS					
		Firm light brown to grey slightly sandy gravelly SILT with frequent cobbles. Gravel is medium and coarse in size. Rare large cobbles.		9.50							
10		--- CONTINUED NEXT PAGE ---									

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT:

PROJECT: Walshestown 07507150296

RECORD OF AUGER HOLE SA1-07

SHEET 2 OF 2

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 13/12/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Light Cable Percussion Shell & Auger	Firm light brown to grey slightly sandy gravelly SILT with frequent cobbles. Gravel is medium and coarse in size. Rare large cobbles.			13	B					
					14	B					
					15	SDS					
11					16	SDS					Hole backfilled with cuttings and original ground
					17	SDS					
12				12.00							EOH
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT:

PROJECT: Walshestown 07507150296

RECORD OF WINDOW SAMPLE WS1-07

SHEET 1 OF 1

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 27/11/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (25 50 75 100); nat V. + Q - ●; rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE									
0	Tertier Rig Window Sampler	Greyish brown fine SAND.		0.00							
		Compact greyish brown SILT.		0.50							
1		Greyish brown very fine SAND.		1.00							
		Compact, greyish-brown, very sandy SILT (sand slightly cemented from 2.7-3.0 m).		1.20	1	B					
2											
3		Greyish-brown, fine SAND.		3.15							
4		EOH. (Dense sands, too compact to probe).		3.90							
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT:

PROJECT: Walshestown 07507150296

RECORD OF WINDOW SAMPLE WS2-07

SHEET 1 OF 1

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 27/11/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (25 50 75 100); nat V. + Q - ●; rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE									
0	Terrier Rig Window Sampler	Compact greyish brown, sandy SILT. Laminations clearly visible.		0.00							
1		Cohesive greyish brown, slightly sandy SILT/CLAY. Laminations clearly visible.		1.00	1	B					
2		Greyish brown silty SAND.		2.00							
		Greyish brown SILT/CLAY		2.30							
		Greyish brown fine SAND.		2.70							
3		Very wet, greyish brown SILT.		3.15							
		Greyish brown fine sandy SILT.		3.70							
4		EOH. Hole collapsing.		4.00							
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT:

PROJECT: Walshestown 07507150296

RECORD OF WINDOW SAMPLE WS3-07

SHEET 1 OF 1

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 27/11/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE									
0	Terrier Rig Window Sampler	Greyish brown, very fine sandy SILT. Laminations visible.		0.00							
1		Very wet, greyish brown SILT. Compacted greyish brown sandy SILT. Some sand & black-grey clay lenses visible.		1.00							
2		EOH. Hole collapsing.		2.00							
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT:

PROJECT: Walshestown 07507150296

RECORD OF WINDOW SAMPLE WS4-07

SHEET 1 OF 1

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 27/11/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE									
0	Terrier Rig / Window Sampler	Greyish brown SILT with some fine sand. Laminations clearly visible.		0.00							
		Very wet, greyish brown SILT/CLAY.		0.80							
1		Very wet greyish brown very silty, clayey fine SAND.		1.00	1	B					
2		EOH. Hole collapsing.		2.00							
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT:

PROJECT: Walshestown 07507150296

RECORD OF WINDOW SAMPLE WS5-07

SHEET 1 OF 1

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 27/11/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE									
0	Terrier Rig Window Sampler	Greyish brown, fine sandy SILT.		0.00							
		Very wet greyish brown SILT/CLAY.		0.20							
		Compact, greyish brown gravelly (<10%) SILT.		0.70							
1		Very wet, greyish brown SILT.		1.00							
		Grey, fine to coarse SAND and GRAVEL.		1.20							
		Greyish brown fine sandy SILT.		1.80							
2		EOH. Hole collapsing.		2.00							
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT:

PROJECT: Walshestown 07507150296

RECORD OF WINDOW SAMPLE WS6-07

SHEET 1 OF 1

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 27/11/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE									
0	Terrier Rig Window Sampler	Greyish brown sandy SILT.	× × ×	0.00							
		EOH. Hole collapsing.		0.30							
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT:

PROJECT: Walshestown 07507150296

RECORD OF WINDOW SAMPLE WS7-07

SHEET 1 OF 1

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 27/11/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (25 50 75 100)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE									
0	Terrier Rig Window Sampler	Very wet, greyish brown silty fine SAND. Laminations visible.	× . . ×	0.00							
1		EOH. Hole collapsing.		0.50							
2											
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT:

PROJECT: Walshestown 07507150296

RECORD OF WINDOW SAMPLE WS8-07

SHEET 1 OF 1

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 27/11/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE									
0	Terrier Rig / Window Sampler	Very wet, greyish brown, very fine sandy SILT, interbedded with silt. Laminations visible.		0.00							
1		Very wet, greyish brown sandy SILT/CLAY.		1.50	1	B					
2		Compact, greyish brown fine sandy SILT.		2.80							
3		EOH. Hole collapsing.		3.00							
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT:

PROJECT: Walshestown 07507150296

RECORD OF WINDOW SAMPLE WS9-07

SHEET 1 OF 1

LOCATION: Silt Pond (See Fig. GI/01)

BORING DATE: 27/11/2007

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (25 50 75 100) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (5 10 15 20)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE									
		Greyish brown, fine SAND.		0.00							
		EOH. Hole collapsed.		0.20							
1	Terrier Rig Window Sampler										
2											
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CC
CHECKED: PK

GOLDER-IRELAND - DI LOGS WALSHESTOWN SHELL&AUGAR SILT POND 2007.GPJ GLDR_LDN.GDT 26/9/08 DATA INPUT: