



Tier Environmental Ltd
Suite 513
Chadwick House
Warrington Road
Birchwood
WA3 6AE

Liberty Properties
5th Floor
HQ
Nicholas Street
Chester
CH1 2NP

For the attention of Phillip Morris

BY EMAIL

20 July 2016

Ref: T/14/1400/LO1

Dear Phillip,

RE: LAND AT RHOSROBIN, WREXHAM – SUPPLEMENTARY PERMEABILITY TESTING

Tier Environmental was commissioned by Liberty Properties to undertake supplementary permeability tests for the Land between New Road and Plas Acton Road, Rhosrobin, Wrexham, LL11 4RB. A Site location plan is presented in Drawing No. T/14/1400/SI/1.

The objectives of this investigation were to determine the potential suitability of sustainable drainage systems (SuDS) within the Site. A previous investigation comprising soakaway testing in the area of proposed development in the south of the Site found the ground to be unsuitable for sustainable drainage systems. Following analysis of the suspected site geology, supplementary locations were selected in the north of the Site to target potentially viable areas of sustainable drainage systems.

Please find below the results of these supplementary permeability tests, undertaken from the 20th of June to the 21st of June 2016.

Site Works

Site works were supervised by a suitably qualified engineer and ultimately comprised of the advancement of 6 No. window sample boreholes (WS1-WS6) to depths between 2.00m and 5.50m bgl in order to undertake falling head tests in the northern part of the Site. Exploratory holes were backfilled with arising on completion of the tests.

The exploratory hole locations and current Site features are shown on Drawing No. T/14/1400/SI/2. Depths and accurate descriptions of strata and groundwater observations made during investigation works are presented on the Engineer's exploratory hole logs enclosed within this report.

Tier Environmental's standard strata description criteria are compliant with BS EN ISO 14688:2002 and 2004 and BS EN ISO 14689:2003. Falling head test are conducted in accordance with BS:5930

Structural Engineering	• Civil Engineering	• Project Management	• Planning Supervision
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Permeability Testing

The boreholes were installed using a window sampling rig extended to a depth of 2.00m bgl (WS5) and 5.50m bgl (WS6); groundwater strikes were not encountered prior to the tests being undertaken. Falling head tests were conducted by casing off the borehole down to the response zone, filling the borehole with water and measuring the fall in water level over time increments. During the test two methodologies were employed. The first method involved the casing being flush with the bottom of the borehole and the response zone restricted to the base of the test section, for this method the intake factor for the permeability calculations was taken from scenario A in Figure 6 of BS:5930. The second method involved the borehole extending below the base of the casing, leaving a cylindrical response zone in the target strata. For this method the calculation of intake factor was taken from scenario D of figure 6 in BS:5930.

Records of the tests are enclosed with this report. A summary of results is provided in Table 1 below.

Table 1 - Summary of Falling Head Test Results.

Borehole ID	Response Zone Depth	Response Zone Strata	Coefficient of Permeability (k)
WS1	2.10m bgl	Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps. – Glaciofluvial Sheet Deposits	3.52x10 ⁻³ ms ⁻¹
WS1	2.10m bgl	Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps. – Glaciofluvial Sheet Deposits	3.46x10 ⁻³ ms ⁻¹
WS1	2.45m to 3.15m bgl	Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps. – Glaciofluvial Sheet Deposits	8.52x10 ⁻⁵ ms ⁻¹
WS1	3.15m bgl	Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone. – Glacial Till.	Test Failed – Terminated after 5 minutes fall in water level of 70mm.
WS2	1.65m to 2.15m bgl	No recovery.	4.57X10 ⁻⁶ ms ⁻¹
WS2	2.15m bgl	Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone. – Glacial Till.	Test Failed- Terminated after 5 minutes with a 90mm fall in water level.
WS2	3.15m bgl	Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone. – Glacial Till.	Test Failed – Terminated after 10 minutes with a 10mm fall in water level.
WS3	2.12m bgl	No recovery.	9.64x10 ⁻⁵ ms ⁻¹
WS3	2.12m bgl	No recovery.	9.75x10 ⁻⁵ ms ⁻¹

Cont'd...



WS3	3.15m bgl	No recovery.	3.78x10-5 ms-1
WS4	1.64 – 2.14m bgl	Red brown, slightly clayey, gravelly, medium occasionally fine and coarse SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz. – Glaciofluvial Sheet Deposits	5.47X10-05 ms-1
WS4	2.14m bgl	Brown, slightly sandy, clayey subangular to rounded, fine to medium occasionally coarse GRAVEL of quartzite and quartz. – Glaciofluvial Sheet Deposits	Test Failed – Terminated after 10 minutes with a 130mm fall in water level.
WS4	3.14m bgl	Brown, slightly sandy, slightly clayey, slightly cobbly, angular to rounded, medium to coarse GRAVEL of quartzite and quartz. – Glaciofluvial Sheet Deposits	1.19X10-03 ms-1
WS5	2.10m bgl	Red brown, slightly clayey, very gravelly, coarse occasionally medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz. – Glaciofluvial Sheet Deposits	5.18X10-6 ms-1
WS6	2.10m bgl	Red brown, slightly clayey, very gravelly, coarse occasionally medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz. – Glaciofluvial Sheet Deposits	8.41X10-5 ms-1
WS6	3.00m bgl	Brown, slightly clayey, very gravelly, coarse SAND. Gravel is angular to subangular, fine to medium of quartzite and quartz. – Glaciofluvial Sheet Deposits	Test Failed - Terminated after 60 minutes with a 470mm fall in water level.

Based on the soil infiltration rates determined from the falling head tests, SUDS will provide a viable drainage option for the north of the Site, subject to detailed design.

Kind Regards,

D Roberts

Daniel Roberts MSc BSc (Hons) FGS

Assistant Geoenvironmental Engineer

Tier Environmental Ltd

Cc.

Encs.

- T/14/1400/SI/1 – Site Location Plan
- T/14/1400/SI/1 – Exploratory Hole Location Plan
- Engineers Logs
- Falling Head Test Results



Contract Number	T/14/1400
Contract	Land off New Road, Rhosrobin
Client	Liberty Properties

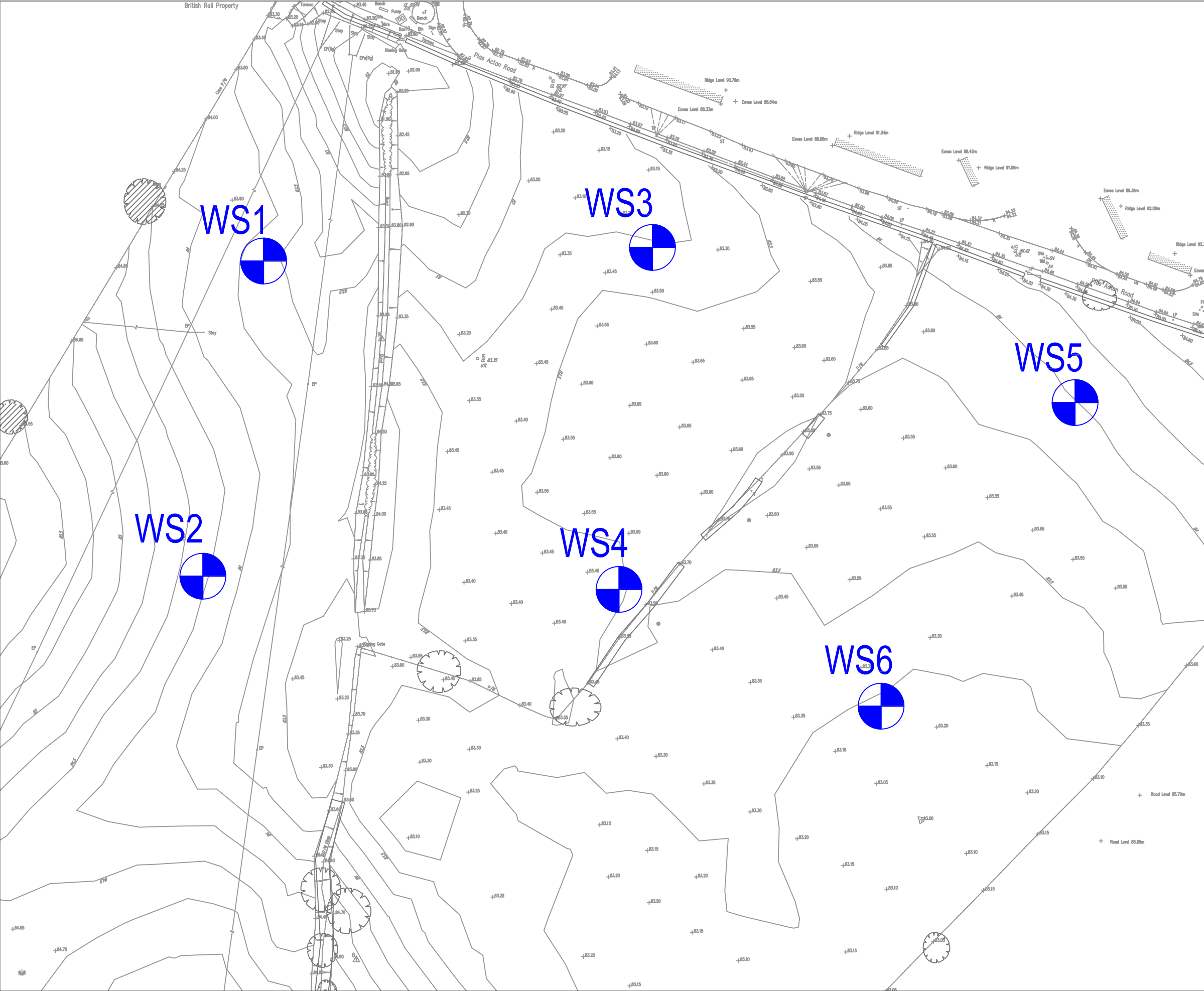
Site Location Plan



THE SITE

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Scale	NTS	
Drawn by	JH	Approved AR
Drawing Number	T/14/1400/SI/1	



DO NOT SCALE

Window Sample
Borehole Location

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS:

Final

Tier Consult Ltd.
Elm House Farm
Salghon
Chester
CH3 6EN

Telephone:
01244 333080
Fax:
01244 333081
Mobile:
07966 687066
Email:
info@tieruk.com

CLIENT:

Liberty Properties

ARCHITECT:

PROJECT:

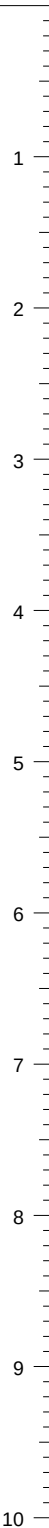
Land at Rhosrobin,
Wrexham

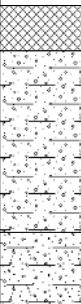
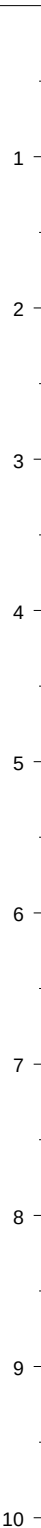
TITLE:

Exploratory Hole Location Plan

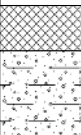
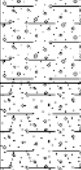
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CAD FILE:	DESIGN/DRAWN: DR	DATE: June 2016
PROJECT No: T/14/1400	DRAWING No: T/14/1400/SI/2	REV: 1

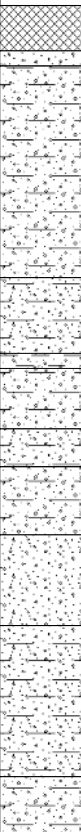
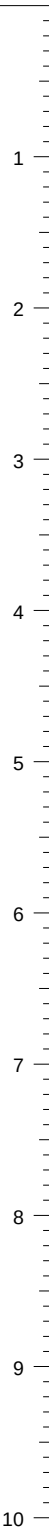
					Borehole Log			Borehole No. WS1 Sheet 1 of 1		
Project Name: Land at Rhosrobin					Project No. T/14/1400		Co-ords: 333295.00 - 353011.00		Hole Type WS	
Location: Wrexham					Level: 83.50		Scale 1:50			
Client: Liberty Properties					Dates: 21/06/2016 -		Logged By DR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					0.30	83.20	 MADE GROUND: Soft consistency, dark brown, slightly gravelly, sandy CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone, with abundant rootlets.  MADE GROUND  Red brown, clayey, very gravelly, fine to coarse SAND. Gravel is subrounded to rounded, fine to coarse of quartz and quartzite.  GLACIOFLUVIAL DEPOSITS  Red brown, slightly clayey, medium to coarse SAND. Gravel is subangular to rounded, fine to medium occasionally coarse of quartz and quartzite.  GLACIAL TILL  Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps.  GLACIOFLUVIAL DEPOSITS  Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone.  GLACIAL TILL  Occasional cobbles of subrounded quartzite from 2.90m to 3.50m bgl.	0.50	83.00	1
					0.90	82.60		2		
					2.40	81.10		3		
					3.50	80.00		4		
								5		
					6					
					7					
					8					
					9					
					10					
End of borehole at 3.50 m										
Remarks 1) Hand dug pit to 1.20m bgl. 2) Borehole dry. 3) Borehole cased to 3.00m bgl. 4) Falling head tests undertaken for response zones at 2.10m, 2.45 to 3.15m and 3.15m bgl. 5) Terminated at 3.50m bgl at refusal in natural ground.										
										

					Borehole Log			Borehole No. WS2 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. T/14/1400		Co-ords: 333279.00 - 352928.00		Hole Type WS
Location: Wrexham					Level: 84.25		Scale 1:50		
Client: Liberty Properties					Dates: 21/06/2016 -		Logged By DR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20	84.05		MADE GROUND: Soft consistency, dark brown, slightly gravelly, very sandy CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone, with abundant rootlets.	
					0.95	83.30		MADE GROUND	
					1.10	83.15		Red brown, slightly gravelly, very clayey, fine SAND. Gravel is subangular to rounded, fine to medium occasionally coarse of quartzite.	
					1.20	83.05		GLACIOFLUVIAL DEPOSITS	
								Red brown, slightly clayey, gravelly, fine to medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.	
								GLACIOFLUVIAL DEPOSITS	
								Brown, slightly clayey, subangular to rounded, fine to medium occasionally coarse GRAVEL of quartz and quartzite.	
								GLACIOFLUVIAL DEPOSITS	
								No recovery.	
								Rounded cobble of quartzite at 1.20m bgl.	
							Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone.		
							GLACIAL TILL		
					3.80	80.45		Red brown, fine to medium SAND.	
					4.00	80.25		GLACIOFLUVIAL DEPOSITS	
					4.10	80.15		Brown, slightly gravelly, medium to coarse SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.	
					4.20	80.05		GLACIOFLUVIAL DEPOSITS	
								Red brown, slightly gravelly, fine to medium SAND. Gravel is subangular to rounded, fine of quartz and quartzite.	
								GLACIOFLUVIAL DEPOSITS	
								End of borehole at 4.20 m	
Remarks 1) Hand dug pit to 1.20m bgl. 2) Borehole dry. 3) Borehole cased to 3.00m bgl. 4) Falling head tests undertaken for response zones at 1.65 to 2.15m, 2.15m and 3.15m bgl. 5) Terminated at 4.20m bgl at refusal in natural ground.									
									

					Borehole Log			Borehole No. WS3 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. T/14/1400		Co-ords: 333398.00 - 353014.00		Hole Type WS
Location: Wrexham					Level: 83.40		Scale 1:50		
Client: Liberty Properties					Dates: 21/06/2016 -		Logged By DR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30	83.10		MADE GROUND: Soft consistency, dark brown, slightly gravelly, very sandy CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone, with abundant rootlets.	
					1.50	81.90		MADE GROUND Red brown, sandy, clayey, subangular to rounded, fine to medium occasionally coarse, GRAVEL of quartzite, quartz and sandstone, with occasional cobbles of rounded quartzite.	
					2.00	81.40		GLACIOFLUVIAL DEPOSITS Red brown, slightly clayey, very gravelly, coarse occasionally medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.	
								GLACIOFLUVIAL DEPOSITS No recovery.	
					5.00	78.40		End of borehole at 5.00 m	
Remarks 1) Hand dug pit to 1.20m bgl. 2) Borehole dry. 3) Borehole cased to 3.00m bgl. 4) Falling head tests undertaken for response zones at 2.15m and 3.15m bgl. 5) Terminated at 5.00m bgl in natural ground.									



					Borehole Log			Borehole No. WS5 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. T/14/1400		Co-ords: 333509.00 - 352974.00		Hole Type WS
Location: Wrexham					Level: 84.00		Scale 1:50		
Client: Liberty Properties					Dates: 20/06/2016 -		Logged By DR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30	83.70	  	MADE GROUND: Soft consistency, brown, slightly gravelly, sandy CLAY. Gravel is subangular to rounded, fine to medium of quartzite, with abundant rootlets and occasional ceramic fragments. MADE GROUND Red brown, sandy, clayey, subangular to rounded, fine to medium occasionally coarse, GRAVEL of quartzite, quartz and sandstone, with occasional cobbles of subrounded quartzite. GLACIOFLUVIAL DEPOSITS <i>Very clayey from 1.00m to 1.10m bgl, with clay in 10mm to 30mm diameter clumps.</i> <i>Very sandy from 1.10m to 1.40m bgl.</i>	1
					1.40	82.60		Red brown, slightly clayey, very gravelly, coarse occasionally medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz. GLACIOFLUVIAL DEPOSITS	2
					2.00	82.00		End of borehole at 2.00 m	3
									4
									5
									6
									7
									8
									9
									10
Remarks 1) Hand dug pit to 1.20m bgl. 2) Borehole dry. 3) Borehole cased to 2.00m bgl. 4) Falling head tests undertaken for response zone at 2.10m bgl 5) Terminated at 2.00m bgl in natural ground.									

					Borehole Log			Borehole No. WS6 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. T/14/1400		Co-ords: 333458.00 - 352894.00		Hole Type WS
Location: Wrexham					Level: 83.20		Scale 1:50		
Client: Liberty Properties					Dates: 20/06/2016 -		Logged By DR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30	82.90		MADE GROUND: Soft consistency, dark brown, slightly gravelly, very sandy CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone, with abundant rootlets.	
					0.40	82.80		MADE GROUND	
								Red brown, slightly clayey, very gravelly, medium to coarse SAND. Gravel is subangular to subrounded of quartz and quartzite.	
								GLACIOFLUVIAL DEPOSITS	
					1.80	81.40		Red brown, sandy, clayey, subangular to rounded, fine to medium occasionally coarse, GRAVEL of quartzite, quartz and sandstone, with rare 10mm to 30mm clumps of clay.	
								GLACIOFLUVIAL DEPOSITS	
								<i>Very sandy from 1.00m to 1.80m bgl.</i>	
					2.30	80.90		Red brown, slightly clayey, very gravelly, coarse occasionally medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.	
					2.40	80.80		GLACIOFLUVIAL DEPOSITS	
					2.80	80.40		GLACIOFLUVIAL DEPOSITS	
			3.05	80.15	Firm consistency, red brown, slightly sandy, gravelly CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone.				
			3.50	79.70	GLACIOFLUVIAL DEPOSITS				
					Brown, slightly sandy, slightly clayey, subrounded to rounded, fine to medium GRAVEL of quartzite and quartz.				
			4.10	79.10	GLACIOFLUVIAL DEPOSITS				
					<i>Occasional decaying wood fragments from 2.70m to 2.80m bgl.</i>				
					Brown, slightly clayey, very gravelly, coarse SAND. Gravel is angular to subangular, fine to medium of quartzite and quartz.				
			5.10	78.10	GLACIOFLUVIAL DEPOSITS				
					Brown, sandy, clayey, subangular to subrounded, fine to medium GRAVEL of quartzite, quartz and siltstone.				
			5.50	77.70	GLACIOFLUVIAL DEPOSITS				
					Red brown, very gravelly, coarse SAND. Gravel is subangular to rounded, fine to medium of quartz and siltstone.				
					GLACIOFLUVIAL DEPOSITS				
					Orange brown, slightly clayey, very gravelly, medium SAND. Gravel is subangular to rounded, fine to medium of quartzite, siltstone and quartz, with rare coal.				
					GLACIOFLUVIAL DEPOSITS				
					Brown, sandy, clayey, subangular to subrounded, fine to medium GRAVEL of quartzite, quartz and siltstone.				
					GLACIOFLUVIAL DEPOSITS				
End of borehole at 5.50 m									
Remarks 1) Hand dug pit to 1.20m bgl. 2) Borehole dry. 3) Borehole cased to 3.00m bgl. 4) Falling head tests undertaken for response zones at 2.10m and 3.00m bgl 5) Terminated at 5.50m bgl in natural ground.									
									

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS1	TEST No.:		1				
		DEPTH (m)	2.10	DATE	28/06/2016	SHEET	1		

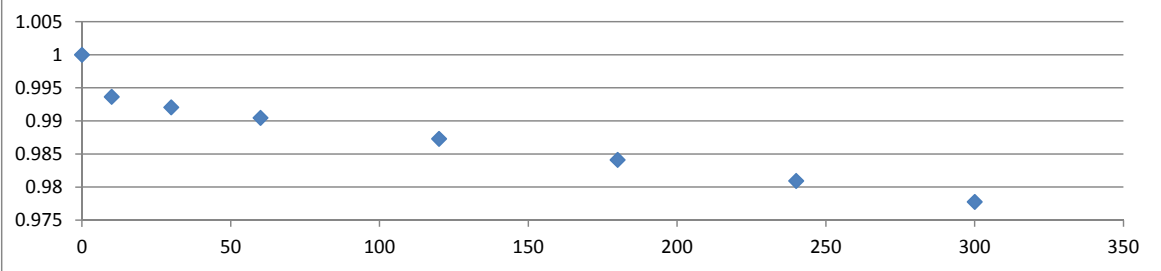
Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i -d _l)	h _i /h ₀				
0	0.9	1.2	1		Test Section Depth	m	2.1
10	1.29	0.81	0.675		Borehole Depth	m	2.1
20	1.57	0.53	0.4416667		Borehole Diameter	m	0.103
30	1.96	0.14	0.1166667		Casing Depth	m	2.1
40	2.09	0.01	0.0083333		Depth to Standing Water Level (d _l)	Assumed m	
					Height of casing agl (h _c)	m	0
					Height of top of casing above water table	m	0
					Depth to Water at Start of Test below casing level (d ₀)	m	0
					Depth to Water at End of Test below casing level	m	0
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
					Basic Time Lag = (T)	t ₁ =	0.00
						t ₂ =	40.00
						s.h ₁ =	1.00
						s.h ₂ =	0.01
					Coefficient of Permeability (k) ms ⁻¹ =	3.52E-03	
Remarks							
Borehole cleaned out prior to test.							
Compiled By	JB	Date	17/11/2014				
Checked By	AR	Date	19/11/2014				
Geology of Test Section:		Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps.					
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388							
				Project Number	T/14/1400		
				Project Name	Land at Rhosrobin		
				Client	Liberty Property		

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS1	TEST No.:		2				
		DEPTH (m)	2.10		DATE	28/06/2016		SHEET	1

Time (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _i)	h _i /h ₀
0	1	1.1	1
10	1.35	0.75	0.6818182
20	1.69	0.41	0.3727273
30	1.99	0.11	0.1
40	2.09	0.01	0.0090909

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _i)	h _i /h ₀			
0	1	1.1	1	Test Section Depth	m	2.1
10	1.35	0.75	0.6818182	Borehole Depth	m	2.1
20	1.69	0.41	0.3727273	Borehole Diameter	m	0.103
30	1.99	0.11	0.1	Casing Depth	m	2.1
40	2.09	0.01	0.0090909	Depth to Standing Water Level (d ₁)	Assumed m	
				Height of casing agl (h _c)	m	0
				Height of top of casing above water table	m	0
				Depth to Water at Start of Test below casing level (d ₀)	m	0
				Depth to Water at End of Test below casing level	m	0
				Depth to Filter at Start of Test	m	
				Depth to Filter at End of Test	m	
				Response Zone Length	m	0
				Borehole Diameter in Test Section	m	0.103
				Cross-sectional Area of Borehole	m ²	0.01
				Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
				Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00
					t ₂ = 40.00	s.h ₂ = 0.01
				Coefficient of Permeability (k) ms ⁻¹ =	3.46E-03	
Remarks Borehole cleaned out prior to test. Compiled By JB Date 17/11/2014 Checked By AR Date 19/11/2014 Geology of Test Section: Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps. Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388 Project Number T/14/1400 Project Name Land at Rhosrobin Client Liberty Property						

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS1	TEST No.:		3				
		DEPTH (m)	3.15		DATE	28/06/2016		SHEET	1



Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i -d _l)	h _i /h ₀				
0	0	3.15	1		Test Section Depth	m	3.15
10	0.02	3.13	0.9936508		Borehole Depth	m	3.15
30	0.025	3.125	0.9920635		Borehole Diameter	m	0.103
60	0.03	3.12	0.9904762		Casing Depth	m	3.15
120	0.04	3.11	0.9873016		Depth to Standing Water Level (d _i)	Assumed m	
180	0.05	3.1	0.984127		Height of casing agl (h _c)	m	0
240	0.06	3.09	0.9809524		Height of top of casing above water table	m	0
300	0.07	3.08	0.9777778		Depth to Water at Start of Test below casing level (d ₀)	m	0
					Depth to Water at End of Test below casing level	m	0
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
					Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00
						t ₂ = 300.00	s.h ₂ = 0.98
					Coefficient of Permeability (k) ms ⁻¹ =	2.20E-06	
Remarks							
Borehole cleaned out prior to test.							
Compiled By	JB	Date	17/11/2014				
Checked By	AR	Date	19/11/2014				
Geology of Test Section:		Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps.					
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388							
				Project Number	T/14/1400		
				Project Name	Land at Rhosrobin		
				Client	Liberty Property		

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE										
BOREHOLE No.:		WS1	TEST No.:		4					
		DEPTH (m)	3.15		DATE		28/06/2016		SHEET	1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i -d _i)	h _i /h ₀				
0	0.09	3.06	1		Test Section Depth	m	3.15
55	2.1	1.05	0.3431373		Borehole Depth	m	3.15
80	2.2	0.95	0.3104575		Borehole Diameter	m	0.103
90	2.5	0.65	0.2124183		Casing Depth	m	2.45
120	2.5	0.65	0.2124183		Depth to Standing Water Level (d _i)	Assumed m	
180	2.51	0.64	0.2091503		Height of casing agl (h _c)	m	0
240	2.52	0.63	0.2058824		Height of top of casing above water table	m	0
					Depth to Water at Start of Test below casing level (d ₀)	m	0
					Depth to Water at End of Test below casing level	m	0
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0.7
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	1.68
					Basic Time Lag = (T)	t ₁ =	0.00
						t ₂ =	90.00
						s.h ₁ =	1.00
						s.h ₂ =	0.21
					Coefficient of Permeability (k) ms ⁻¹ =		8.52E-05
Remarks Borehole cleaned out prior to test.							
Compiled By	JB	Date	17/11/2014				
Checked By	AR	Date	19/11/2014				
Geology of Test Section:		Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone.					
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388 Project Number Project Name Client T/14/1400 Land at Rhosrobin Liberty Property							

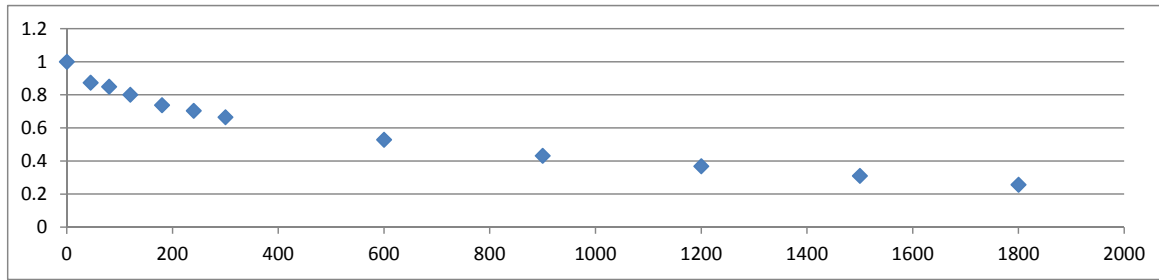
VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS2	TEST No.:		1				
		DEPTH (m)	2.15	DATE		28/06/2016	SHEET		1

Time (secs)	Water Level (m)
0	1.00
10	0.99
30	0.985
60	0.98
120	0.97
300	0.96

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i -d _i)	h _i /h ₀				
0	0	2.15	1		Test Section Depth	m	2.15
10	0.025	2.125	0.9883721		Borehole Depth	m	2.15
30	0.035	2.115	0.9837209		Borehole Diameter	m	0.103
60	0.045	2.105	0.9790698		Casing Depth	m	2.15
120	0.065	2.085	0.9697674		Depth to Standing Water Level (d _i)	Assumed m	
300	0.09	2.06	0.9581395		Height of casing agl (h _c)	m	0
					Height of top of casing above water table	m	0
					Depth to Water at Start of Test below casing level (d ₀)	m	0
					Depth to Water at End of Test below casing level	m	0
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
					Basic Time Lag = (T)	t ₁ =	0.00
						t ₂ =	300.00
						s ₁ h ₁ =	1.00
						s ₂ h ₂ =	0.96
					Coefficient of Permeability (k) ms ⁻¹ =		4.19E-06
Remarks Borehole cleaned out prior to test.							
Compiled By	JB	Date	17/11/2014				
Checked By	AR	Date	19/11/2014				
Geology of Test Section:		Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone.					
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388 Project Number T/14/1400 Project Name Land at Rhosrobin Client Liberty Property							

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE

BOREHOLE No.:	WS2	TEST No.:	2		
	DEPTH (m)	2.15	DATE	28/06/2016	SHEET 1



Time Elapsed (secs)	Depth of water below top of casing - d ₁ (m)	h (m) - (d ₁ - d ₂)	h ₁ /h ₀		
0	0.09	2.06	1		Test Section Depth
45	0.35	1.8	0.8737864		m
80	0.4	1.75	0.8495146		m
120	0.5	1.65	0.8009709		m
180	0.63	1.52	0.7378641		m
240	0.7	1.45	0.7038835		m
300	0.78	1.37	0.6650485		m
600	1.06	1.09	0.5291262		m
900	1.26	0.89	0.4320388		m
1200	1.39	0.76	0.368932		m
1500	1.51	0.64	0.3106796		m
1800	1.62	0.53	0.2572816		m
					Response Zone Length
					m
					0.5
					Borehole Diameter in Test Section
					m
					0.103
					Cross-sectional Area of Borehole
					m ²
					0.01
					Intake factor (BS5930 p51):
					Figure 7 (F) =
					1.38
					Basic Time Lag = (T)
					t ₁ =
					0.00
					s.h ₁ =
					1.00
					t ₂ =
					1800.00
					s.h ₂ =
					0.26
					Coefficient of Permeability (k) ms ⁻¹ =
					4.57E-06
Remarks Borehole cleaned out prior to test. Compiled By JB Date 17/11/2014 Checked By AR Date 19/11/2014 Geology of Test Section: No recovery.					
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388				Project Number T/14/1400	
				Project Name Land at Rhosrobin	
				Client Liberty Property	

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS2	TEST No.:		2				
		DEPTH (m)	3.15	DATE		28/06/2016	SHEET		1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i -d _l)	h _i /h ₀														
0	0	3.15	1		Test Section Depth	m	3.15										
10	0.01	3.14	0.9968254		Borehole Depth	m	3.15										
30	0.01	3.14	0.9968254		Borehole Diameter	m	0.103										
60	0.01	3.14	0.9968254		Casing Depth	m	3.15										
120	0.01	3.14	0.9968254		Depth to Standing Water Level (d _l)	Assumed m											
					Height of casing agl (h _c)	m	0										
					Height of top of casing above water table	m	0										
					Depth to Water at Start of Test below casing level (d ₀)	m	0										
					Depth to Water at End of Test below casing level	m	0										
					Depth to Filter at Start of Test	m											
					Depth to Filter at End of Test	m											
					Response Zone Length	m	0										
					Borehole Diameter in Test Section	m	0.103										
					Cross-sectional Area of Borehole	m ²	0.01										
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28										
					Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00										
						t ₂ = 120.00	s.h ₂ = 1.00										
					Coefficient of Permeability (k) ms ⁻¹ =	7.79E-07											
Remarks																	
Compiled By	JB	Date	17/11/2014														
Checked By	AR	Date	19/11/2014														
Geology of Test Section:		Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone.															
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388 <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Project Number</td><td>T/14/1400</td></tr> <tr><td>Project Name</td><td>Land at Rhosrobin</td></tr> <tr><td>Client</td><td>Liberty Property</td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </table>								Project Number	T/14/1400	Project Name	Land at Rhosrobin	Client	Liberty Property				
Project Number	T/14/1400																
Project Name	Land at Rhosrobin																
Client	Liberty Property																

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS3	TEST No.:		1				
		DEPTH (m)	2.12	DATE		28/06/2016	SHEET		1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _i)	h _i /h ₀														
0	0	2.12	1		Test Section Depth	m	2.12										
10	0.32	1.8	0.8490566		Borehole Depth	m	2.12										
20	0.55	1.57	0.740566		Borehole Diameter	m	0.103										
30	0.7	1.42	0.6698113		Casing Depth	m	2.12										
40	0.88	1.24	0.5849057		Depth to Standing Water Level (d ₁)	Assumed m											
60	1.05	1.07	0.504717		Height of casing agl (h _c)	m	0										
90	1.23	0.89	0.4198113		Height of top of casing above water table	m	0										
120	1.37	0.75	0.3537736		Depth to Water at Start of Test below casing level (d ₀)	m	0										
150	1.44	0.68	0.3207547		Depth to Water at End of Test below casing level	m	0										
180	1.5	0.62	0.2924528		Depth to Filter at Start of Test	m											
240	1.58	0.54	0.254717		Depth to Filter at End of Test	m											
300	1.64	0.48	0.2264151		Response Zone Length	m	0										
360	1.7	0.42	0.1981132		Borehole Diameter in Test Section	m	0.103										
420	1.75	0.37	0.1745283		Cross-sectional Area of Borehole	m ²	0.01										
480	1.79	0.33	0.1556604		Intake factor (BS5930 p51):	Figure 7 (F) =	0.28										
600	1.86	0.26	0.1226415		Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00										
720	1.92	0.2	0.0943396			t ₂ = 720.00	s.h ₂ = 0.09										
					Coefficient of Permeability (k) ms ⁻¹ =	9.64E-05											
Remarks																	
Borehole cleaned out prior to test.																	
Compiled By	JB	Date	17/11/2014														
Checked By	AR	Date	19/11/2014														
Geology of Test Section:		No recovery.															
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388						<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Project Number</td> <td>T/14/1400</td> </tr> <tr> <td>Project Name</td> <td>Land at Rhosrobin</td> </tr> <tr> <td>Client</td> <td>Liberty Property</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> </table>		Project Number	T/14/1400	Project Name	Land at Rhosrobin	Client	Liberty Property				
Project Number	T/14/1400																
Project Name	Land at Rhosrobin																
Client	Liberty Property																

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS3	TEST No.:		2				
		DEPTH (m)	2.12	DATE		28/06/2016	SHEET		1

Time Elapsed (secs)	Depth of water below top of casing - d ₁ (m)	h (m) - (d ₁ - d ₀)	h ₁ /h ₀														
0	0	2.12	1		Test Section Depth	m	2.12										
10	0.28	1.84	0.8679245		Borehole Depth	m	2.12										
20	0.5	1.62	0.7641509		Borehole Diameter	m	0.103										
30	0.66	1.46	0.6886792		Casing Depth	m	2.12										
40	0.85	1.27	0.5990566		Depth to Standing Water Level (d ₁)	Assumed m											
50	0.95	1.17	0.5518868		Height of casing agl (h _c)	m	0										
60	1.05	1.07	0.504717		Height of top of casing above water table	m	0										
90	1.205	0.915	0.4316038		Depth to Water at Start of Test below casing level (d ₀)	m	0										
120	1.31	0.81	0.3820755		Depth to Water at End of Test below casing level	m	2.58										
150	1.4	0.72	0.3396226		Depth to Filter at Start of Test	m											
180	1.48	0.64	0.3018868		Depth to Filter at End of Test	m											
240	1.56	0.56	0.2641509		Response Zone Length	m	0										
300	1.63	0.49	0.2311321		Borehole Diameter in Test Section	m	0.103										
360	1.69	0.43	0.2028302		Cross-sectional Area of Borehole	m ²	0.01										
430	1.74	0.38	0.1792453		Intake factor (BS5930 p51):	Figure 7 (F) =	0.28										
480	1.76	0.36	0.1698113		Basic Time Lag = (T)	t ₁ =	0.00										
600	1.83	0.29	0.1367925			t ₂ =	600.00										
						s.h ₁ =	1.00										
						s.h ₂ =	0.14										
					Coefficient of Permeability (k) ms ⁻¹ =	9.75E-05											
Remarks																	
Borehole cleaned out prior to test.																	
Compiled By	JB	Date	17/11/2014														
Checked By	AR	Date	19/11/2014														
Geology of Test Section:		No recovery.															
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388 <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Project Number</td> <td>T/14/1400</td> </tr> <tr> <td>Project Name</td> <td>Land at Rhosrobin</td> </tr> <tr> <td>Client</td> <td>Liberty Property</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> </table>								Project Number	T/14/1400	Project Name	Land at Rhosrobin	Client	Liberty Property				
Project Number	T/14/1400																
Project Name	Land at Rhosrobin																
Client	Liberty Property																

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS3	TEST No.:		3				
		DEPTH (m)	3.15		DATE	28/06/2016		SHEET	1

Time Elapsed (secs)	Depth of water below top of casing - d ₁ (m)	h (m) - (d ₁ - d ₂)	h ₁ /h ₀						
0	0.18	2.97	1		Test Section Depth	m	3.15		
10	0.51	2.64	0.8888889		Borehole Depth	m	3.15		
20	0.69	2.46	0.8282828		Borehole Diameter	m	0.103		
30	0.81	2.34	0.7878788		Casing Depth	m	3.15		
60	1.12	2.03	0.6835017		Depth to Standing Water Level (d ₁)	Assumed m			
90	1.29	1.86	0.6262626		Height of casing agl (h _c)	m	0		
120	1.43	1.72	0.5791246		Height of top of casing above water table	m	0		
150	1.52	1.63	0.5488215		Depth to Water at Start of Test below casing level (d ₀)	m	0		
180	1.59	1.56	0.5252525		Depth to Water at End of Test below casing level	m	0		
240	1.68	1.47	0.4949495		Depth to Filter at Start of Test	m			
300	1.76	1.39	0.4680135		Depth to Filter at End of Test	m			
420	1.95	1.2	0.4040404		Response Zone Length	m	0		
540	2.08	1.07	0.3602694		Borehole Diameter in Test Section	m	0.103		
600	2.15	1	0.3367003		Cross-sectional Area of Borehole	m ²	0.01		
720	2.23	0.92	0.3097643		Intake factor (BS5930 p51):	Figure 7 (F) =	0.28		
840	2.31	0.84	0.2828283		Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00		
960	2.36	0.79	0.2659933			t ₂ = 1080.00	s.h ₂ = 0.25		
1080	2.41	0.74	0.2491582		Coefficient of Permeability (k) ms ⁻¹ =	3.78E-05			
<u>Remarks</u> Borehole cleaned out prior to test. Compiled By: JB Date: 17/11/2014 Checked By: AR Date: 19/11/2014 Geology of Test Section: No recovery.									
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388								Project Number: T/14/1400 Project Name: Land at Rhosrobin Client: Liberty Property	

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS4	TEST No.:		1				
		DEPTH (m)	2.10	DATE		28/06/2016	SHEET		1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d ₁ -d ₀)	h _i /h ₀				
0	0	2.14	1		Test Section Depth	m	2.14
10	0.04	2.1	0.9813084		Borehole Depth	m	2.14
20	0.05	2.09	0.9766355		Borehole Diameter	m	0.103
30	0.062	2.078	0.971028		Casing Depth	m	2.1
40	0.067	2.073	0.9686916		Depth to Standing Water Level (d ₁)	Assumed m	
60	0.075	2.065	0.9649533		Height of casing agl (h _c)	m	0
120	0.087	2.053	0.9593458		Height of top of casing above water table	m	0
300	0.1	2.04	0.953271		Depth to Water at Start of Test below casing level (d ₀)	m	0
600	0.13	2.01	0.9392523		Depth to Water at End of Test below casing level	m	2.58
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0.2
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
					Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00
						t ₂ = 600.00	s.h ₂ = 0.94
					Coefficient of Permeability (k) ms ⁻¹ =	3.07E-06	
<u>Remarks</u> Borehole cleaned out prior to test. Compiled By: JB Date: 17/11/2014 Checked By: AR Date: 19/11/2014 <u>Geology of Test Section:</u> Brown, slightly sandy, clayey subangular to rounded, fine to medium occasionally coarse GRAVEL of quartzite and quartz.							

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS4	TEST No.:		2				
		DEPTH (m)	2.14		DATE	28/06/2016		SHEET	1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)
0	0.13
25	1.35
60	1.55
80	1.65
120	1.76
180	1.85
240	1.91

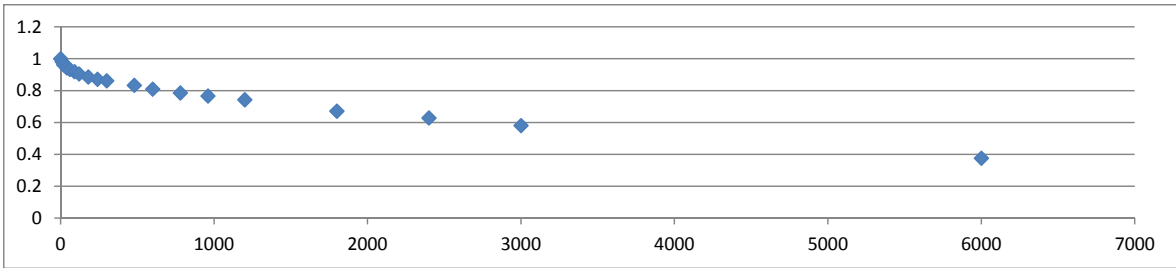
Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i -d _l)	h _i /h ₀				
0	0.13	2.01	1		Test Section Depth	m	2.14
25	1.35	0.79	0.3930348		Borehole Depth	m	2.14
60	1.55	0.59	0.2935323		Borehole Diameter	m	0.103
80	1.65	0.49	0.2437811		Casing Depth	m	1.64
120	1.76	0.38	0.1890547		Depth to Standing Water Level (d ₁)	Assumed m	
180	1.85	0.29	0.1442786		Height of casing agl (h _c)	m	0
240	1.91	0.23	0.1144279		Height of top of casing above water table	m	0
					Depth to Water at Start of Test below casing level (d ₀)	m	0
					Depth to Water at End of Test below casing level	m	0
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0.5
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	1.38
					Basic Time Lag = (T)	t ₁ =	0.00
						t ₂ =	240.00
						s.h ₁ =	1.00
						s.h ₂ =	0.11
					Coefficient of Permeability (k) ms ⁻¹ =		5.47E-05
Remarks Borehole cleaned out prior to test.							
Compiled By	JB	Date	17/11/2014				
Checked By	AR	Date	19/11/2014				
Geology of Test Section:		Red brown, slightly clayey, gravelly, medium occasionally fine and coarse SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.					
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388							
				Project Number	T/14/1400		
				Project Name	Land at Rhosrobin		
				Client	Liberty Property		

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE										
BOREHOLE No.:		WS4	TEST No.:		3					
		DEPTH (m)	3.14		DATE		28/06/2016		SHEET	1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _l)	h _i /h ₀														
0	0.2	2.94	1		Test Section Depth	m	3.14										
10	0.84	2.3	0.7823129		Borehole Depth	m	3.14										
20	1.44	1.7	0.5782313		Borehole Diameter	m	0.103										
30	1.93	1.21	0.4115646		Casing Depth	m	3.14										
40	2.22	0.92	0.3129252		Depth to Standing Water Level (d _l)	Assumed m											
60	2.57	0.57	0.1938776		Height of casing agl (h _c)	m	0										
70	2.79	0.35	0.1190476		Height of top of casing above water table	m	0										
90	2.95	0.19	0.0646259		Depth to Water at Start of Test below casing level (d ₀)	m	0.2										
100	3.03	0.11	0.037415		Depth to Water at End of Test below casing level	m	0										
120	3.09	0.05	0.0170068		Depth to Filter at Start of Test	m											
140	3.13	0.01	0.0034014		Depth to Filter at End of Test	m											
					Response Zone Length	m	0										
					Borehole Diameter in Test Section	m	0.103										
					Cross-sectional Area of Borehole	m ²	0.01										
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28										
					Basic Time Lag = (T)	t ₁ =	0.00										
						t ₂ =	140.00										
						s.h ₁ =	1.00										
						s.h ₂ =	0.00										
					Coefficient of Permeability (k) ms ⁻¹ =		1.19E-03										
Remarks																	
Borehole cleaned out prior to test.																	
Compiled By	JB	Date	17/11/2014														
Checked By	AR	Date	19/11/2014														
Geology of Test Section:		Brown, slightly sandy, slightly clayey, slightly cobbly, angular to rounded, medium to coarse GRAVEL of quartzite and quartz.															
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388 <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Project Number</td> <td>T/14/1400</td> </tr> <tr> <td>Project Name</td> <td>Land at Rhosrobin</td> </tr> <tr> <td>Client</td> <td>Liberty Property</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> </table>								Project Number	T/14/1400	Project Name	Land at Rhosrobin	Client	Liberty Property				
Project Number	T/14/1400																
Project Name	Land at Rhosrobin																
Client	Liberty Property																

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE	
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100	100

BOREHOLE No.:	WS5	TEST No.:	1		
	DEPTH (m)	2.10	DATE	28/06/2016	SHEET 1



Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d ₁ -d _i)	h _i /h ₀					
0	0	2.1	1		Test Section Depth	m	2.1	
10	0.04	2.06	0.980952381		Borehole Depth	m	2.1	
20	0.08	2.02	0.961904762		Borehole Diameter	m	0.103	
40	0.12	1.98	0.942857143		Casing Depth	m	2.1	
60	0.14	1.96	0.933333333		Depth to Standing Water Level (d ₁)	Assumed m		
90	0.17	1.93	0.919047619		Height of casing agl (h _c)	m	0	
120	0.2	1.9	0.904761905		Height of top of casing above water table	m		
180	0.24	1.86	0.885714286		Depth to Water at Start of Test below casing level (d _o)	m	0	
240	0.27	1.83	0.871428571		Depth to Water at End of Test below casing level	m	2.58	
300	0.29	1.81	0.861904762		Depth to Filter at Start of Test	m		
480	0.35	1.75	0.833333333		Depth to Filter at End of Test	m		
600	0.4	1.7	0.80952381		Response Zone Length	m	0	
780	0.45	1.65	0.785714286		Borehole Diameter in Test Section	m	0.103	
960	0.49	1.61	0.766666667		Cross-sectional Area of Borehole	m ²	0.01	
1200	0.54	1.56	0.742857143		Intake factor (BS5930 p51):	Figure 7 (F) =	0.28	
1800	0.69	1.41	0.671428571		Basic Time Lag = (T)	t _e =	0.00	s.h ₁ = 1.00
2400	0.78	1.32	0.628571429			t _e =	7500.00	s.h ₂ = 0.27
3000	0.88	1.22	0.580952381		Coefficient of Permeability (k) ms ⁻¹ =		5.18E-06	
6000	1.31	0.79	0.376190476					
7500	1.54	0.56	0.266666667					

Remarks

Borehole cleaned out prior to test.

Compiled By

JB

Date	17/11/2014
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Checked By	AR
Geology of Test Section:	

Date	19/11/2014		
Red brown, slightly clayey, very gravelly, coarse occasionally medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.			

Tier Environmental Ltd

Chadwick House
Birchwood Park
Warrington, WA3 6AE
Tel. 01925 818 388



Tier
Environmental

Project Number

T/14/1400

Project Name

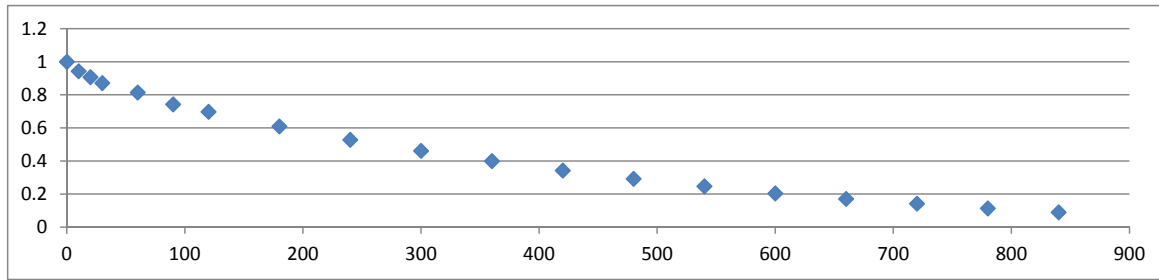
Land at Rhosrobin	
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Client

Liberty Property

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE

BOREHOLE No.:	WS6	TEST No.:	1		
	DEPTH (m)	2.10	DATE	28/06/2016	SHEET 1



Time Elapsed (secs)	Depth of water below top of casing - d ₁ (m)	h (m) - (d ₁ -d ₂)	h ₁ /h ₀					
0	0	2.1	1		Test Section Depth	m	2.1	
10	0.12	1.98	0.9428571		Borehole Depth	m	2.1	
20	0.195	1.905	0.9071429		Borehole Diameter	m	0.103	
30	0.27	1.83	0.8714286		Casing Depth	m	2.1	
60	0.39	1.71	0.8142857		Depth to Standing Water Level (d ₁)	Assumed m	0	
90	0.54	1.56	0.7428571		Height of casing agl (h _c)	m	0	
120	0.635	1.465	0.697619		Height of top of casing above water table	m	0	
180	0.82	1.28	0.6095238		Depth to Water at Start of Test below casing level (d ₀)	m	0	
240	0.99	1.11	0.5285714		Depth to Water at End of Test below casing level	m	0	
300	1.13	0.97	0.4619048		Depth to Filter at Start of Test	m		
360	1.26	0.84	0.4		Depth to Filter at End of Test	m		
420	1.38	0.72	0.3428571		Response Zone Length	m	0	
480	1.485	0.615	0.2928571		Borehole Diameter in Test Section	m	0.103	
540	1.58	0.52	0.247619		Cross-sectional Area of Borehole	m ²	0.01	
600	1.67	0.43	0.2047619		Intake factor (BS5930 p51):	Figure 7 (F) =	0.28	
660	1.74	0.36	0.1714286		Basic Time Lag = (T)	t ₁ =	0.00	s.h ₁ = 1.00
720	1.8	0.3	0.1428571			t ₂ =	840.00	s.h ₂ = 0.09
780	1.86	0.24	0.1142857		Coefficient of Permeability (k) ms ⁻¹ =			8.41E-05
840	1.91	0.19	0.0904762					
Remarks								
Borehole cleaned out prior to test.								
Compiled By	JB	Date	17/11/2014					
Checked By	AR	Date	19/11/2014					
Geology of Test Section:		Red brown, slightly clayey, very gravelly, coarse occasionally medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.						
Tier Environmental Ltd								
Chadwick House					Project Number			
Birchwood Park					T/14/1400			
Warrington, WA3 6AE					Project Name			
Tel. 01925 818 388					Land at Rhosrobin			
					Client			
					Liberty Property			

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE										
BOREHOLE No.:		WS6	TEST No.:		2					
		DEPTH (m)	3.00		DATE		28/06/2016		SHEET	1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d ₁ -d ₀)	h _i /h ₀				
0	0	3	1		Test Section Depth	m	3
10	0.05	2.95	0.9833333		Borehole Depth	m	3
40	0.07	2.93	0.9766667		Borehole Diameter	m	0.103
120	0.09	2.91	0.97		Casing Depth	m	3
240	0.11	2.89	0.9633333		Depth to Standing Water Level (d ₁)	Assumed m	
360	0.13	2.87	0.9566667		Height of casing agl (h _c)	m	0
480	0.15	2.85	0.95		Height of top of casing above water table	m	0
600	0.175	2.825	0.9416667		Depth to Water at Start of Test below casing level (d ₀)	m	0
900	0.195	2.805	0.935		Depth to Water at End of Test below casing level	m	0
1200	0.23	2.77	0.9233333		Depth to Filter at Start of Test	m	
1800	0.3	2.7	0.9		Depth to Filter at End of Test	m	
2400	0.36	2.64	0.88		Response Zone Length	m	0
3000	0.415	2.585	0.8616667		Borehole Diameter in Test Section	m	0.103
3600	0.47	2.53	0.8433333		Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
					Basic Time Lag = (T)	t ₁ =	0.00
						t ₂ =	3600.00
						s ₁ h ₁ =	1.00
						s ₂ h ₂ =	0.84
					Coefficient of Permeability (k) ms ⁻¹ =		1.39E-06
<u>Remarks</u> Borehole cleaned out prior to test. Compiled By: JB Date: 17/11/2014 Checked By: AR Date: 19/11/2014 <u>Geology of Test Section:</u> Brown, slightly clayey, very gravelly, coarse SAND. Gravel is angular to subangular, fine to medium of quartzite and quartz.							