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Our Ref: 371293-L03 (00)

13th October 2014

Simon Robinson
Engineers Haskins Robinson Waters
Unit 2 Blue Lion Place
237 Long Lane
London
SE1 4PU

Dear Mr Robinson

Re: Revised Ground Movement Analysis in Response to CGL's Comments of 22nd July 2014

Further to CGL's comments of the 22nd July 2014, the revised cross-section of the site containing updated level information from SHH Architects (633(PL)005 Rev C see Appendix A) and updated drawings received from HRW (901/SK/020 P11 and 901/SK/023 P1 see Appendix B) we would make the following comments.

1. PROPOSED MODIFICATION TO KING POST WALL

It is understood from drawings 901/SK/020 P11 and 901/SK/023 P1 that it is intend to reduce the spacing of the king posts from 2.4m to 1.2m to stiffen the behaviour of the wall and facilitate construction adjacent to the boundary retaining wall. In addition to this it is understood that a wailing will be installed near the top of the wall and that stiff props will be adopted to support the wailing at this level at alternate king post locations. Further to this it is also understood that the existing concrete retaining wall located on the boundary between No.49 and the Waterhouse will be propped off the wailing at each king post location to prevent lateral movement.

Based on this modification it is our opinion that the proposed retaining wall can be considered as a High Stiffness wall for the purpose of carrying out a C580 movement assessment assuming that a high standard of workmanship is adopted during construction and that the temporary props are replaced as soon as possible by permanent props forming part of the permanent works. A suitably experienced and competent contractor should be able to ensure that the required standard of workmanship is achieved.

We have also carried out a further C580 movement assessment assuming the wall to be Moderately Stiff (mid way between stiff and flexible in CIRIA 580) for comparison purposes.

2. C580 MOVEMENT ASSESSMENT

In order to assess the likely movements to the various structures at 49 Fitzroy Park associated with the proposed basement excavation at the Waterhouse we have carried out movement analyses using the information contained in CIRIA 580. With regards to the comments made by CGL in their letter of 22nd July 2014 that the "*derivation of movements that RSK have used for the King Post wall is contentious*" we would note that CIRIA 580 covers king post walls as well as contiguous and secant pile walls.

For this purpose two analyses have been carried out the first assuming the wall to be of high stiffness as defined in CIRIA 580 and the second assuming it to be moderately stiff (mid way between high stiffness and flexible in CIRIA 580).

These analyses have considered the dimensions presented in Figure 1 recently provided by SHH Architects. These have also been summarised in Table 2.

Figure 1 Modified Cross-Section of the Site Produced by SHH Architects

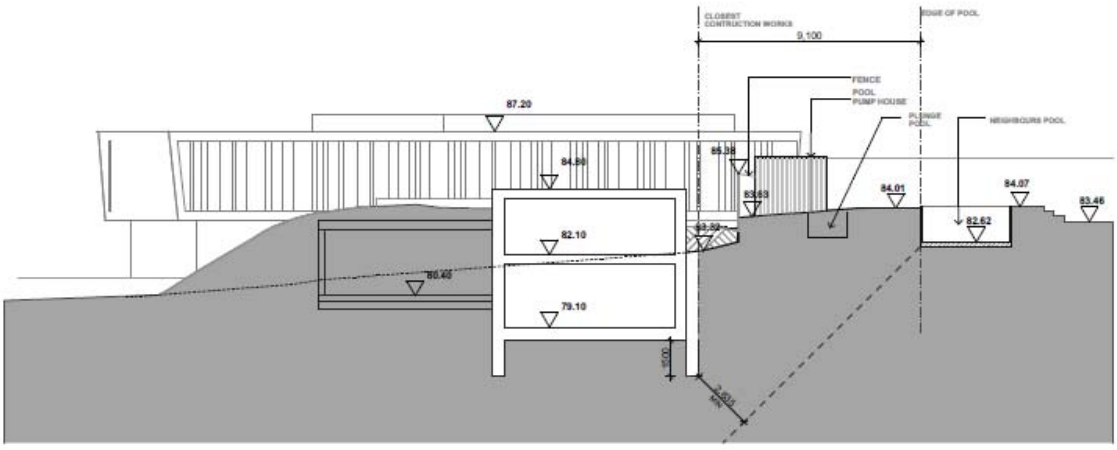


Table 2 Dimensions Used for CIRIA 580 Analyses

Structure	Retaining Wall Depth (m)	Excavation Depth (m)	Distance from Wall to Structure (m)	Length of Structure Perpendicular to Wall (m)	Distance to Back of Structure (m)
49 Fitzroy Park	10	4	12.4	5.2	17.6
Swimming Pool	10	4	9.1	3.8	12.9
Plunge Pool	10	4	5.6	1.7	7.3
Pump House	10	4	2.4	3.0	5.4

For the purpose of the analyses both the movements associated with installation of the retaining wall and those associated with excavation of the basement have been considered. With regards to the first of these the movements associated with the installation of a contiguous bored pile wall, as provided in CIRIA 580 have been adopted. This is considered to be a conservative approach as with the installation of a king post wall far less pile bores are required (every 1.2m) compared to a contiguous pile wall

(approximately every 0.6m). For the case of excavation, movements associated with both high and moderate stiffness walls have been considered.

High Stiffness Wall

The results of the movement analysis assuming the retaining wall to be of high stiffness are presented in Appendix C.

A summary of the estimated lateral and vertical movements are provided in Tables 2 and 3 below.

Table 2 Summary of Estimated Lateral Ground Movements Assuming a High Stiffness Retaining Wall Structure

Structure	Lateral Ground Movement due to Wall Installation (mm)		Lateral Ground Movement due to Basement Excavation (mm)		Total Lateral Ground Movement (mm)		Differential Lateral Ground Movement Front to Back (mm)	Lateral Ground Strain (%)
	Front	Back	Front	Back	Front	Back		
49 Fitzroy Park	0.42	0.00	1.35	0.00	1.77	0.00	**1.77**	0.054*
Swimming Pool	1.06	0.33	2.59	1.16	3.64	1.49	**2.15**	0.057
Plunge Pool	1.91	1.45	3.90	3.26	5.81	4.71	**1.10**	0.064
Pump House	3.07	1.97	5.10	3.98	8.17	5.95	**2.22**	0.074

* Strain calculated over shorter length than that of the building as zero movement at rear of building

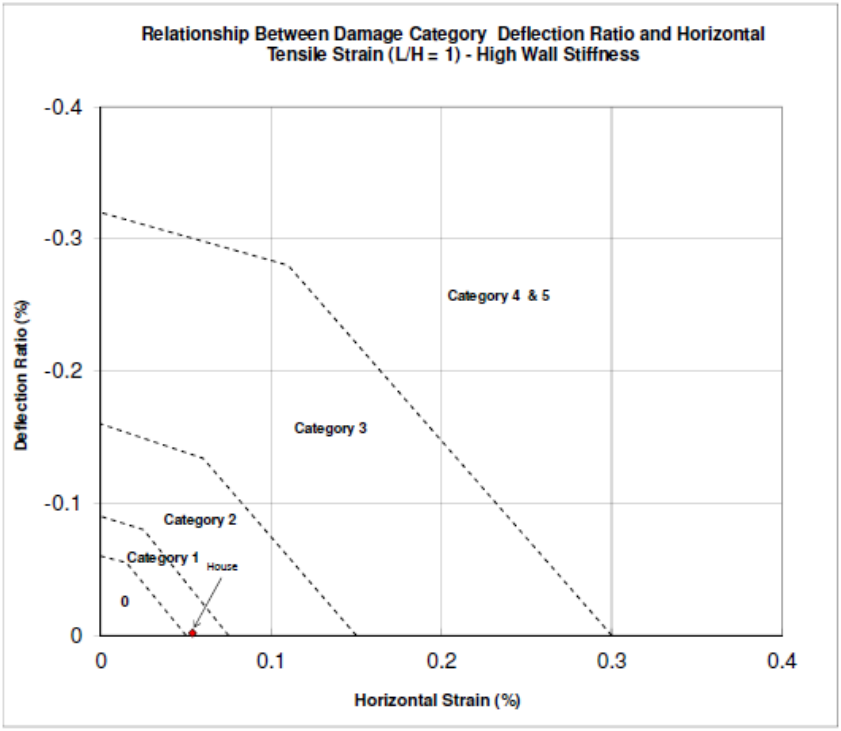
Table 3 Summary of Estimated Vertical Ground Movements Assuming a High Stiffness Retaining Wall Structure

Structure	Vertical Ground Movement due to Wall Installation (mm)		Vertical Ground Movement due to Basement Excavation (mm)		Total Vertical Ground Movement (mm)		Differential Vertical Ground Movement Front to Back (mm)	Deflection Ratio (%)
	Front	Back	Front	Back	Front	Back		
49 Fitzroy Park	1.52	0.48	0.33	0.00	1.85	0.48	1.37	-0.002
Swimming Pool	2.18	1.42	1.14	0.20	3.32	1.62	1.70	0
Plunge Pool	2.88	2.54	2.25	1.65	5.13	4.19	0.94	0
Pump House	3.52	2.92	3.18	2.33	6.70	5.25	1.46	0

From the results in Tables 2 and 3 it is clear that the lateral and vertical movements that are estimated to impact on the various structures are extremely small and very unlikely to cause any significant damage.

The associated deflection ratio and horizontal strain for No.49 Fitzroy Park has been plotted on a strain rosette in the way recommended in CIRIA 580 in Figure 2. This show the estimated damage to fall into Category 1 as defined in CIRIA 580 (see Appendix E) assuming a stiff retaining wall system is adopted. It should be stressed however that the damage categories that have been superimposed relate to masonry structures with mortar and as such are only relevant to the house at 49 Fitzroy Park. Such structures are far more susceptible to damage than the other structures considered which appear to be constructed of reinforced concrete and timber.

Figure 2 Strain Rosette Showing Damage Categories for No.49 Fitzroy Park Assuming High Stiffness Retaining Wall



Considering each of the other structures in turn assuming a High Stiffness retaining wall;

Swimming Pool

From the movement analysis carried out it is seen that there will be a differential lateral ground movement of 2.15mm between the front and back of the swimming pool. In reality the swimming pool will not stretch by this amount as there will be insufficient friction on the base of the pool to allow this to occur. As such there will be differential movement between the base of the pool and the soil.

Calculations indicate that the force required to stretch the pool by 2.15mm would be in the region of 5000kN/m length of the pool (based on a 300mm thick 3.8m long base slab comprising 30N/mm^2 concrete with a Young's Modulus of 30,000N/mm^2). The maximum friction on the base of the pool is unlikely to exceed 1% of this value and as such the pool will simply move forward as a monolith with almost no stretch or damage occurring.

The differential vertical movements will result in an extremely small tilt of the pool (1.7mm front to back). This will not lead to damage as the swimming pool will rotate as a monolith.

Plunge Pool

Similar arguments to those presented above can be made for the plunge pool. In reality however its small size and circular shape will mean that any differential movements are small and very unlikely to lead to damage. It is also noted that the plunge pool is located within the decking to the south of the main pool and it seems likely that it is in fact located above ground level.

Pump House

As with the other structures the Pump House is estimated to be subject to relatively small differential movements (2.22mm lateral and 1.46mm vertical). Given the flexible nature of its construction (appears to be timber) it is considered unlikely this will lead to significant damage. Even if this building is constructed of a less flexible material it is considered that its small dimension perpendicular to the proposed retaining wall will mean that only small lateral differential strains and deflection ratios will result.

Boundary Retaining Wall

As noted previously the concrete boundary retaining wall will be propped from the proposed king post wall. As such lateral movements will be limited to that of the props. Because the wall is relatively narrow the differential movement across its width will be small as will be the associated damage.

Moderate Stiffness Retaining wall

As mentioned earlier we have carried out a second movement analysis assuming moderate retaining wall stiffness. This has been based on an average of the movements calculated assuming a high wall stiffness and a low wall stiffness using the graphs in CIRIA 580. The results of this analysis are presented in Appendix D. A summary of the estimated lateral and vertical movements are provided in Tables 4 and 5 below.

Table 4 Summary of Estimated Lateral Ground Movements Assuming a Moderate Stiffness Retaining Wall Structure

Structure	Lateral Ground Movement due to Wall Installation (mm)		Lateral Ground Movement due to Basement Excavation (mm)		Total Lateral Ground Movement (mm)		Differential Lateral Ground Movement Front to Back (mm)	Lateral Ground Strain (%)
	Front	Back	Front	Back	Front	Back		
49 Fitzroy Park	0.42	0.00	2.48	0.00	2.90	0.00	**2.90**	0.085
Swimming Pool	1.06	0.33	4.74	2.13	5.80	2.46	**3.34**	0.088
Plunge Pool	1.91	1.45	7.15	5.98	9.06	7.43	**1.63**	0.096
Pump House	3.07	1.97	9.35	7.29	12.42	9.26	**3.16**	0.105

* Strain calculated over shorter length than that of the building as zero movement at rear of building

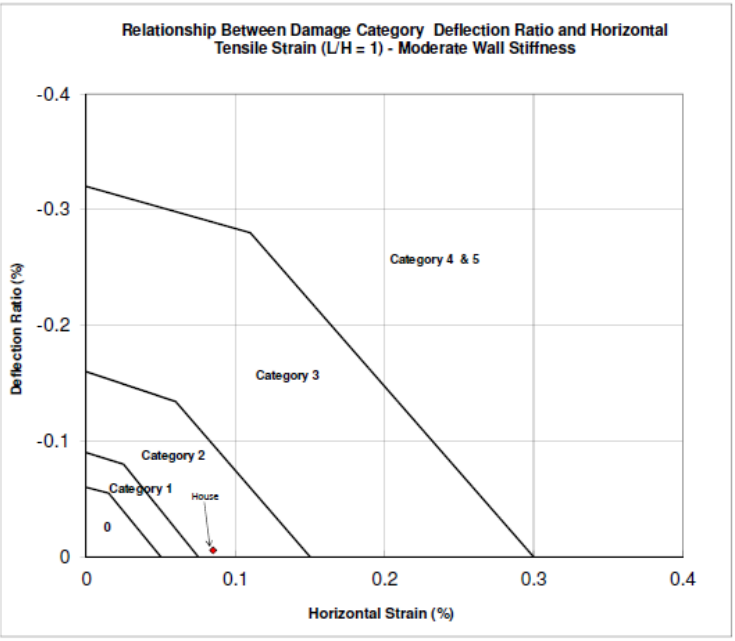
Table 5 Summary of Estimated Vertical Ground Movements Assuming a Moderate Stiffness Retaining Wall Structure

Structure	Vertical Ground Movement due to Wall Installation (mm)		Vertical Ground Movement due to Basement Excavation (mm)		Total Vertical Ground Movement (mm)		Differential Vertical Ground Movement Front to Back (mm)	Deflection Ratio (%)
	Front	Back	Front	Back	Front	Back		
49 Fitzroy Park	1.52	0.48	0.95	0.00	2.47	0.48	**1.99**	-0.006
Swimming Pool	2.18	1.42	2.32	0.80	4.50	2.22	**2.28**	0
Plunge Pool	2.88	2.54	4.35	3.31	7.23	5.85	**1.38**	0
Pump House	3.52	2.92	6.37	4.48	9.89	7.40	**2.49**	0

From the results in Tables 4 and 5 it is clear that the lateral and vertical movements that are estimated to impact on the various structures assuming a moderately stiff wall are still extremely small and very unlikely to cause any significant damage to the various structures.

The associated deflection ratios and horizontal strains for the house at 49 Fitzroy Park have been plotted on a strain rosette in the way recommended in CIRIA 580 in Figure 3. This show the estimated damage to fall into Category 2 as defined in CIRIA 580 (see Appendix E) assuming a moderately stiff retaining wall system is adopted. It should be stressed however that the damage categories that have been superimposed relate to masonry structures with mortar and as such are only relevant to the house at 49 Fitzroy Park. Such structures are far more susceptible to damage than the other structures considered which appear to be constructed of reinforced concrete and timber.

Figure 3 Strain Rosette Showing Damage Categories for No.49 Fitzroy Park Assuming Moderate Stiffness Retaining Wall



Considering each of the other structures in turn assuming a Moderate Stiffness retaining wall;

Swimming Pool

From the movement analysis carried out it is seen that there will be a differential lateral ground movement of 3.34mm between the front and back of the swimming pool. As noted previously the swimming pool will not stretch by this amount as there will be insufficient friction on the base of the pool to allow this to occur. As such there will be differential movement between the base of the pool and the soil.

The differential vertical movements will result in an extremely small tilt of the pool (2.28mm front to back). This will not lead to damage as the swimming pool will rotate as a monolith.

Plunge Pool

As note previously the small size and circular shape of the plunge pool will mean that any differential movements are small and very unlikely to lead to damage.

Pump House

As with the other structures the Pump House is estimated to be subject to relatively small differential movements (3.16mm lateral and 2.49mm vertical). Given the flexible nature of its construction (timber) it is considered unlikely this will lead to significant damage.

Boundary Retaining Wall

As noted previously the concrete boundary retaining wall will be propped from the proposed king post wall. As such lateral movements will be limited to that of the props. Because the wall is relatively narrow the differential movement across its width will be small as will be the associated damage.

3. CONCLUSION

In conclusion the proposed changes to the king post wall are considered to ensure it falls into the category of High Stiffness wall as defined in CIRIA 580 assuming that a high quality of workmanship is adopted. A suitably experienced and competent contractor should be able to ensure that this standard of workmanship is achieved.

Based on the High Stiffness wall assessment the damage to the house at No.49 Fitzroy Park falls into Damage Category 1 (very slight) as defined in CIRIA 580. Should the wall stiffness drop to moderate this will move to Damage Category 2 (slight). Both these damage categories are considered acceptable by Camden Planning Guidance document CPG4.

The other structures on site do not appear to be constructed of masonry and as such it is difficult to define a damage category. However review of the conservatively estimated lateral and vertical movements suggests that the resulting damage will be very small.

We trust that the above meets with your approval.

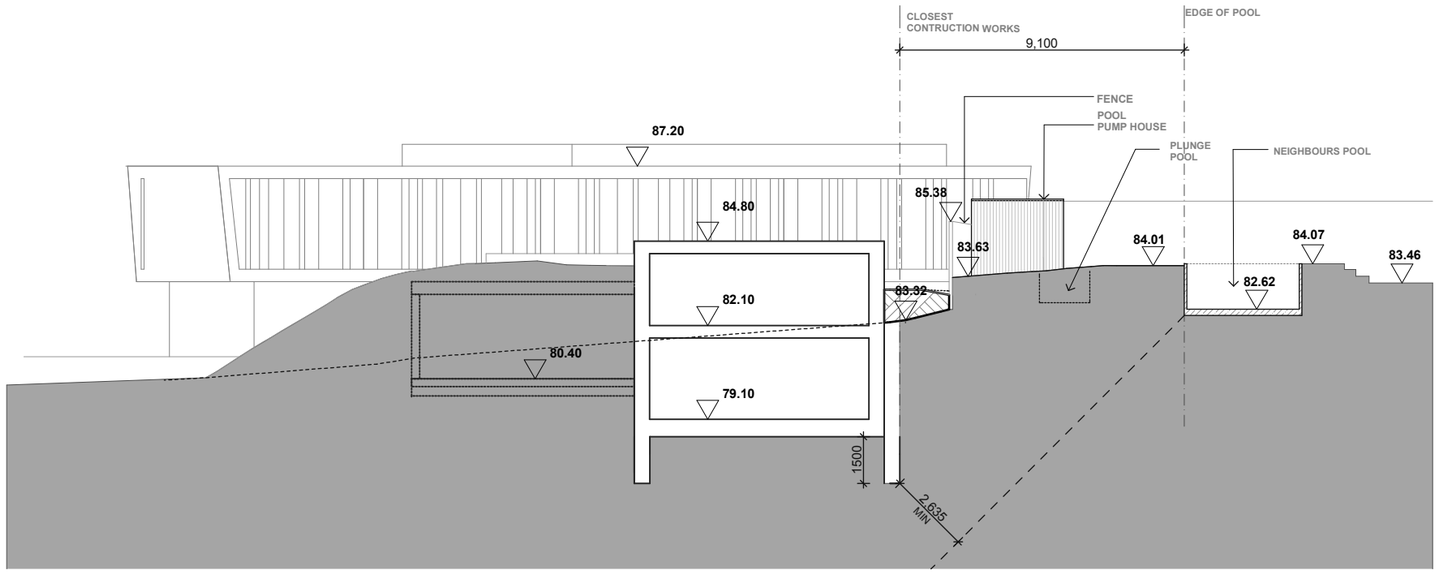
Yours sincerely,

Dr Shon Williams
Director of Geotechnics

Encl.

Appendix A	SHH Architects Drawings
Appendix B	Haskins Robinson Waters Drawings
Appendix C	Results of Ground Movement Assessment – High Stiffness Wall
Appendix D	Results of Ground Movement Assessment – Moderate Stiffness Wall
Appendix E	Damage Categories CIRIA 580

APPENDIX A



1

SCALE 1 : 100 @ A1

PROPOSED SITE SECTION B1-B1

1

SCALE 1 : 200 @ A1

PROPOSED SITE PLAN

Figured dimensions only are to be taken from this drawing. All dimensions are to be checked on site before any work is put in hand.

If in doubt, ask.

NOTES

APPLICATION SITE BOUNDARY

AOD 79.40 = **PROJECT LEVEL** 0.00

0 10m

Rev	Description	Drawn	Date	Checked
C	For Planning	PB	21.08.14	JSM
B	For Planning	PB	18.06.14	JSM
A	For Planning	PB	19.05.14	JSM
-	For Planning	PB	14.04.14	JSM

Spence Harris Hogan associates
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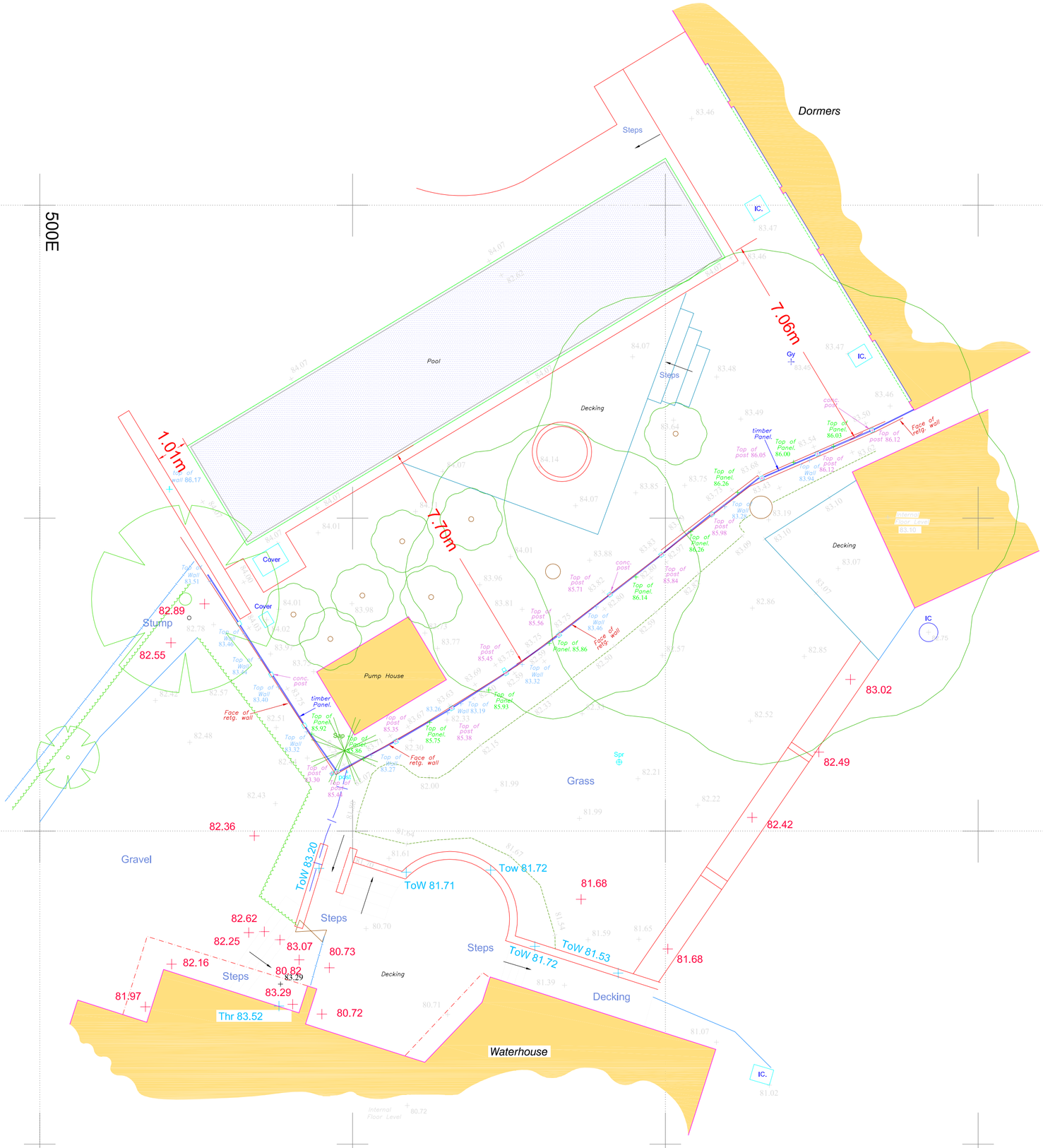
web : ww.shh.co.uk

Project No: 633	Project: The Water House
Author: JM	Site Address: Millfield Lane Highgate N6 6HQ
Checked: JSM	Client: Corp. City Dev. No. 2 Ltd
	Title: 000 Site Plans Site Section
Status: PLANNING	Scale A1: 1:100/ 200 / Scale A3: 1:400
Project no. / Stage / Drawing no.: 633(PL)005	Date: SEP. '11 / Revision: C



N

Topographical Survey Legend

B	Bollard	GV	Gas valve	rwp	Rain water pipe	Level prefix descriptions	
Bin	Litter bin	Hyd	Hydrant	SP	Soil pipe	AL	Arch level
BS	Bus stop	IC	Inspection cover	ST	Stop tap	BL	Bed level
BT	British telecom lc	JB	Junction box	Stay	Cable stay	CL	Cover level
CCTV	Cctv camera pole	LB	Letter box	SV	Stop valve	EL	Eaves level
CTV	Cable television cover	LB	Letter box	TCB	Telecomms cab box	FL	Floor level
DR	Drain	LP	Lamp post	TL	Traffic light	IL	Invert level
Elec	Electricity	Mkr	Utility marker	TP	Telegraph pole	PL	Parapet level
EP	Elec. pole	MP	Mile post	TPS	Tactile paving slabs	RL	Roof/ridge level
ER	Earth rod	NP	Name plate	VP	Vent pipe	SL	Soffit level
FP	Flagpole	P	Post	WM	Water meter	Spr	Arch springing level
FL	Floodlight	PM	Parking meter	WC	Water outlet	TL	Top level
G	Gully	RE	Rodding eye	U/L	Unable to lift	Thr	Threshold level
GP	Gate post	RS	Road sign			WL	Water level

Fence annotation: B/W Barbed wire; C/B Closed boarded; C/L Chain link; C/L Chain link; C/P Concrete panel; H/R Hand rail; I/R Iron railings; O/B Open boarded; P/C Post & chain; P/R Post & rail; P/W Post & wire; W/M Wire mesh

Fence; Safety barrier; Gate; Stile; Hedge; Limit of foliage & tree canopy; Spot level; SSL1 50.00 Survey control station (Coordinated point); Tree

Levels definting edge of carriageway are observed at channel (bottom of kerb). Unless otherwise stated.

Legend:

	Buildings / walls	TT	Tac-tile (paving)
	Kerb line	TS	Traffic Signal Duct
	Edge of surface	Elec	Electric
	Canopy / Overhang	BT	British Telecom
Fence types:	Hedge		
HW	Interwoven	Fh	Fire Hydrant
MR	Metal Railings	St	Stop tap
WM	Wire Mesh	Sv	Stop valve
PR	Post & Rail	Wo	Wash Out
PW	Post & Wire	Wm	Water Meter
CL	Chain Link	Mkr	Service Marker
WP	Wooden Panels	Re	Rodding eye
CP	Concrete Panels	Av	Air Valve
SP	Steel Palisade	Fl	Floodlight
	Chamber	Lp	Lamp Post
	Woodland	Sp	Sign Post
	Canopy Hatch	Ep	Electricity Post
1	Station and Name	Tp	Telegraph Post
100,000	Station Level	TL	Traffic light
	Tree / Bush / Sapling	Bs	Bus Stop
	Area of Undergrowth	Lb	Litter Bin
	Gate	Bo	Bollard
Gy	Gully	Pb	Post box
P.Inv ⌀0.25	Pipe Invert (diameter)	BP	Brick Paving Slabs
IC	Inspection chamber	Er	Earth rod
CVR	Unidentified Inspection Cover	CPS	Concrete Paving Slabs
MH	Manhole	IFL	Internal floor level
		THL	Threshold level
		Gas	Gas Valve
		TCL	Tree Canopy Level
		G	Tree Girth (m)
		MG	Multi-girth Tree
		FRL	Flat Roof Level
		RL	Ridge Level
		EL	Eaves Level

Rev	Date	Description	Drawn	Q. Ref

greenhatch group
Topographical Surveys
Site Engineering
Measured Building Surveys
3D Laser Scanning
Rowan House
Duffield Road
Little Eaton
Derby
DE21 5DR
Tel (01332) 830044 Fax (01332) 830055
admin@greenhatch-group.co.uk

CLIENT
Shh Architects

PROJECT
Fitzroy Park London

TITLE
Topographical Survey Boundary Levels

SCALE	DATE	DRAWN	QUALITY REF
1: 100	08.08.14	CM	G0581

Level datum	Previous Survey Datum
Grid orientation	Previous Survey Datum
Job number	14624

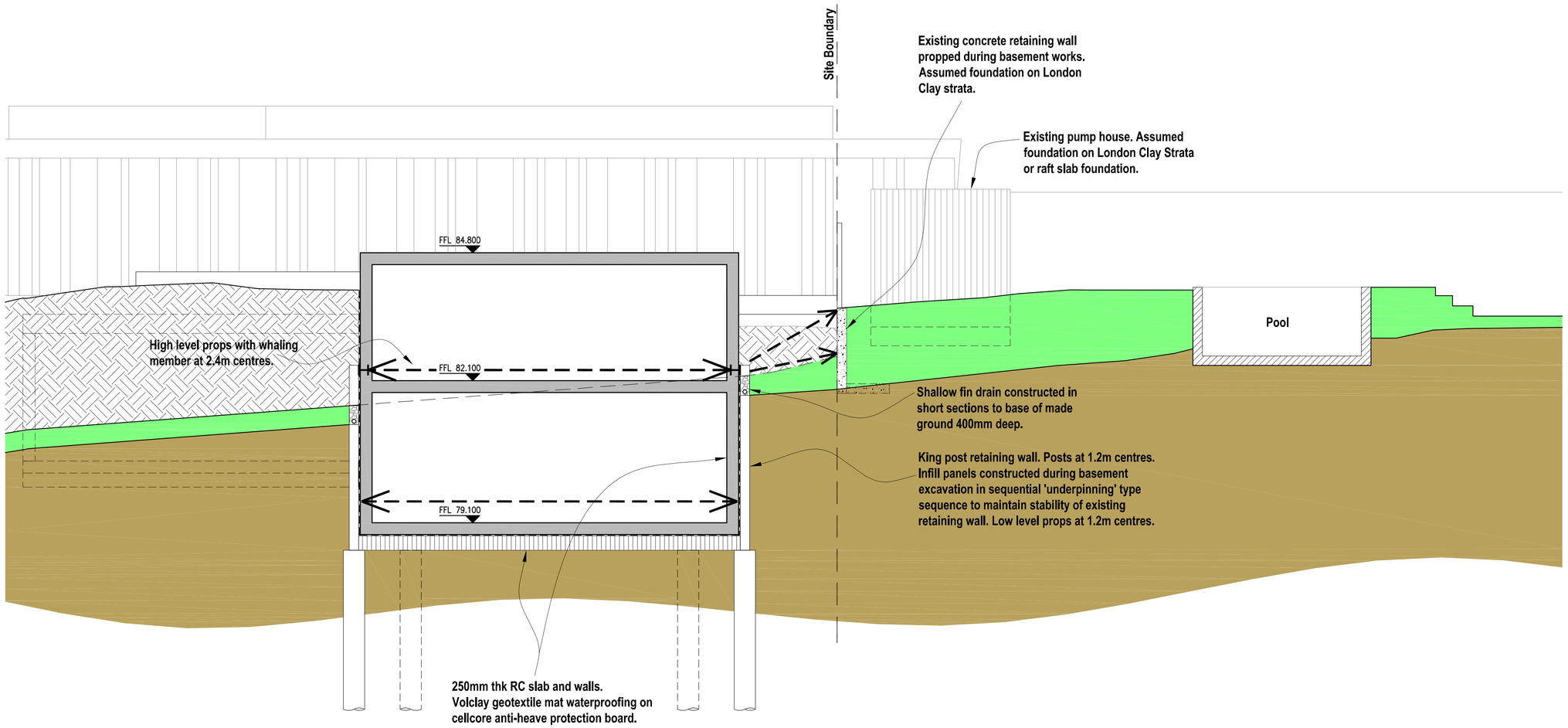
Drawing No.: 14624_01_P — Rev.:

Comments
This plan should only be used for its original purpose. GreenHatch Ltd accepts no responsibility for this plan if supplied to any party other than the original client.
All dimensions should be checked on site prior to design and construction.
Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

DO NOT SCALE

APPENDIX B



Section E-E

LEGEND

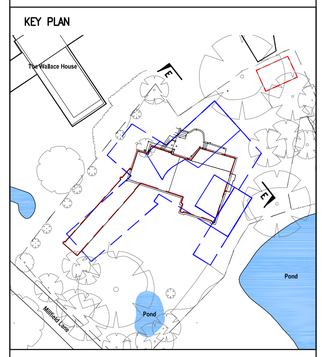
1. FOR SECTIONS LOCATION SEE DRG. 901/SK/020

- EXISTING BUILDING
- MADE GROUND
- EXISTING POND
- LONDON CLAY
- VOID FORMER (CELLCORE)
- POSSIBLE GROUNDWATER FLOW OVER CLAY.

FFL 80.500 PROPOSED FINISHED FLOOR LEVEL

EX 80.500 EXISTING GROUND LEVEL

KEY PLAN



Rev.	Date	Amendment	By	Chk'd
P1	07.10.14	PRELIMINARY ISSUE	AR	SR

PLANNING

engineers
Haskins Robinson Waters
Unit 2, Blue Lion Place, 237 Long Lane, London. SE1 4PU
Tel: 020 7407 9575
Fax: 020 7407 9571
Email: mail@engineers-hrw.co.uk

Project:
Water House
Highgate

Drawing title:
Hydro Geological
Section E-E

Date	Scale	Drawn by:
OCT'14	1:50 @ A1 1:100 @ A3	AR
Cad file No. 901_Sk_023.dwg		Chk'd by: SR

Drawing No: **901/SK/023** Revision: **P1**

Investigation / Monitoring Works

1. Ground Penetration Radar Survey To Confirm Existence/Extent Of Any Land Drains In Area Of Basement Construction Prior To Works And Any Necessary Diversions To Be Undertaken
2. The Site Has A Sensitive Local Ground Water Hydrology And Mitigating Measures Are Required To Avoid Any Contamination Of The Water Course. Temporary And Permanent Land Drainage Proposed.

See Further Proposed Investigation Works ③ - ⑤ Refer To SWP Drawings For Drainage Details.

Refer To SWP Drawings For Drainage Details

Key To Investigation

LOCATION

- BOREHOLE – BH1 (0.2m) – DEPTH OF MADE GROUND
- WINDOW SAMPLE LOCATION WS1–6 (0.2m) – DEPTH OF MADE GROUND
- TRIAL PIT – TP1–4 (NO TP2)

Existing Foundations Removed. New Fin Drain Provided Around Proposed Basement In Both The Temporary and Permanent Conditions Improves Water Flow.

Inert Soil From Excavations Relocated On Site Where Possible Avoiding Root Protection Areas

The Wallace House

Pool

No. 49 Fitzroy Park

No. 51 Fitzroy Park

No. 53 Fitzroy Park

⑤ Monitoring

No Change In Levels Proposed to Boundaries With No's 49+51+53. Ground Water Levels to be Monitored During construction

④ Investigation

Existence Of Spring Below Existing Building To Be Investigated During Demolition.

Existing retaining wall back propped of king post during basement construction.

BH2 (0.4m)

WS6 (0.5m)

WS4 (1.4m)

TP4

Spring

WS1 (0.2m)

TP3

BH1 (0.5m)

TP1

WS3 (1.2m)

WS2 (1.2/2.0m)

WS5 (1.2m)

Temporary Works To Basement Adjacent To Boundary To Be Fully Cross Propped At High And Low Level During Construction To Minimise Lateral Movement And Ensure Any Ground Movement Is Within Acceptable Values.

Adjacent to existing retaining wall king posts to be constructed at 1.2m centres. Infill panels constructed in serquential underpinning type sequence to maintain stability of wall.

Low Retaining Wall To Garage Boundary 0 To 1.4m Full King Post Permeable Retaining Wall Construction.

Existing Pond At Higer Level.

Pond

No Change To Level On Boundary.

③ Investigation / Monitoring

Local Hydrology And Possible Ground Water Linkage To Existing Pond To Be Further Investigated. Prior to Construction And Mitigation Documentation + Monitoring Put In Place If Necessary

Swimming Pool (Half Basement)

Ornamental Pond Investigated As Part Of Site Investigation.

Boundary Temporary Cut Off Drain At Surface Level In Root Protection Build up To Trap Excess Surface Water Flow Taken To Settlement Tank.Temporary Discharge To Storm Water System. See Detailed Section SK022

Millfield Lane

General Slope

A/SK021 B/SK021 C/SK021 D/SK022 E/SK021

83.31 82.89 82.38 83.06 82.74 82.55 82.49 81.64 81.47 81.65 81.86 80.64 80.57 81.68 85.81 81.40 81.49 81.29 81.47 81.41 81.00 80.82 80.46 80.61 80.26 80.29 80.74 80.77 80.30 80.10 81.04 80.94 80.51 80.31 80.68 80.22 80.36 80.40 80.20 80.26 80.03 80.00 79.77 79.12 79.76

2400 2400 2400

Rev.	Date	Amendment	By	Chk'd
P11	07.10.14	REVISED AS CLOUDED	ARR	SR
P10	23.05.14	REVISED AS CLOUDED	DB	SR
P9	18.02.13	INVESTIGATION/ MONITORING NOTES REVISED	DJP	SR
P8	15.02.13	PLANNING ISSUE	DJP	SR
P7	17.01.13	REDRAWN, DRAWING TO BE READ IN CONJUNCTION WITH DRAWING 019.	DB	SR
P6	21.06.11	BASEMENT TO WING AND EXTERNAL POOL REMOVED	DJP	SR
P5	26.05.11	POND AMENDED, DEPTH OF MADE GROUND ADDED.	DB	SR
P4	16.05.11	No. 53 DESIGN PROPOSALS ADDED, EXISTING POND REVISED	MH	SR
P3	05.05.11	REVISED AS CLOUDED	MH	SR
P2	25.02.11	EXISTING BUILDING REVISED	MH	SR
P1	01.02.11	PRELIMINARY ISSUE	DB	SR

PLANNING

LEGEND

- EXISTING BUILDING
- PROPOSED BASEMENT STRUCTURE
- PROPOSED GROUND FLOOR STRUCTURE
- ASSUMED SITE BOUNDARY
- TEMPORARY LAND DRAIN
- 83.00 EXISTING LEVEL
- APPROXIMATE LINE OF CLAYGATE BEDS
- MINOR SURFACE/PERCHED WATER FLOW OVER CLAY NAVIGATES AROUND BUILDINGS
- EXISTING/PROPOSED ADJACENT BASEMENTS

engineers
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Project:
Water House
Highgate

Drawing title:
Hydro Geological Schematics

Date	Scale	Drawn by
28.01.11	1:100 @ A1 1:200 @ A3	MH
Cad file No. 901_sk_020.dwg		Chk'd by: SR

Drawing No: **901/SK/020** Revision: **P11**

APPENDIX C

CIRIA C580 EMBEDDED RETAINING WALL ASSESSMENT

Wall Stiffness	High Stiffness

Base Data

	Section	Estimated Wall Depth	Excavation Depth	Distance to Face of Adjacent Property	Length of Adjacent Property Perpendicular to Wall	Distance to Far Side of Adjacent Property	L/W_D Face of Adjacent Property	L/W_D Far Side of Adjacent Property	L/D Face of Adjacent Property	L/D Far Side of Adjacent Property
		(m)	(m)	(m)	(m)	(m)				
		W_D	D	L						
49 Fitzroy Park		10.0	4.0	12.4	5.2	17.6	1.24	1.76	3.10	4.40
Swimming pool		10.0	4.0	9.1	3.8	12.9	0.91	1.29	2.28	3.23
Plunge Pool		10.0	4.0	5.6	1.7	7.3	0.56	0.73	1.40	1.83
Pump House		10.0	4.0	2.4	3.0	5.4	0.24	0.54	0.60	1.35

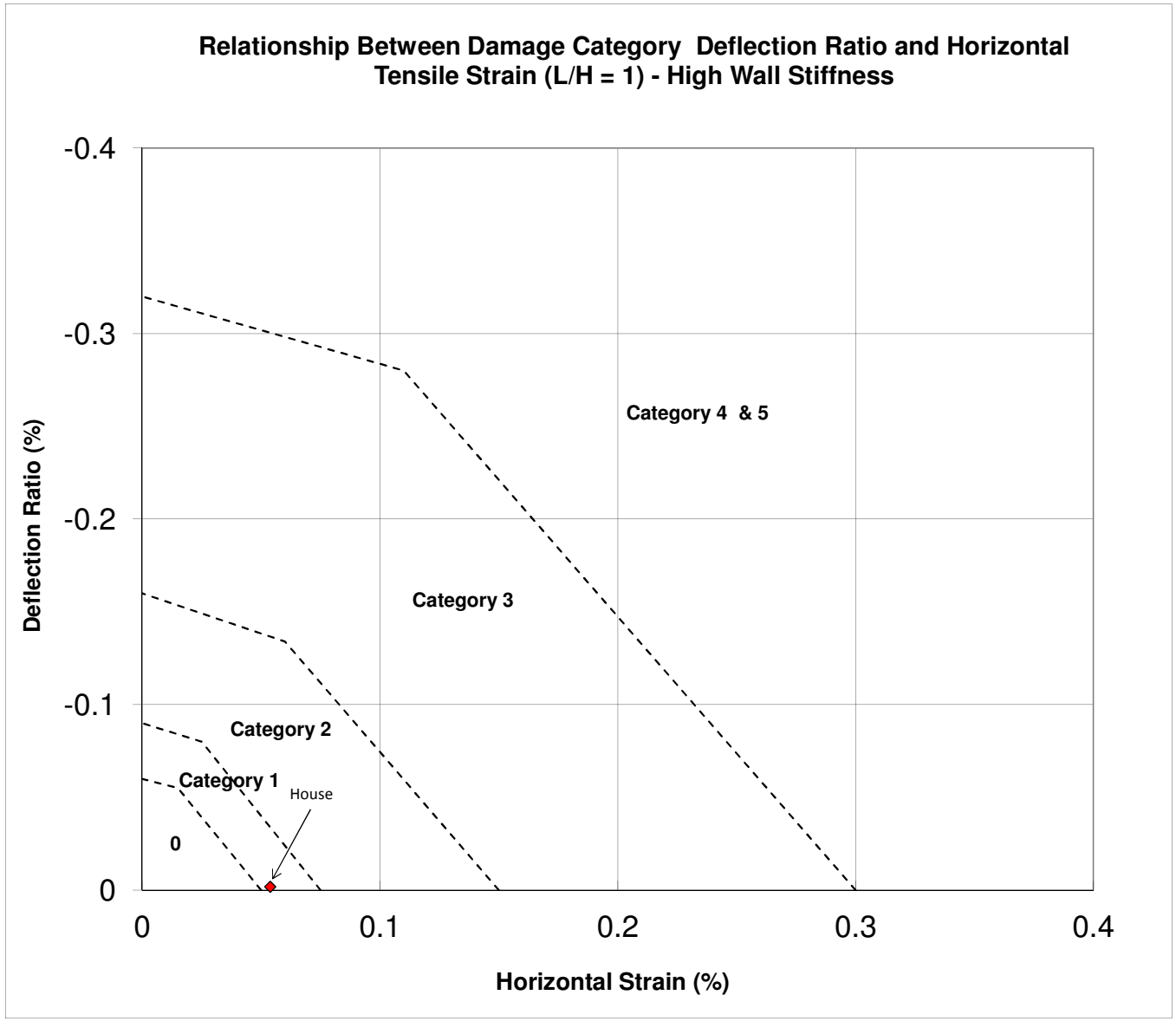
Empirically Estimated Displacements - Wall Installation

	Immediately to Rear of Wall				At Face of Adjacent Property				Distance from Wall to Point of Zero Lateral Displacement	Distance from Face of Property to Point of Zero Lateral Displacement	Lateral Δ at rear face of Adjacent Property	Lateral Δ at rear face of Adjacent Property	Horizontal Strain ε_h	Distance from Wall to Point of Zero Vertical Displacement	Distance from Face of Property to Point of Zero Vertical Displacement	Vertical Δ at rear face of Adjacent Property	Vertical Δ at rear face of Adjacent Property	Deflection Ratio
	Lateral Δ	Lateral Δ	Vertical Δ	Vertical Δ	Lateral Δ	Lateral Δ	Vertical Δ	Vertical Δ										
	$\%W_D$	(mm)	$\%W_D$	(mm)	$\%W_D$	(mm)	$\%W_D$	(mm)	(m)	(m)	$\%W_D$	(mm)	%	(m)	(m)	$\%W_D$	(mm)	%
49 Fitzroy Park	0.040	4.0	0.040	4.0	0.004	0.4	0.015	1.5	15.0	2.6	0.000	0.0	0.016	20.0	7.6	0.005	0.5	0.000
Swimming pool	0.040	4.0	0.040	4.0	0.011	1.1	0.022	2.2	15.0	5.9	0.003	0.3	0.019	20.0	10.9	0.014	1.4	0.000
Plunge Pool	0.040	4.0	0.040	4.0	0.019	1.9	0.029	2.9	15.0	9.4	0.015	1.5	0.027	20.0	14.4	0.025	2.5	0.000
Pump House	0.040	4.0	0.040	4.0	0.031	3.1	0.035	3.5	15.0	12.6	0.020	2.0	0.037	20.0	17.6	0.029	2.9	0.000

Empirically Estimated Displacements Due to Excavation

	Immediately to Rear of Wall				At Location of Adjacent Structure				Distance from Wall to Point of Zero Lateral Displacement	Distance from Face of Property to Point of Zero Lateral Displacement	Lateral Δ at rear face of Adjacent Property	Lateral Δ at rear face of Adjacent Property	Horizontal Strain ε_h	Distance from Wall to Point of Zero Vertical Displacement	Distance from Face of Property to Point of Zero Vertical Displacement	Vertical Δ at rear face of Adjacent Property	Vertical Δ at rear face of Adjacent Property	Deflection Ratio
	Lateral Δ	Lateral Δ	Vertical Δ	Vertical Δ	Lateral Δ	Lateral Δ	Vertical Δ	Vertical Δ										
	%D	(mm)	%D	(mm)	%D	(mm)	%D	(mm)	(m)	(m)	%D	(mm)	%	(m)	(m)	%D	(mm)	%
49 Fitzroy Park	0.150	6.0	0.040	1.6	0.034	1.4	0.008	0.3	16.0	3.6	0.000	0.0	0.038	16.0	3.6	0.000	0.0	-0.002
Swimming pool	0.150	6.0	0.040	1.6	0.065	2.6	0.029	1.1	16.0	6.9	0.029	1.2	0.038	16.0	6.9	0.005	0.2	0.000
Plunge Pool	0.150	6.0	0.040	1.6	0.098	3.9	0.056	2.2	16.0	10.4	0.082	3.3	0.038	16.0	10.4	0.041	1.6	0.000
Pump House	0.150	6.0	0.040	1.6	0.128	5.1	0.080	3.2	16.0	13.6	0.099	4.0	0.038	16.0	13.6	0.058	2.3	0.000

	Combined	
	Horizontal Strain ε_h	Deflection Ratio Δ/L
	%	%
49 Fitzroy Park	0.054	-0.002
Swimming pool	0.057	0.000
Plunge Pool	0.064	0.000
Pump House	0.074	0.000


Relationship Between Damage Category Deflection Ratio and Horizontal Tensile Strain (L/H = 1) - High Wall Stiffness
-0.4
-0.3
-0.2
-0.1
0
Deflection Ratio (%)
Category 4 & 5
Category 3
Category 2
Category 1
0
House
0
0.1
0.2
0.3
0.4
Horizontal Strain (%)

APPENDIX D

CIRIA C580 EMBEDDED RETAINING WALL ASSESSMENT

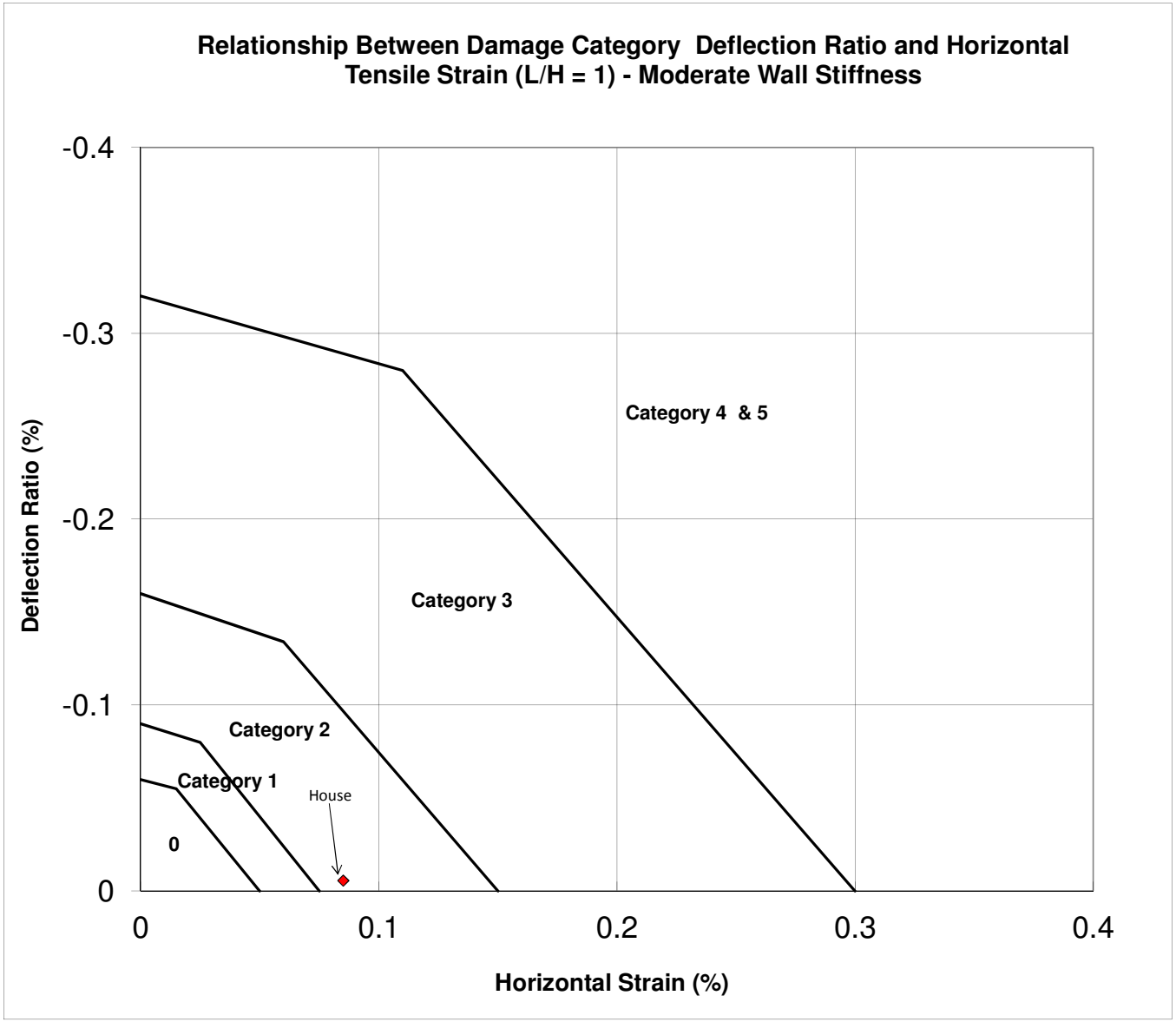
Wall Stiffness	Medium Stiffness

Base Data										
	Section	Estimated Wall Depth	Excavation Depth	Distance to Face of Adjacent Property	Length of Adjacent Property Perpendicular to Wall	Distance to Far Side of Adjacent Property	L/W_D Face of Adjacent Property	L/W_D Far Side of Adjacent Property	L/D Face of Adjacent Property	L/D Far Side of Adjacent Property
		(m)	(m)	(m)	(m)	(m)				
		W_D	D	L						
49 Fitzroy Park		10.0	4.0	12.4	5.2	17.6	1.24	1.76	3.10	4.40
Swimming pool		10.0	4.0	9.1	3.8	12.9	0.91	1.29	2.28	3.23
Plunge Pool		10.0	4.0	5.6	1.7	7.3	0.56	0.73	1.40	1.83
Pump House		10.0	4.0	2.4	3.0	5.4	0.24	0.54	0.60	1.35

Empirically Estimated Displacements - Wall Installation																		
	Immediately to Rear of Wall				At Face of Adjacent Property				Distance from Wall to Point of Zero Lateral Displacement	Distance from Face of Property to Point of Zero Lateral Displacement	Lateral Δ at rear face of Adjacent Property	Lateral Δ at rear face of Adjacent Property	Horizontal Strain ε_h	Distance from Wall to Point of Zero Vertical Displacement	Distance from Face of Property to Point of Zero Vertical Displacement	Vertical Δ at rear face of Adjacent Property	Vertical Δ at rear face of Adjacent Property	Deflection Ratio
	Lateral Δ	Lateral Δ	Vertical Δ	Vertical Δ	Lateral Δ	Lateral Δ	Vertical Δ	Vertical Δ										
	$\%W_D$	(mm)	$\%W_D$	(mm)	$\%W_D$	(mm)	$\%W_D$	(mm)	(m)	(m)	$\%W_D$	(mm)	%	(m)	(m)	$\%W_D$	(mm)	%
49 Fitzroy Park	0.040	4.0	0.040	4.0	0.004	0.4	0.015	1.5	15.0	2.6	0.000	0.0	0.016	20.0	7.6	0.005	0.5	0.000
Swimming pool	0.040	4.0	0.040	4.0	0.011	1.1	0.022	2.2	15.0	5.9	0.003	0.3	0.019	20.0	10.9	0.014	1.4	0.000
Plunge Pool	0.040	4.0	0.040	4.0	0.019	1.9	0.029	2.9	15.0	9.4	0.015	1.5	0.027	20.0	14.4	0.025	2.5	0.000
Pump House	0.040	4.0	0.040	4.0	0.031	3.1	0.035	3.5	15.0	12.6	0.020	2.0	0.037	20.0	17.6	0.029	2.9	0.000

Empirically Estimated Displacements Due to Excavation																		
	Immediately to Rear of Wall				At Location of Adjacent Structure				Distance from Wall to Point of Zero Lateral Displacement	Distance from Face of Property to Point of Zero Lateral Displacement	Lateral Δ at rear face of Adjacent Property	Lateral Δ at rear face of Adjacent Property	Horizontal Strain ε_h	Distance from Wall to Point of Zero Vertical Displacement	Distance from Face of Property to Point of Zero Vertical Displacement	Vertical Δ at rear face of Adjacent Property	Vertical Δ at rear face of Adjacent Property	Deflection Ratio
	Lateral Δ	Lateral Δ	Vertical Δ	Vertical Δ	Lateral Δ	Lateral Δ	Vertical Δ	Vertical Δ										
	%D	(mm)	%D	(mm)	%D	(mm)	%D	(mm)	(m)	(m)	%D	(mm)	%	(m)	(m)	%D	(mm)	%
49 Fitzroy Park	0.275	11.0	0.195	7.8	0.062	2.5	0.024	0.9	16.0	3.6	0.000	0.0	0.069	16.0	3.6	0.000	0.0	-0.006
Swimming pool	0.275	11.0	0.195	7.8	0.119	4.7	0.058	2.3	16.0	6.9	0.053	2.1	0.069	16.0	6.9	0.020	0.8	0.000
Plunge Pool	0.275	11.0	0.195	7.8	0.179	7.2	0.109	4.3	16.0	10.4	0.150	6.0	0.069	16.0	10.4	0.083	3.3	0.000
Pump House	0.275	11.0	0.195	7.8	0.234	9.4	0.159	6.4	16.0	13.6	0.182	7.3	0.069	16.0	13.6	0.112	4.5	0.000

	Combined	
	Horizontal Strain ε_h	Deflection Ratio Δ/L
	%	%
49 Fitzroy Park	0.085	-0.006
Swimming pool	0.088	0.000
Plunge Pool	0.096	0.000
Pump House	0.105	0.000


Relationship Between Damage Category Deflection Ratio and Horizontal Tensile Strain (L/H = 1) - Moderate Wall Stiffness
-0.4
-0.3
-0.2
-0.1
0
Deflection Ratio (%)
Category 4 & 5
Category 3
Category 2
Category 1
0
House
0
0.1
0.2
0.3
0.4
Horizontal Strain (%)

APPENDIX E

Table 2.5 *Classification of visible damage to walls (after Burland* et al, *1977, Boscardin and Cording, 1989; and Burland, 2001)*

Category of damage	Description of typical damage (ease of repair is underlined)	Approximate crack width (mm)	Limiting tensile strain ε_{lim} (per cent)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible.	< 0.1	0.0–0.05
1 Very slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection.	< 1	0.05–0.075
2 Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly.	< 5	0.075–0.15
3 Moderate	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5–15 or a number of cracks > 3	0.15–0.3
4 Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 but also depends on number of cracks	> 0.3
5 Very severe	This requires a major repair involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	usually > 25 but depends on number of cracks.	

Notes

1. In assessing the degree of damage, account must be taken of its location in the building or structure.
2. Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.