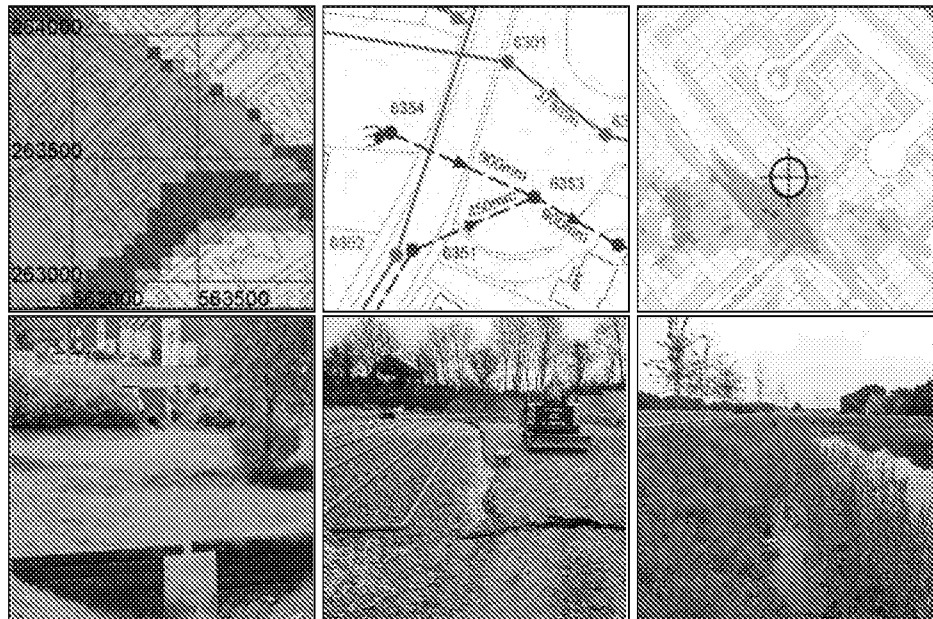




Flood Risk Assessment and Drainage Strategy

Sefter Farm Pagham, West Sussex

Reference: 21058

Issue: Date:

1 31/7/2021

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Appendices

A	Existing Layout & Proposed Site Layout
B	EA Flood Mappings, Local Sewer Plan & Soils Data
C	Surface Water Assessment
D	Conditions & Limitations

1. Introduction

- 1.1 Instructions were received from Barfoots of Botley to undertake a Flood Risk Assessment (FRA) and set out a Drainage Strategy (DS) for a planning application for the development a packhouse and relocation of a car park at Sefter Farm, Pagham, West Sussex.
- 1.2 This assessment has been undertaken by A P Traves BSc CEng MStructE MCIHT.
- 1.3 The client's attention is drawn to the conditions and limitations contained in Appendix D.

2. Development Description & Location

- 2.1 The site comprises part of the estate access and circulation roads, a gravel car park and part of the field to the east of the farm building complex amounting to of some 2.5 Ha located at Sefter Farm, Pagham Road, Pagham, West Sussex (grid ref 489300 099650). The site extents are indicated on the annotated aerial photograph and Curtis Leeves Technical location plan 2102-001-02 contained in Appendix A. An extract of the topographic survey is shown on the drawing contained in Appendix A of this report.
- 2.2 It is proposed to develop a new yard on the existing car park with adjacent packhouse and to relocate the existing car park to the field to the east. The proposed layout is identified on Curtis Leeves Technical drawing number 2102-005-09 contained in Appendix A of this report.

3. Local Development Documents & Strategic Flood Risk Assessment

- 3.1 The Arun DC Strategic Flood Risk Assessment (SFRA) has been reviewed and this indicates the following:
- 3.2 SFRA map set A1 indicates the site is located in Flood Zone FZ1.
- 3.3 SFRA map set C1 indicates the site will remain outside the 2106 climate change flood risk area.
- 3.4 SFRA map G1 indicates the site is in a region with a medium susceptibility to groundwater flooding.
- 3.5 SFRA map H does not indicate any historical flooding to the site.
- 3.6 SFRA map S does not indicate any historical sewer flooding to the site.
- 3.7 SFRA map W does not indicate the site to be in an EA flood warning area.
- 3.8 Flood mapping data has been reviewed from the Environment Agency (EA) website. (refer to Appendix B). This indicates the following:
- 3.9 The EA mapping indicates the site is located in FZ1.
- 3.10 The EA mapping indicates the site is generally at very low (<0.1% AEP) surface water flood risk. The area of medium to low surface water flood risk indicated towards the eastern side of the present car park is considered to be a legacy indication from the previous presence of an earthwork bund on this alignment which is no longer present. Surface water can no longer accrue at this location as the site morphology retains an overall east to west fall.
- 3.11 The EA mapping indicates the site is not in an area of reservoir flood risk.

4. Catchment Flood Management & Shoreline Management Plans

- 4.1 The site is at an elevation of some 5-6 m AOD and is remote from the influence of tidal flooding. Shoreline Management Plans are not applicable at this location.

- 4.2 The Arun and Western Streams Catchment Flood Management plan summary – December 2009 (CFMP) indicates the site falls within sub-area 8 Manhood peninsula and Upper Chalk Streams Catchments. The CFMP states that policy 3 is the preferred policy approach:

“Areas of low moderate or high flood risk where we are generally managing existing flood risk effectively.”

- 4.3 Overall the SMP and CFMP do not present any issues that would prohibit the development of this site with respect to flood issues provided the surface water drainage is based on SuDS principles.

5. Catchment Data

- 5.1 The BGS mapping indicates the site geology to comprise River Terrace Deposits over London Clay.
- 5.2 The River Terrace Deposits are of low permeability. The soil permeability test results from February 2018 and contained in Appendix B. The infiltration rate of 1.53×10^{-6} m/sec is insufficient for infiltration drainage.

6. Sewage Authority Data

- 6.1 The site is remote from the public sewer network and is served by private on site sewer network.
- 6.2 The new packhouse will connect to the private foul sewer network within the site.

7. Site Particulars

- 7.1 The site comprises some 2.5 Ha of the Seftor Farm estate including the estate access and part of the circulation road, a gravel car park and part of the field to the east of the farm building complex.
- 7.2 The site falls east to west from some 5.8m AOD adjacent Pagham Road to some 5.3m AOD in the car on the western edge of the development area.
- 7.3 The existing estate access and circulation roads are of concrete pavement construction.
- 7.4 The existing staff car park is of porous gravel construction.
- 7.5 Surface water run-off from the existing roads and car park is harvested into the agricultural reservoir complex operated by the farm. A copy of the existing drainage layout is shown on Archibald Shaw drawing 28725-101-C2 a copy of which is contained in Appendix B.
- 7.6 The surrounding land use comprises the farm complex and agricultural fields and reservoirs.

8. Source-Pathway-Receptor Assessment

- 8.1 The site is at an elevation of above 5-6m AOD and is not susceptible to tidal flooding.
- 8.2 The EA mapping indicates the site is at very low risk of surface water flooding. The low to medium surface water flood risk area indicated on EA mapping is a legacy mapping anomaly relating to a previous earthwork bank which is no longer present. Paragraph 3.10 refers.
- 8.3 The EA mapping indicates the site is not at risk of reservoir flooding.
- 8.4 The site is remote from the public sewer network.

- 8.5 The critical flood source is pluvial flooding and run-off within the site. The site surface water system will accord with the principles of CIRIA C753.
- 8.6 The flood receptors of the development would be:
- Commercial property
 - Users of the commercial property
- 8.7 The proposed development and existing site classifications to Table 2 (Paragraph 066 Reference ID: 7-066-20140306) are as follows:
- Existing commercial Less vulnerable
 - Existing agricultural Less vulnerable
 - Proposed commercial Less vulnerable

9. Flood Probability

- 9.1 The EA flood zones shown on the outputs and included in Appendix B represent current best estimates of zone 2 and zone 3 flooding. It does not take account of potential climate change impacts. The flood zone definitions to Table 1 (NPPG Reference ID: 7-065-20140306) are as follows:

Zone 1	Low probability of flooding (<0.1% AEP)
Zone 2	Medium probability of tidal flooding (0.1-0.5% AEP)
	Medium probability of fluvial flooding (0.1-1% AEP)
Zone 3a	High probability of tidal flooding (>0.5% AEP)
	High probability of fluvial flooding (>1% AEP)
Zone 3b	Functional floodplain (>5% AEP probability of flooding)

The flood map does not differentiate between zones 3a and 3b.
 Zone 3b is only considered appropriate for water-compatible development.
 Zone 3a is additionally considered appropriate for less vulnerable uses.

- 9.2 The site is wholly in flood zone 1 (low risk).

10. Climate Change

- 10.1 The proposed development is in flood zone 1. The new climate change allowances for flood risk assessment GOV.UK 20 July 2021 update have been used. Climate change values for the site are:

- Peak rainfall intensity: Table 1, third epoch, upper end +40%
- Sea level rise: Table 2, southeast, higher central +1.2m

- 10.2 Surface water drainage strategy is discussed in Chapter 11. The volumes and flows for this strategy have been derived in accordance with CIRIA C753 and include for climate change effects.

11. Detailed Development Proposals & Surface Water Strategy

- 11.1 As set out in paragraph 5.2 an infiltration discharge for surface water run-off is not viable. The farm is arable and has a high demand for water for irrigation and is located in an area with low average annual rainfall of around 700mm per annum. The farm therefore operates a network of water supply reservoirs which harvest and hold rainfall for irrigation use in drier periods when irrigation demand is high.
- 11.2 Run-off from the existing farm building complex including the porous gravel staff car park is harvested into the reservoirs immediate to the farm buildings complex from where it can be redistributed to the wider reservoir network as may be required.

- 11.3 The reservoir system has a total capacity of 105,000 m³. The increase in drained area from the proposed development is some 12,800m². The M100_{24hr} rainfall for the site location is some 85mm. the maximum recorded regional rainfall occurred in June 2012 when 106mm of rain fell in 24 hours. Allowing for 5% depression the run-off volume for this would be some 1,285m³. Although the site geology is unable to support an infiltration discharge the proposed porous gravel car park construction has a footprint of some 5,100m² and the calculations contained in appendix C indicate the factored 24 hour infiltration to the footprint would be some 135m³. The net run-off to the reservoir network from the proposed development would therefore be some 1,150m³, which is about 1% of the reservoir network capacity. Whilst any one storm may produce significant rainfall, the rainfall pattern over the year amounts to an average of some 700mm over 12 months, and 106mm represent some 15% of the entire average annual rainfall. Unlike domestic rainwater harvesting which operates across a very short period, agricultural rainfall harvesting operates over a much longer period to safeguard against low rainfall over a period of months-years. The ability to harvest rainwater into the reservoirs is complemented by an additional approved abstraction of water from Pagham Rife up to a total of 91,000m³ per year (87% of storage capacity). In the event of a particularly wet Winter less water would be drawn from the Rife.
- 11.4 The relocated staff car park will be of porous construction providing storage for surface water run-off within the pavement matrix. The gradual discharge from the pavement matrix and run-off from the new packhouse and adjacent hardstand will be harvested to the farm's reservoir network for agricultural water supply. This will avoid any increase in run-off from the development and reduce demand on the water supply into the site.
- 11.5 It is proposed to extend the existing surface water drainage network upslope to the east such that this drains by gravity to the existing pumping infrastructure to the reservoir. The pumping capacity will be reviewed as part of the detailed design and augmented or upgraded should this be indicated to be required from analysis of the modified extended network.
- 11.6 The surface water drainage system will be designed to accommodate a 1 in 100 year +40% and +10% urban creep rainfall event. With respect to the Non-statutory Technical Standards for Sustainable Drainage Systems (NTS SuDS) the design accords with requirements S3, S5-6 and S7-9. Design and construction details will accord with Building Regulations and Sewers for Adoption, as appropriate, so according with S10-11 and S13-14. The extension to the farm buildings complex will drain by gravity to the existing pump facilities to the west which accord with S12.
- 11.7 The proposed development is low-medium pollution hazard levels (C753 Table 26.2) and does not require groundwater risk screening.
- 11.8 Simple index approach calculations are contained in Appendix C. The yard area is a medium hazard level. The proposed arrangements incorporate the existing interceptor prior to the harvesting to the farm reservoir network.
- 11.9 In summary source control will be provided by:
- Rainwater harvesting/reservoir storage as outlined in paragraph 11.5
- 11.10 The existing east to west exceedance flow path on the site down towards Pagham Rife will be retained.
- 11.11 The surface water strategy mimics the existing run-off regime. There will therefore be no adverse impact on flood flow rates outside the site.
- 11.12 A schedule of O&M maintenance requirements for the SuDS infrastructure is also contained in Appendix C. The maintenance will be undertaken by the operators.

12. Sequential & Exceptions Tests

- 12.1 The site is located wholly in FZ1 and inherently meets the Sequential Test.
- 12.2 Application of the Exceptions Test is not required.

13. Flood Risk Management Measures

- 13.1 The source pathway receptor assessment is contained in Chapter 5.
- 13.2 FFLs should be set at least 150mm above external ground levels.

14. Off Site Impacts

- 14.1 The surface water strategy mimics the existing run-off regime. There will therefore be no adverse impact on flood flow rates outside the site.

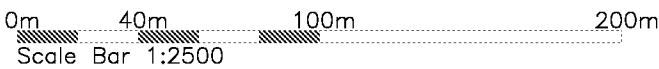
15. Residual Risks

- 15.1 The proposed surface water strategy for the development provides for flood events up to 1:100 year 2021_{AD} + CC rainfall. The residual flood risk is therefore events in excess of 1:100 year 2021_{AD} + CC rainfall.

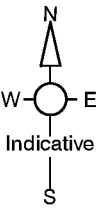
Appendix A

Location Plan

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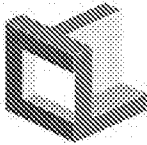


NOTE:
Dimensions to be checked on site before commencing work.
Any discrepancies shall be reported to Curtis Levese Technical
Ltd. immediately.
Do not scale from these drawings except for planning purposes.
The figured dimensions only.
Where applicable this drawing is to be read in conjunction with
other consultant drawings.
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02	Issued for Planning	27/07/21
01	Issued for comment	14/07/21

rev	description	date
status:	PLANNING	



CURTIS LEEVES TECHNICAL LTD
01243 378070 | mail@cltechnical.co.uk

client BARFOOTS OF BOTLEY LTD			
project SEFTER EAST Proposed New Packhouse & Car Park Relocation			
title Location Plan			
date July 2021	scale @ A3 1:2500	drawn GBC	chkd GBC
project no. 2102	drawing no. 001	rev 02	





BRIM DISTRICT COUNCIL: B/11721/01

date	scale @ A1	drawn	chkd
Jan. 2021	1:500	GBC	GBC
project no.	drawing no.	rev	
2102	005	09	



Aerial view of site
(some of the farm reservoirs can be seen in this view)



View on existing car park



View on existing access road



View north over development site



View west over development site

Appendix B



Flood map for planning

Your reference

21058

Location (easting/northing)

489285/99692

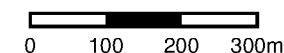
Scale

1:10000

Created

2 Aug 2021 8:42

-  Selected area
-  Flood zone 3
-  Flood zone 3: areas benefitting from flood defences
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Flood storage area





Extent of flooding from surface water

High
 Medium
 Low
 Very low

+
 Location you selected

Surface water flood risk



Extent of flooding from reservoirs

Maximum extent of flooding Location you selected

Reservoir flood risk



TRENCH WIDTH TO SUBGRADE DIAMETER OF DRAIN

LINE OF INFLUENCE

45°

ST2 CONCRETE BED AND SURROUND TO DRAIN & CONCRETE SIDEFILL TO UNDISTURBED TRENCH WALL.

NOTE 6' (1.8 m)

GW = Recessed, double sealed, gas and watertight bolt down cover & frame (see standard detail)

SURFACE WATER MANHOLE / CATCHPI T SCHEDULE								
M.H. REF.	INVERT LEVEL LOWEST PIPE	COVER LEVEL (See note 10)	CHAMBER SIZE INTERNAL DIMS	COVER SIZE CLEAR OPENING	COVER TYPE	M.H. TYPE	COMMENT	/ DRG.
S1	1.500	3.600	ø1800	600 x 600	D400	P4	STD 01.24	
S2	1.830	3.600	ø1350	600 x 600	D400	C7C	STD 01.44	
S3	1.810	3.540	900 x 900	600 x 600	D400	C2B	STD 01.50	
S3A	2.500	3.700	1200 x 675	1200 x 600	D400	P2	STD 01.22	
S4	2.350	3.800	900 x 675	600 x 600	D400	C2A	STD 01.50	
S5	2.600	3.340	900 x 675	600 x 600	D400	C2A	STD 01.50	
S5A	2.650	3.340	900 x 675	600 x 600	D400	C2A	STD 01.50	
S6	2.700	3.450	900 x 675	600 x 600	D400	C2A	STD 01.50	
S7	2.750	3.500	900 x 675	600 x 600	D400	C2A	STD 01.50	
S8	3.250	4.640	1200 x 675	1200 x 600	D400	P2	STD 01.22	
S9	3.650	4.300	750 x 675	750 x 600	D400	P2	STD 01.22	
S10	4.600	5.300	750 x 675	750 x 600	D400	P2	STD 01.22	
S11	3.480	4.600	1200 x 675	1200 x 600	D400	P2	STD 01.22	
S12	3.725	4.830	1200 x 675	1200 x 600	D400	P2	STD 01.22	
S13	4.050	5.050	1200 x 675	1200 x 600	D400	P2	STD 01.22	
S14	4.750	5.175	750 x 675	750 x 600	D400	P2	STD 01.22	

M.H. F.	INVERT LEVEL (LOWEST PIPE)	COVER LEVEL (see note 10)	CHAMBER SIZE INTERNAL DIM S	COVER CLEAR	SIZE OPENING	COVER TYPE	M.H. TYPE	COMMENT	DRG.
S1	1.500	3.600	ø1800	600 x 600	D400	P4	STD 01.24		
S2	1.630	3.480	ø1350	600 x 600	D400	C1C	STD 01.45		
S3	1.810	3.540	900 x 900	600 x 600	D400	C2B	STD 01.50		
SSA	2.500	3.700	1200 x 675	1200 x 600	D400	P2	STD 01.22		
S4	2.350	3.800	900 x 675	600 x 600	D400	C2A	STD 01.50		
SS	2.600	3.340	900 x 675	600 x 600	D400	C2A	STD 01.50		
SSA	2.650	3.340	900 x 675	600 x 600	D400	C2A	STD 01.50		
SS6	2.700	3.450	900 x 675	600 x 600	D400	C2A	STD 01.50		
S7	2.750	3.600	900 x 675	600 x 600	D400	C2A	STD 01.50		
S8	3.250	4.660	1200 x 675	1200 x 600	D400	P2	STD 01.22		
S9	3.650	4.300	750 x 675	750 x 600	D400	P2	STD 01.22		
S10	4.600	5.300	750 x 675	750 x 600	D400	P2	STD 01.22		
S11	3.480	4.800	1200 x 675	1200 x 600	D400	P2	STD 01.22		
S12	3.725	4.830	1200 x 675	1200 x 600	D400	P2	STD 01.22		
S13	4.050	5.050	1200 x 675	1200 x 600	D400	P2	STD 01.22		
S14	4.750	5.175	750 x 675	750 x 600	D400	P2	STD 01.22		

M.H. REF.	INVERT LEVEL LOWEST PIPE.	COVER LEVEL (See note 10)	CHAMBER SIZE INTERNAL DIMS	COVER SIZE CLEAR OPENING	COVER TYPE	M.H. TYPE	COMMENT	DRG.
P1	1.950	5.040	ø1200	600 x 600	D400	SPECIAL	FILTER PLATE, WH	
P2	2.220	4.850	ø1200	600 x 600	D400	P4	STD.01.24	
P3	3.170	5.050	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P4	3.550	5.050	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P5	3.720	5.050	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P6	2.620	3.700	750 x 675	750 x 600	D400	SPECIAL	FILTER PLATE, WH	
P7	3.020	5.050	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P8	3.700	5.040	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P9	2.870	3.770	750 x 675	750 x 600	D400	P2	STD.01.22	
P10	3.320	4.250	750 x 675	750 x 600	D400	P2	STD.01.22	
P11	3.460	5.050	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P12	3.620	5.030	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P13	3.700	5.030	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P14	3.880	5.030	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P15	2.970	4.275	ø1200	600 x 600	D400	P4	STD.01.24	
P16	2.990	4.970	750 x 675	750 x 600	D400	SPECIAL	FILTER PLATE, WH	
P17	3.040	4.950	ø1200	600 x 600	D400	P4	STD.01.24	
P18	3.100	4.980	ø1200	600 x 600	D400	P4	STD.01.24	
P19	3.720	5.040	750 x 675	750 x 600	D400	P2	STD.01.22	
P20	3.720	5.040	750 x 675	750 x 600	D400	P4	STD.01.24	
P21	3.210	5.060	ø1200	600 x 600	D400	P2	STD.01.24	
P22	3.350	5.070	ø1200	600 x 600	D400	P4	STD.01.24	
P23	3.480	5.080	ø1200	600 x 600	D400	P4	STD.01.24	
P24	3.680	5.090	ø1200	600 x 600	D400	P4	STD.01.24	
P25	3.620	5.080	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P26	3.620	5.030	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P27	3.920	5.030	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P28	3.920	5.030	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P29	3.500	5.020	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P30	3.640	5.020	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P31	3.710	5.020	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	
P32	4.000	5.020	600 x 450	600 x 450	B125(SS)	P2	SEE DRG. 106	

SS = Stainless steel, non-slip, double sealed, gas and watertight bolt down cover & frame (See DRG. 106)

REF.	INVERT LEVEL INLET	INVERT LEVEL OUTLET	TYPE	NOTE
PI.1	1.615	1.515	CLASS 1 CONDER, TYPE CNS150s/11	FULL RETENTION
---	---	---	---	---

The interceptors shall have coalescing filters and be alarmed. Alarm and vent locations to be confirmed with The Engineer. Equivalent interceptors other than Conder shall be accepted.

Note configuration of pipe inlets / outlets when ordering, together with pipe sizes.

SS = Stainless steel, non - slip, double sealed, gas and watertight bolt down cover & frame (see Drg. 106)

Sketch/Calc ☒ Site Visit ☐ Memo ☐
 Phone Call ☐ Meeting ☐ File Note ☐

Project No./Ref: SEFTER FARM

Project: SOIL INFILTRATION RATE

Section: CALCULATION

Prepared: PEF

Checked:

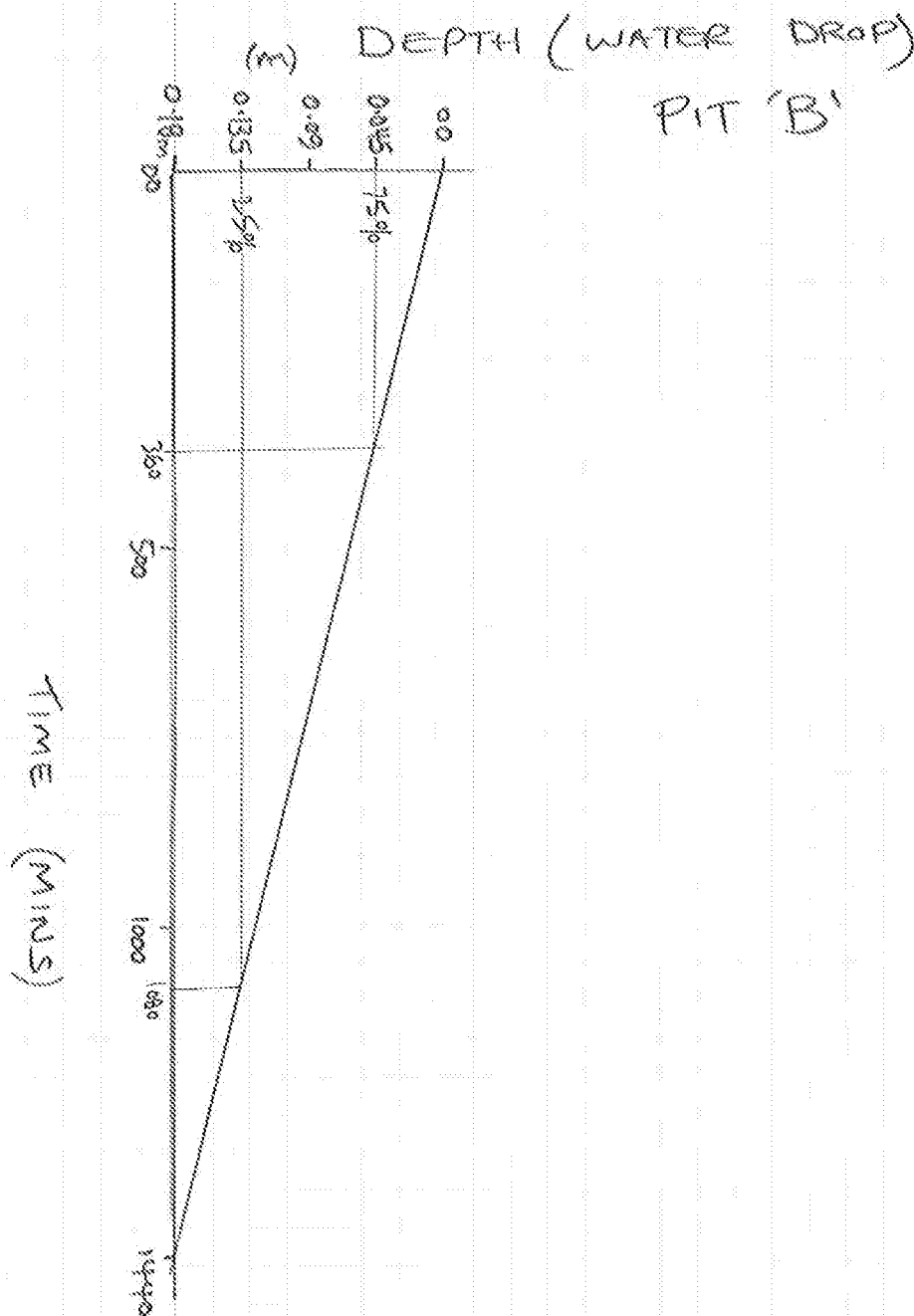
Date: FEB-2018

Time:

28725

Archibald Shaw

Consulting Civil and Structural Engineers

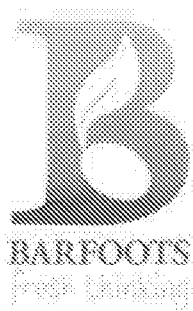


PIT SIZE
 = 1m LONG
 1m WIDE
 1m DEEP

$$\frac{1080 - 360}{720 \text{ mins}}$$

$$= 0.0055 \text{ m/hr}$$

Appendix C



Barfoots of Botley Ltd.

Sefter Farm
Pagham
Bognor Regis
West Sussex
PO21 3PX

12th January 2018

Dear Paul Cann,

Reservoir level management procedure

Aim

To take available roof / yard water and collect in the existing reservoir system for summer irrigation purposes and simultaneously provide flood attenuation for the new build.

Method

Water will be collected from both the roof of the new build and the yard area and directed through pipes to reservoir 1 sited to the rear of Sefter farm. Reservoir 1 will be kept with 1 m of freeboard. The surface area of the reservoir being 10000 sq. m creates 10000 cubic meters of storm event capacity.

Water level in reservoir 1 would be maintained at 1m freeboard by pumping water to reservoirs 2 and 3 to help fill these reservoirs for summer irrigation purposes on the farm. All the reservoirs are interconnected by an underground 15cm diameter main and water can be moved by electric pump from location to location as required.

The farm management team measures water levels daily and monitoring of all reservoir water levels is maintained to avoid overfilling. A balance between field irrigation requirements and reservoir capacity will enable the capture of water for farm use and to mitigate storm event rainfall.

The reservoir system has a total capacity of 105,000 cubic meters.

The ability to fill the reservoirs is complemented by an additional approved abstraction of water from the Pagham Rife up to a total of 91,000 cubic meters.

The highest rainfall event occurred in June 2012 when 106mm rain fell in 24 hours. This would have created 1060 cubic meters of water off the new build site comfortably fitting into the strategy of space described above. Any ability to capture rainfall water is both a benefit financially and environmentally for the business.

Yours Sincerely

Nathan Dellicott
Farm Director



Project No : 21058
Project Title : Sefter farm car park

Drainage blanket/CGA pavement or 2D planar infiltration (R156)

Site Location: Pagham Catchment ID: gross car park

$r = 0.36$ (range 0.12 to 0.45)

Drained Area = 5100 m² Infiltration Area = 5100 m²

Design storm 1 in = 100 year

Runoff volume uplift = 40 % for climate change

Urban Creep allowance = 10 % uplift to Drained Area

Site Considerations

Where determined, what is the depth to highest seasonal groundwater level (GWL) from surface 2.00 m

Is the infiltration far enough from drainage mounds/fields or other soakaways etc to avoid impact? Yes

What Source Protection Zone (SPZ) is the proposed soakaway located in? None

What is known and proposed about potential contaminated ground on the site? EA/LPA accept infiltration

Technical Assessment

Consequence of failure = 2-Minor inconvenience

Measured Soil Filtration Rate = 1.53E-06 m/s

Design Soil Filtration Rate = 3.06E-07 m/s

Storage media thickness = 0.30 m

Effective net porosity = 35 %

Depth of cover over media = 0.05 m

Storm Duration	5 min	10 min	15 min	30 min	1 hr	2 hr	4 hr	6 hr	10 hr	24 hr
(secs)	300	600	900	1800	3600	7200	14400	21600	36000	86400
$r = 0.36$ Value Z1	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42
Rainfall M5 (mm)	7.2	10.2	12.4	15.8	20.0	24.4	29.6	33.4	38.0	48.4
M100/M5 gf Value Z2	1.84	1.91	1.95	2.00	2.03	2.01	1.97	1.94	1.91	1.82
Rainfall M100 (mm)	13.3	19.5	24.2	31.5	40.6	49.1	58.4	64.9	72.4	88.2
with CC & UC uplift (mm)	19.9	29.3	36.2	47.3	60.9	73.7	87.6	97.3	108.6	132.3
RUNOFF (m ³)	101.50	149.29	184.83	241.30	310.59	375.63	446.81	496.40	554.07	674.91
Infiltr capacity (m ³)	0.47	0.94	1.40	2.81	5.62	11.24	22.47	33.71	56.18	134.84
INFILTRATED (m ³)	0.47	0.94	1.40	2.81	5.62	11.24	22.47	33.71	56.18	134.84
Req'd STORAGE (m ³)	101.03	148.35	183.42	238.49	304.97	364.40	424.34	462.70	497.89	540.07
	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass

TOTAL STORAGE AVAILABLE 542.64 m³

Time to drain full to half full = 48.1 hours

Overall Assessment

Media base elevation above seasonal high GWL 1.65 m meets GP3

Will the soakaway drain from full to half full in 24 hours or less? No fail

Does the soakaway provide sufficient storage? Yes pass

Date: 02/08/2021

Site Ref

Sefter Farm new packhouse

SuDS Water Quality Management CIRIA C753 Ch26

Simple Index Approach

Catchment

parking

Is discharge to: SPZ1? N Drinking Water Protection Area ? N

Is site in close proximity to an area with sensitive environmental designation?

N

if so how close?

m

Is an additional treatment component required due to sensitivity?

Y

Land Use

car parks -infrequent turn over

Hazard

low

TSS index	Metals index	HydroCar index
0.5	0.4	0.4

Treatments

To surface water discharge Y

Component

- 1 Permeable pavement
- 2 Detention basin
- 3 N/A

mitigation index

X1 N/A

Enhanced mitigation index

Residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0.7	0.6	0.7	1.00
0.5	0.5	0.6	0.50
0	0	0	0.50
0.95	0.85	1	
0	0	0	1.00
0.95	0.85	1	
0	0	0	

Land Use

car parks -infrequent turn over

Hazard

low

TSS index	Metals index	HydroCar index	residual
0	0	0	

Treatments

To groundwater discharge N

Infiltration surface

- 1 N/A
- 2 N/A

Final residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0	0	0	1.00
0	0	0	0.50
0	0	0	

Is a groundwater risk screening required?

N

Notes:

Date: 02/08/2021

Site Ref

Sefter Farm new packhouse

SuDS Water Quality Management CIRIA C753 Ch26

Simple Index Approach

Catchment

yard

Is discharge to: SPZ1? N Drinking Water Protection Area ? N

Is site in close proximity to an area with sensitive environmental designation? N

if so how close? m

Is an additional treatment component required due to sensitivity?

Y

Land Use

yards- commercial & delivery

Hazard

medium

TSS index	Metals index	HydroCar index
0.7	0.6	0.7

Treatments

To surface water discharge Y

Component

- 1 Separator
- 2 Detention basin
- 3 N/A

mitigation index

X1 N/A

Enhanced mitigation index

Residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0.5	0.4	0.8	1.00
0.5	0.5	0.6	0.50
0	0	0	0.50
0.75	0.65	1.1	
0	0	0	1.00
0.75	0.65	1.1	
0	0	0	

Land Use

yards- commercial & delivery

Hazard

medium

TSS index	Metals index	HydroCar index	residual
0	0	0	

Treatments

To groundwater discharge N

Infiltration surface

- 1 N/A
- 2 N/A

Final residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0	0	0	1.00
0	0	0	0.50
0	0	0	

Is a groundwater risk screening required?

N

Notes:

Date: 02/08/2021

Site Ref

Sefter Farm new packhouse

SuDS Water Quality Management CIRIA C753 Ch26

Simple Index Approach

Catchment

packhouse

Is discharge to: SPZ1? N Drinking Water Protection Area ? N

Is site in close proximity to an area with sensitive environmental designation? N

if so how close? m

Is an additional treatment component required due to sensitivity?

Y

Land Use

roofs-non-residential

Hazard

low

TSS index	Metals index	HydroCar index
0.3	0.2	0.05

Treatments

To surface water discharge Y

Component

- 1 Separator
- 2 Detention basin
- 3 N/A

mitigation index

X1 N/A

Enhanced mitigation index

Residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0.5	0.4	0.8	1.00
0.5	0.5	0.6	0.50
0	0	0	0.50
0.75	0.65	1.1	
0	0	0	1.00
0.75	0.65	1.1	
0	0	0	

Land Use

roofs-non-residential

Hazard

low

TSS index	Metals index	HydroCar index	residual
0	0	0	

Treatments

To groundwater discharge N

Infiltration surface

- 1 N/A
- 2 N/A

Final residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0	0	0	1.00
0	0	0	0.50
0	0	0	

Is a groundwater risk screening required?

N

Notes:

SUDS operation and maintenance - general

There are three categories on maintenance activities:

Regular maintenance consists of basic tasks done on a frequent and predictable schedule, including vegetation management, litter and debris removal, and inspections.

Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example). The table below summarises the likely maintenance activities required for each SUDS component and specific maintenance activities is given in the following sections.

Remedial maintenance comprises intermittent tasks that may be required to rectify faults associated with the system. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict. Remedial maintenance items can comprise items such as:

- inlet/outlet repairs
- erosion repairs
- reinstatement or realignment of edgings, barriers, rip-rap or other erosion control
- infiltration surface rehabilitation
- replacement of blocked filter fabrics
- construction stage sediment removal (although this activity should have been undertaken before the maintenance contract)
- system rehabilitation immediately following a pollution event.

O&M activity	SUDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter trench	Modular storage	Pervious pavements	Swale/bioretention/greenroofs	Filter strip	Sand filter	Pre-treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter/debris removal	■	■	■	■	□	■	■	□	■	■	■	■	■
Grass cutting	■	■	■	■	□	■	■	□	□	■	■	□	□
Wee/invasive plant control	□	□	□	□		□	□		□	□	□	□	□
Shrub management	□	□	□	□					□	□	□		□
Shoreline vegetation management	■	■	□										□
Aquatic vegetation management	■	■	□										□
Occasional maintenance													
Sediment management *	■	■	■	■	■	■	■	■	■	■	■	■	■
Vegetation/plant replacement	□	□	□	□						□	□		□
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation/repair	□	□	□	□	□	□	□	□	□	□	□	□	□
Infiltration surface reconditioning				□	□	□	□		□	□	□	□	

■ will be required

□ may be required

* sediment to be collected upstream of the main device

GENERAL MAINTENANCE

Litter/debris removal

This is an integral part of SUDS maintenance and reduces the risks of inlet and outlet blockages, retains amenity value and minimises pollution risks. High litter removal frequencies may be required at high profile commercial/retail parks where aesthetics are a major driver.

Grass cutting

It is recommended that grass cutting be minimised around SUDS facilities, apart from swales and filter strips and structural embankments where a height of 100–150 mm is recommended to prevent the plants falling over, or “lodging”, when water flows across the surface. In general, allowing grass to grow tends to enhance water quality performance. Short grass around a wet system such as pond or wetland provides an ideal habitat for nuisance species such as geese; allowing the grass to grow is an effective means of discouraging them. Grass around wet pond or wetland systems should not be cut to the edge of the permanent water. Grass cutting is an activity undertaken primarily to enhance the perceived aesthetics of the facility. The frequency of cutting will tend to depend on surrounding land uses, and public requirements. Therefore, grass cutting should be done as infrequently as possible, recognising the aesthetic concerns of local residents. However, grass around inlet and outlet infrastructure should be trimmed closely to reduce risks to system performance. If a manicured, parkland effect is required, then cutting will need to be undertaken more regularly than for meadow type grass areas, which aim to maximise habitat and biodiversity potential.

Weed/invasive plant control

Weeds are generally defined as vegetation types that are unwanted in a particular area. For SUDS, weeds are often alien or invasive species, which do not enhance the technical performance or aesthetic value of the system, or non-native species and the spread of which is undesirable. In some places, weeding has to be done by hand to prevent the destruction of surrounding vegetation (hand weeding should generally be required only during the first year, ie during plant establishment). However, over grassed surfaces, mowing can be an effective management measure. The use of herbicides and pesticides should be prohibited since they cause water quality deterioration. The use of fertilisers should also be limited or prohibited to minimise nutrient loadings which are damaging to water bodies.

Shrub management

Shrubs tend to be densely planted and are likely to require weeding at the base, especially during the first year to ensure that they get enough water. Shrubs should be selected so they can grow to their maximum natural height without pruning.

Aquatic/shoreline vegetation management

Aquatic plant aftercare in the first 1–3 years may be required to ensure establishment of planted vegetation and control nuisance weeds/invasive plants. Once established, the build-up of dead vegetation from previous seasons should be removed at convenient intervals to reduce organic silt accumulation (eg every three years and at the end of landscape contract periods).

Emergent vegetation may need to be harvested every 5–10 years to maintain flood attenuation volumes, optimise water quality treatment potential and ensure fresh growth, although this is often not required. Care should be taken to avoid nesting birds during the breeding season and to avoid great crested newt and water vole habitats. The typical window for this activity is towards the end of the growing season (September and October). As vegetation matures, plant height may also become a safety issue in residential areas.

Where emergent vegetation is managed, up to 25 per cent can be removed by cutting at 100 mm above soil level using shearing action machinery. Up to 25 per cent of submerged vegetation can be cut and raked out at any one time, using approved rakes, grabs or other techniques, depending on whether clay or waterproof membranes are present. Aquatic vegetation arisings should be stacked close to the water's edge for 48 hours to de-water and allow wildlife to return to the SUDS feature. They should then be removed to wildlife piles, compost heaps or off site before decomposition, rotting or damage to existing vegetation can occur.

Algae removal may be undertaken for aesthetic purposes during the first 3–5 years of a pond/wetland's life. The growth of algae, which is considered by some to be visually intrusive, is encouraged by nutrients introduced into the water body. This situation should settle down once upstream construction activities are complete.

Management of green waste

Appropriate methods should be implemented to dispose of green waste, including

- The development of wildlife piles
- On- or off-site composting
- Disposal to landfill

REMEDIAL MAINTENANCE

Structure rehabilitation/repair

There will come a time with most SUDS techniques when a major overhaul of the system is required to remove clogged filters, geotextiles, gravel etc. This will typically be between 10 and 25 years, depending on the technique and factors such as the type of catchment and sediment load. For example the use of geotextiles close to the surface in pervious surfaces traps the majority of sediment in a relatively easily accessible location. Reconstruction of the surface layer and bedding layer is all that is required, rather than reconstruction of the whole pavement depth.

Major overhaul is most likely to be required on techniques that rely on filtration through soils or aggregates, such as sand filters and infiltration devices. Other SUDS techniques are unlikely to need major overhaul if routine maintenance is undertaken as required (for example ponds and wetlands).

Rehabilitation activities for each SUDS component are described on the following tables.

Infiltration surface rehabilitation

In the event that grassed surface permeability has reduced, there are a number of landscape techniques that can be used to open the surface to encourage infiltration. Such activities are not commonplace and are likely to be required only in circumstances where silt has not been effectively managed upstream.

1. Scarifying to remove “thatch”. Thatch is a tightly intermingled organic layer of dead and living shoots, stems and roots, developing between the zone of green vegetation and the soil surface. Scarifying with tractor-drawn or self-propelled equipment to a depth of at least 50 mm breaks up silt deposits, removes dead grass and other organic matter and relieves compaction of the soil surface.
2. Spiking or tining the soil, using aerating equipment to encourage water percolation. This is particularly effective if followed by top dressing with a medium to fine sand, and is best undertaken when the soil is moist. Spiking or tining with tractor drawn or self-propelled equipment penetrates and perforates soil layers to a depth of at least 100 mm (at 100 mm centres) and allows the entry of air, water, nutrients and top dressing materials.
3. As a last resort, it may be necessary to remove and replace the grass and topsoil by:
 - removing accumulated silt and (subject to a toxicity test) applying to land or dispose of to landfill
 - removing damaged turf which should be composted
 - cultivating remaining topsoil to required levels
 - re turfing (using turf of a quality and appearance to match existing) or reseeded (to BS 7370: Part 3, Clause 12.6 (BSI, 1991) using seed to match existing turf) area to required levels. It may be necessary to supply and fix fully biodegradable coir blanket to protect seeded soil. Turf and seeded areas should be top dressed with fine sieved topsoil to BS 3882 (BSI, 1994) to achieve final design levels. Watering will be required to promote successful germination and/or establishment.

Rainwater harvesting operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris.	Annually (or following poor performance).
Occasional maintenance	Replacement of any filters.	Three monthly.
Remedial actions	Repair of erosion damage, or damage to tank.	As required
	Pump repairs.	As required
Monitoring	Inspection of the tank for debris and sediment build up.	Annually (or following poor performance).
	Inspection of inlets, outlets and withdrawal devices.	Annually (or following poor performance).
	Inspection of areas receiving overflow, for evidence of erosion.	Annually (or following extreme events).
	Inspection of any pumps – check function and wiring.	Annually.
	Inspection of roof drain filters.	Annually (or following poor performance).

Pervious pavement operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site-specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Removal of weed.	As required
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users.	As required
	Rehabilitation of surface and upper sub-structure.	As required (if infiltration performance is reduced as a result of significant clogging).
Monitoring	Initial inspection.	Monthly for 3 months after installation.
	Inspect for evidence of poor operation and/or weed growth. If required take remedial action.	3-monthly, 48 h after large storms.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually
	Monitor inspection chambers.	Annually

Pond operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter removal.	As required
	Grass cutting – public areas.	Monthly (during growing season)
	Grass cutting – meadow grass.	Half yearly (spring, before nesting season, and autumn)
	Inspect vegetation to pond edge and remove nuisance plants (for first 3 years).	Monthly (at start, then as required)
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface).	Annually.
	Remove 25% of bank vegetation from waters edge to a minimum of 1 m above water level.	Annually.
	Tidy all dead growth before start of growing season.	Annually.
	Remove sediment from forebay.	1–5 years, or as required.
	Remove sediment from one quadrant of the main body of ponds without sediment forebays.	2-10 years.
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%.	>25 years (usually).
Remedial actions	Repair of erosion or other damage.	As required
	Aerate pond when signs of eutrophication are detected.	As required
	Realignment of rip-rap or other damage.	As required
	Repair/rehabilitation of inlets, outlets and overflows.	As required
Monitoring	Inspect structures for evidence of poor operation.	Monthly/after large storms.
	Inspect banksides, structures, pipework etc for evidence of physical damage.	Monthly/after large storms.
	Inspect water body for signs of eutrophication.	Monthly (May–October).
	Inspect silt accumulation rates and establish appropriate removal; frequencies.	Half yearly.
	Check penstocks and other mechanical devices.	Half yearly.

Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For industrial site runoff sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on-site if there is an appropriate safe and acceptable location to do so.

Appendix D



1. The report is confidential to the clients stated in the report and has been prepared to their instructions for their own purposes and it is not permitted to disclose this report to other parties (except NHBC, Local Authority, the Client's own Solicitors and Professional Advisers) without the prior consent of Aqua Callidus Consulting Ltd.
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