



Flood Risk Assessment

'The Paddock' & 'Battery Storage Plot'
Chalcroft Business Park, Burnetts Lane, West End
Southampton SO30 2PA

Client

FIP West End Limited

La Rue des Pres

St Saviour

Jersey

JE1 3UP

Ref: 12746

Date: October 2023

Consulting Engineers

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B	Environment Agency & SFRA Flood Maps
C	Topographic Survey
D	Proposed Scheme Drawings including Drainage Strategy Layout
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Issue	Issue date	Compiled	Checked
Preliminary Issue	31 October 2023	JP	MR
2 nd Preliminary Issue	08 November 2023	JP	MR
First Issue	10 November 2023	JP	MR

1 Introduction

- 1.1 This report has been prepared for FIP West End Limited in relation to two separate land parcels and corresponding planning applications, namely 'The Paddock' & 'Battery Storage plot' within Chalcroft Business Park, Burnetts Lane, West End, Southampton SO30 2PA.
- 1.2 No responsibility is accepted to any third party for all or part of this study in connection with this or any other development.
- 1.3 GTA Civils & Transport Ltd. was appointed by the client to provide a Flood Risk Assessment (FRA), as required by the Environment Agency and Eastleigh Borough Council, in order to achieve Planning Approval at said property.
- 1.4 This report will take the form of a formal Flood Risk Assessment in accordance with the 2023 National Planning Policy Framework (NPPF) and the 2022 Planning Practice Guidance (PPG).
- 1.5 Reference has been made to the local Preliminary Flood Risk Assessment and Local Flood Risk Management Strategy, together with the Strategic Flood Risk Assessment published by the Partnership for Urban South Hampshire (PUSH).
- 1.6 Limitations of this report: this report examines flood risk only. It does not consider potential contamination, biodiversity or other environmental/ecological issues.

2 Existing Site & Current Flood Conditions

- 2.1 The 2 application sites, within the area administered by Eastleigh Borough Council (EBC), comprise two land parcels within the Chalcroft Business Park, located northeast of Southampton, between the villages of West End and Horton Heath. 'The Paddock,' a vacant agricultural field (measuring approximately 1.8ha) is situated near the Business park's entrance to the east. The proposed 'Battery Storage plot' (approximately 0.4ha), located to the west of the Business Park, is predominantly hardstanding ground for industrial storage with grass at its peripheries.
- 2.2 The Business Park is bounded by fields with a railway line passing along the southwest boundary; see the site location plan and aerial view in Appendix A.
- 2.3 Hydrology: The River Itchen flows north-south, passing the Business Park approximately 1.8km to the west before depositing into the English Channel at Southampton. A ditch watercourse flows south-north along the Business Park's western boundary before turning west to converge with the River Itchen. Drainage watercourses are located approximately 10m to the west and 30m metres north of the 'Battery Storage Plot.'
- 2.4 Topography: A topographic survey (see Appendix C) shows ambient levels at the 'Battery Storage Plot' peak at the centre of this area (20.04m AOD) and taper off towards its peripheries, the lowest level measuring 18.37m AOD on the western boundary. 'The Paddock' slopes from east to west, with ambient levels ranging between 26.99m AOD on the east boundary and 22.30m AOD on the northwest boundary.
- 2.5 Geology: the BGS online map shows the solid geology is dominated by the Wittering Formation (sand, silt and clay), with no superficial drift deposits recorded.
- 2.6 Falling head tests were carried out in 2016 by Geo Environmental within the wider site. The lowest of these results is 4.06×10^{-6} m/s. This rate is considered to be too low to be sure that the half drain times will comply with Building Regulations. Full compliance BRE365 soakage testing will be undertaken on the Paddock area during the next stage.
- 2.7 A drainage survey has been undertaken of the complete Business Park. The drainage strategy for this proposal utilises these networks. Southern Water has confirmed that there are no public assets in this vicinity.

- 2.8 A land contamination assessment has been carried out, which states that further assessment of soil quality and leachability will be needed where soakaways (or other infiltration features) are being proposed. This is due to its former use as a Royal Naval victualling yard.
- 2.9 The Paddock's greenfield runoff rate has been calculated – limited to the contributing area of 1.122ha, to determine the discharge rate into the watercourse. This calculation sheet is shown in Appendix E. The Qbar rate is 5.8/s. The offsite flow rate will be limited to this, to comply with the PPG.

3 Flood Risk Assessment and Groundwater

- 3.1 Fluvial flooding: the Environment Agency Flood Map in Appendix B shows both parcels lie within Flood Zone 1 (FZ1 – Low Risk). Sites within Flood Zone 1 are susceptible to less than a 1 in 1000 chance (<0.1%) of river or coastal flooding each year.
- 3.2 Tidal flooding: does not pose a risk due to a combination of the site's distance from the coast and tidally influenced rivers.
- 3.3 Surface water flooding: this can occur when excess rainwater does not infiltrate into the ground, or is not intercepted by urban drainage systems, and instead flows across the surface. The EA's Surface Water Flood Depth Map in a 'Low Risk Scenario' (see Appendix B) shows the 'Battery Storage Plot' to the NW is clear from this risk. Although there is some shallow flooding in the extreme event in the Paddock, this originates within this area – so the precipitation will be intercepted by (flow into) the SuDS network. It can be discounted as a risk, therefore. There is no risk of flooding from off site on to either parcel.
- 3.4 Sewer flooding: occurs due to limited capacity or blockage in the sewer system causing backing up of storm water and effluent. The PUSH Strategic Flood Risk Assessment (SFRA) map shows this site is removed from the nearest Southern Water 'observed flooding' incident – refer to the map in Appendix B.
- 3.5 Groundwater flooding: occurs when water levels in the ground rise above the surface. The SFRA does not show any registered historical groundwater flooding incidents at the site. The interactive map shows the wider area (soil type) possesses 'moderate bedrock permeability'. The nearest Groundwater Source Protection Zone is well removed from this area – see the map in Appendix B.
- 3.6 The EA's mapping for Groundwater Vulnerability (GWV) Zones and Groundwater Source Protection (GWSP) Zones show both land parcels overlie a 'Medium' GWV Zone. This corresponds to the PUSH SFRA map – as set out in section 3.5 above,
- 3.7 Artificial sources: flooding from reservoirs, canals and docks. The EA's reservoir flooding map shows neither land parcel is liable to flood if a reservoir were to fail – see Appendix B. There are no reservoirs in the vicinity of the site.
- 3.8 The EA's historical flood map in Appendix B shows that neither parcel has been affected by flooding.
- 3.9 Conclusion: the 2 parcel's flood risk profile is **Low**: both are removed from all sources of flooding.

4 Proposed Development, Mitigation & The Sequential Test

- 4.1 The Paddock development is an *"outline application for up to 4,130sqm of commercial floorspace (Use Classes E(g)(ii), (iii) and B8) to include farm shop (Use Class E(a)) of up to 327sqm, parking and yard areas (including accessible spaces), landscape buffers and acoustic mitigation. Formation of vehicular and pedestrian access to Estate road (access not a reserved matter)".* The Battery Storage Area comprises *"establishment of Battery Energy Storage System compound and associated infrastructure on existing hardstanding to support energy management at Chalcroft Business Park."* The proposed site plans are shown in Appendix D.
- 4.2 As summarised in section 3.9 above, the flood risk profile is Low. No mitigation measures are needed or proposed.
- 4.3 Vulnerability and the Sequential Test: the Sequential and Exception Tests are policy mechanisms created to discourage 'vulnerable use' developments in FZ2 and FZ3. This process 'steers' higher vulnerability uses to sites in lower flood-risk zones (eg FZ1.) The vulnerability classification of any new development should be considered. All vulnerabilities are 'appropriate development' in FZ1 – **Low Risk**.

5 Surface & Foul Water Drainage – The Paddock

- 5.1 The SuDS Hierarchy (infiltration, watercourses, public sewers, private sewers) was applied. The soil soakage rate of 4×10^{-6} m/s was considered to be too low – refer to section 2.6 above. Full compliance BRE365 soakage testing will be undertaken on the Paddock area during the next stage. If the rate is deemed to be high enough to make infiltration features viable, the drainage design will be amended to suit.
- 5.2 All surface water from roofs and hardstandings - will be routed to the watercourse at the restricted rate of 5.8l/s (in the critical 1% + 45% CC event), this being the Qbar rate – refer to section 2.9 above and Appendix E. As this is an outline planning application, there is flexibility on the layout - and SuDS solution following BRE 365 testing.
- 5.3 The SuDS management train has been set up with the water flowing via the porous pavings to 2 attenuation ponds in the NW corner. The SuDS network has been designed, which shows the nodes with storage (PN refs 1.001, 4.001, 5.001, 6.001, 1.004, 1.006, 9.001 and 8.002 – refer to the drainage calculations in Appendix E). The volume in the critical 100 years + 45% climate change event will be contained within the paved areas and ponds – there is no flooding.
- 5.4 All hardstandings will be of porous pavings. The sub-base will comprise clean granular fill (stone), with 30% voids ratio. This volume will act as an infiltration blanket. Cleansing/Water Quality: the filtration characteristics of granular fill are excellent. The combination of this with the UV action on the 2 balancing ponds provides sufficient mitigation to offset the pollution indices for an industrial development.
- 5.5 Exceedance: the exceedance flows are shown on the drainage strategy layout in Appendix D. The flow is generally northwest to the watercourse.
- 5.6 Maintenance of the SuDS system will be the overall responsibility of the Applicant. The ongoing maintenance regime will be contracted out to a Property Maintenance company. Regular inspections of the ponds and porous pavings shall be made in line with industry standards.
- 5.7 Proposed foul system: It is proposed to route the foul effluent to the Business Park's sewerage network to the NW of the Paddock. This now incorporates reed bed filtration following the successful implementation of a scheme to replace the original Ministry of Defence site treatment works.

6 Surface & Foul Water Drainage – Battery Storage Area

- 6.1 The battery storage area comprises a row of battery containers, DNO/customer substations, Transformer/Inverter and storage area. These units will be placed on concrete bases that will sit on the hardstanding area. These are all – effectively – outbuildings that have no positive drainage.
- 6.2 All precipitation will therefore run off to the sides of the hardstanding – just as it does currently. No change is deemed to be required, therefore – as there will be no adverse impact on downstream properties.
- 6.3 This development will not increase the flood risk of this site or neighbouring properties – and so complies fully with the 2021 National Planning Practice Guidance and 2022 National Planning Policy Framework.

- End of Report -

Appendix A

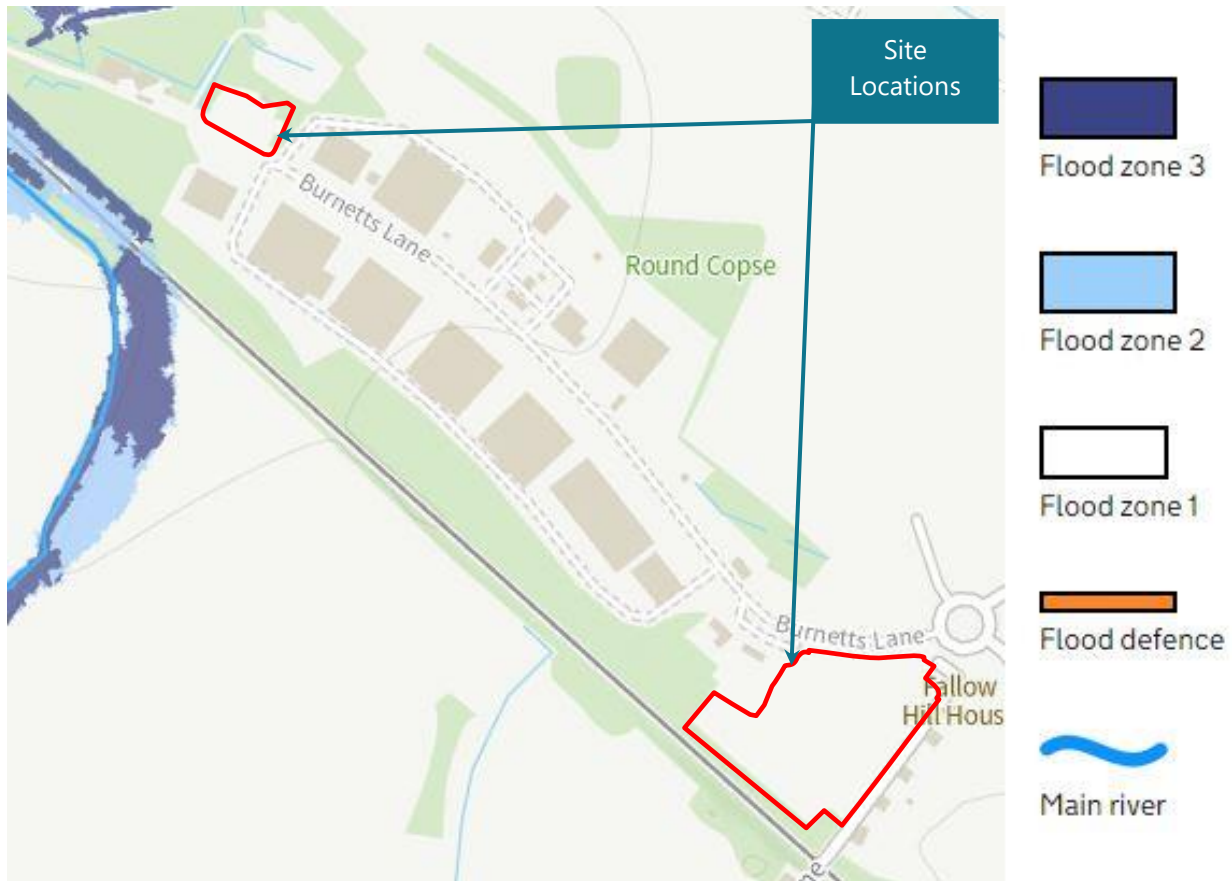
Site Location Map & Aerial View





Appendix B

Environment Agency Flood Maps



EA's Online Flood Map for Planning (Rivers and Seas)

Both land parcels are located in fluvial Flood Zone 1



Surface water flood risk: water depth in a low risk scenario

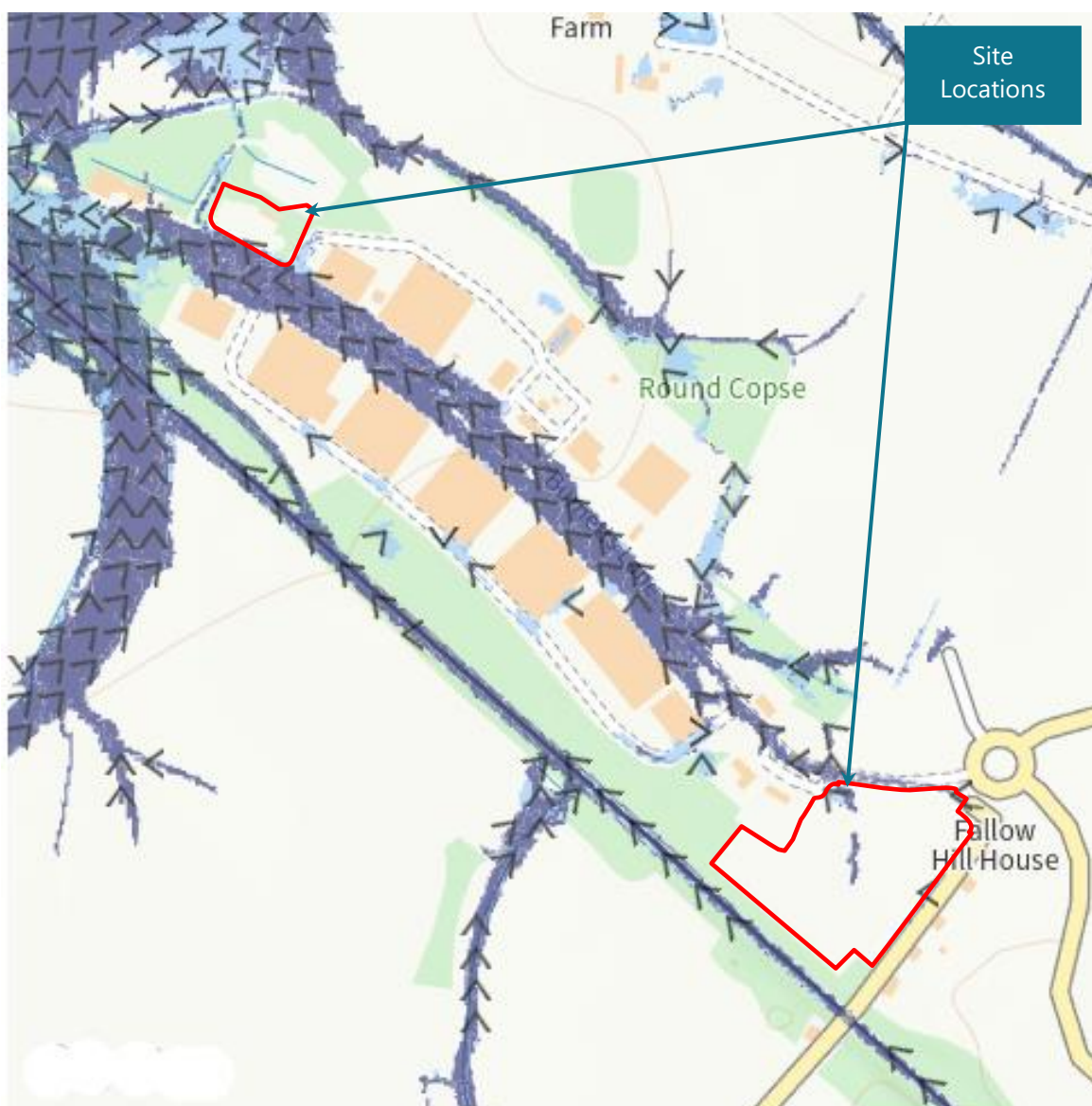
Flood depth (millimetres)



EA's Online Surface Water Flood Depth Map in a 'Low Risk Scenario'

(1 in 1000 years storm event)

While the majority of 'The Paddock' parcel is clear from this risk, the north of the plot and an isolated area in the centre are liable to flood below 300mm. The land parcel to the NW is clear from this risk



Surface water flood risk: water velocity in a low risk scenario
Flood velocity (metres/second)

 Over 0.25 m/s
  Less than 0.25 m/s
  Direction of water flow

EA's Online Surface Water Flood Velocity Map in a 'Low Risk Scenario'
(1 in 1000 years storm event)

This small pattern originates within the site – and so will be intercepted/routed into the SuDS network

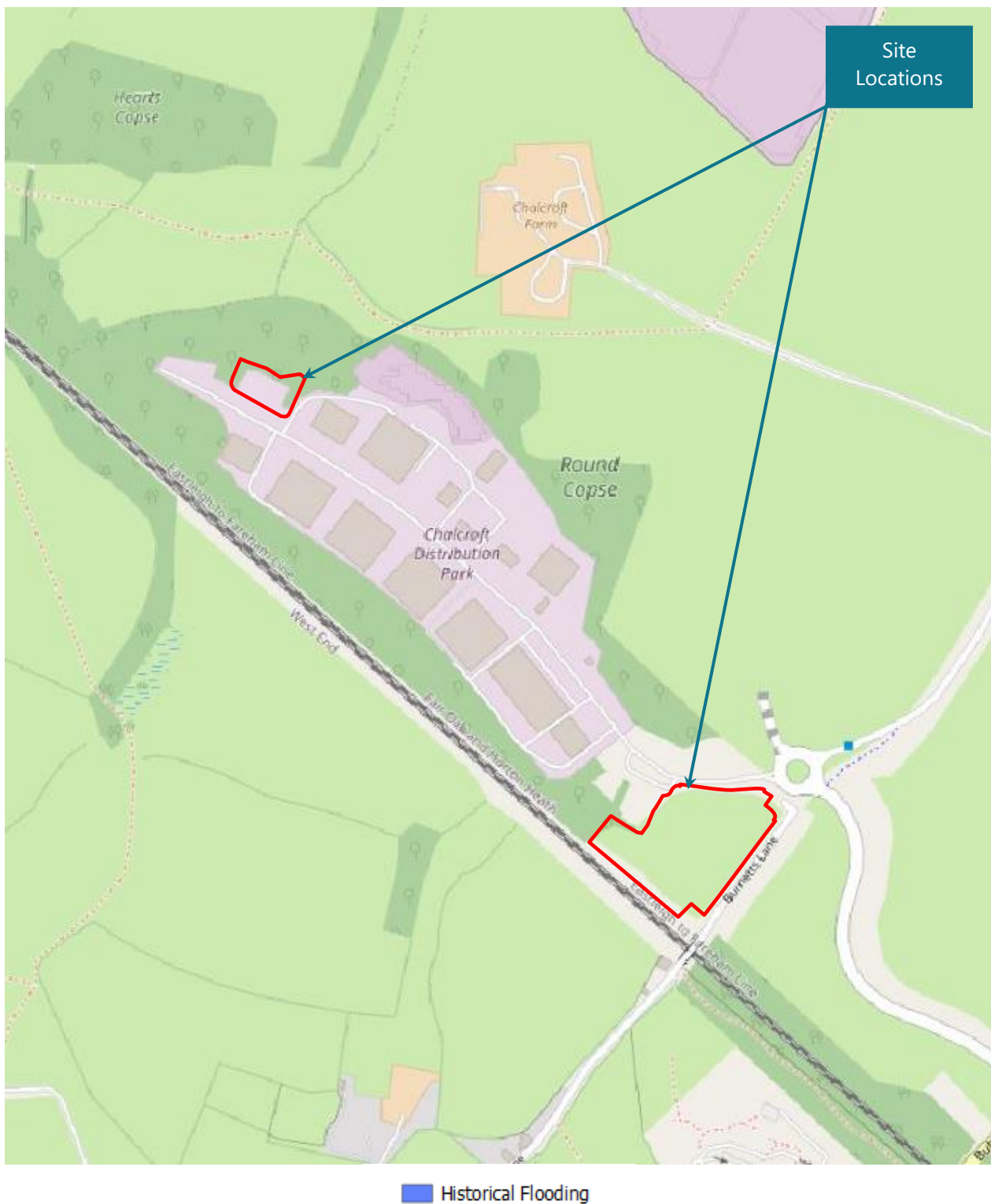


Maximum extent of flooding from reservoirs:

● when river levels are normal ● when there is also flooding from rivers

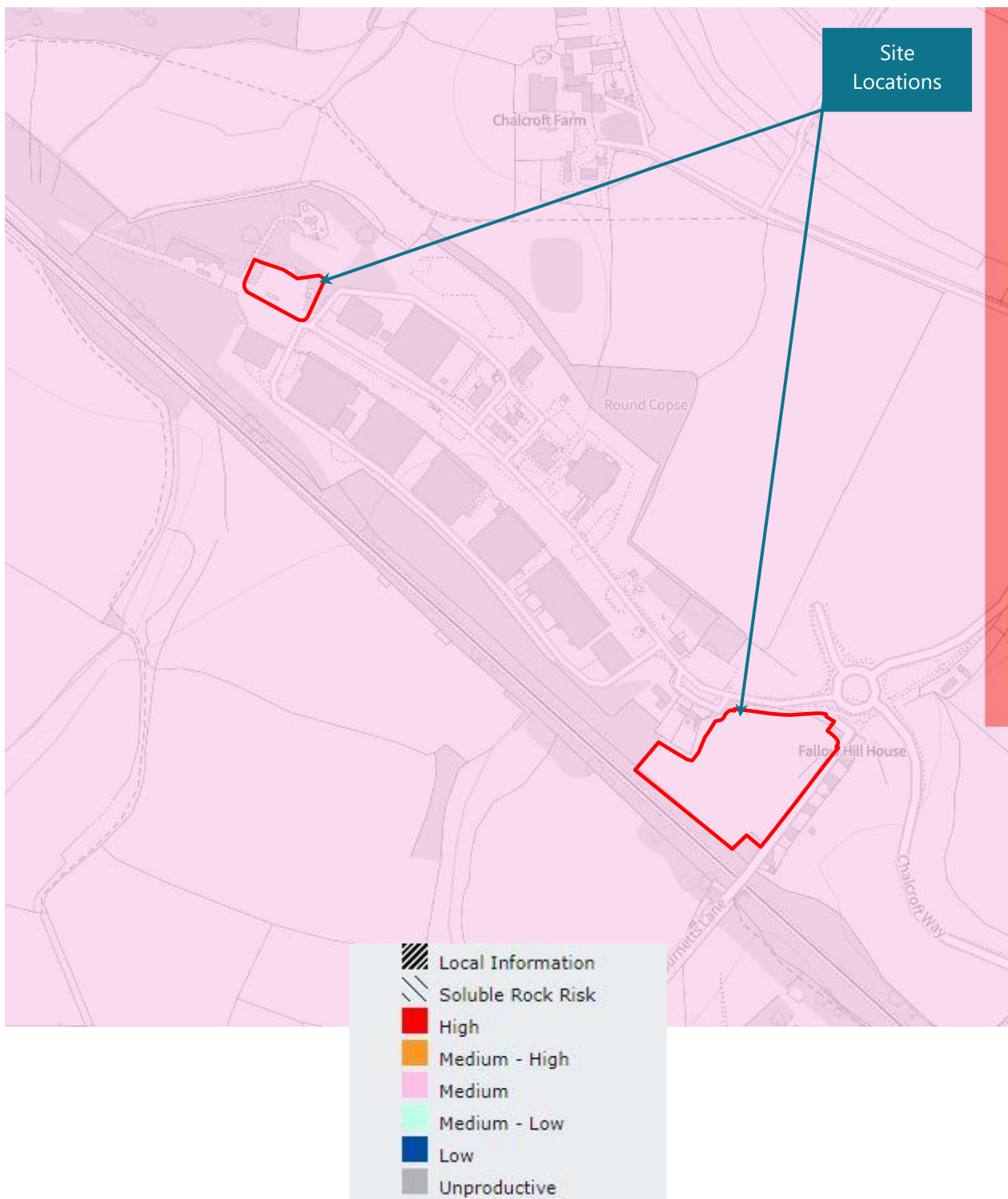
EA's Online Risk of Flooding from Reservoirs' Map

Neither land parcel is liable to flood from this source



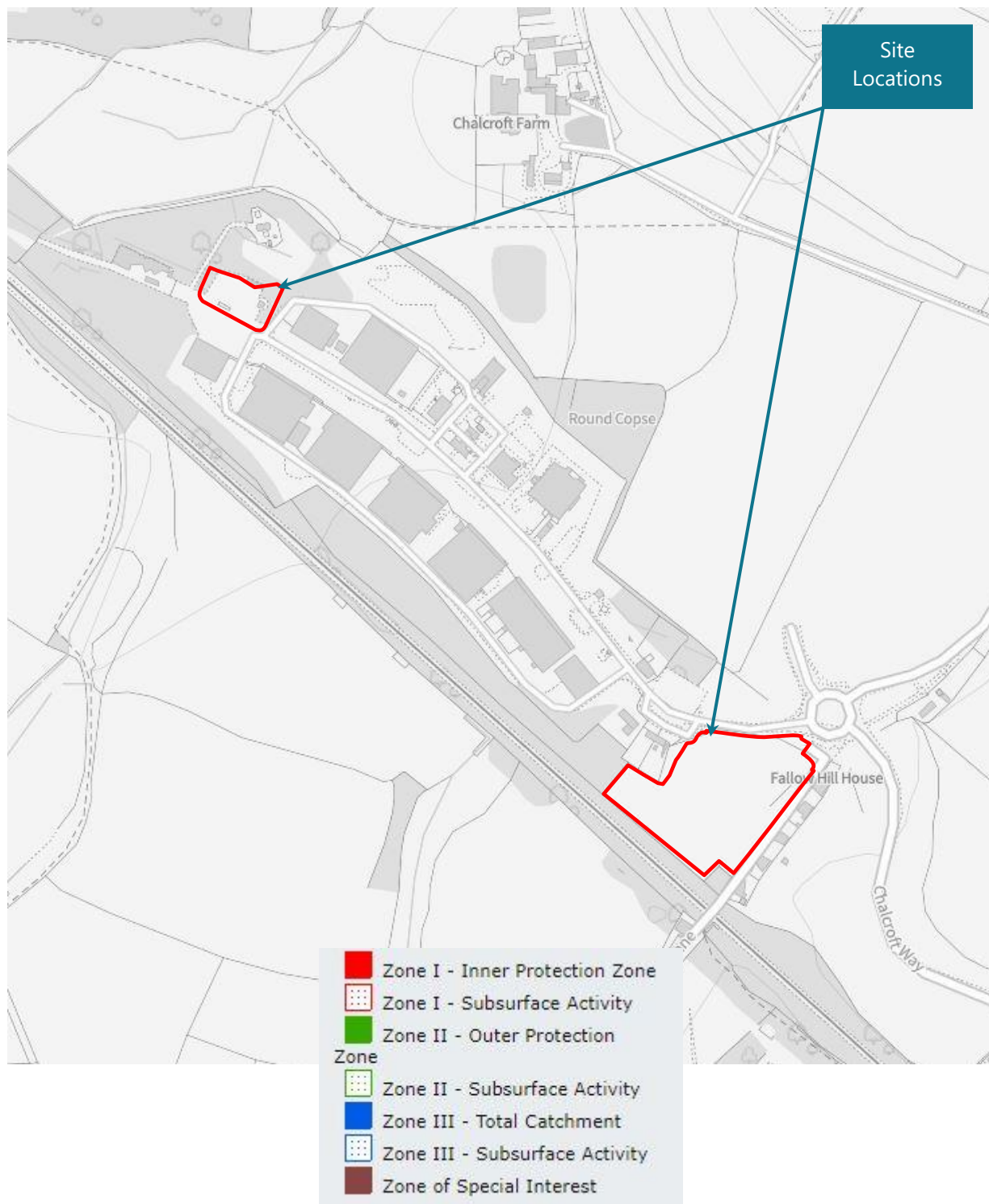
Environment Agency's Online Historic Flood Map

Neither land parcel has been affected by flooding



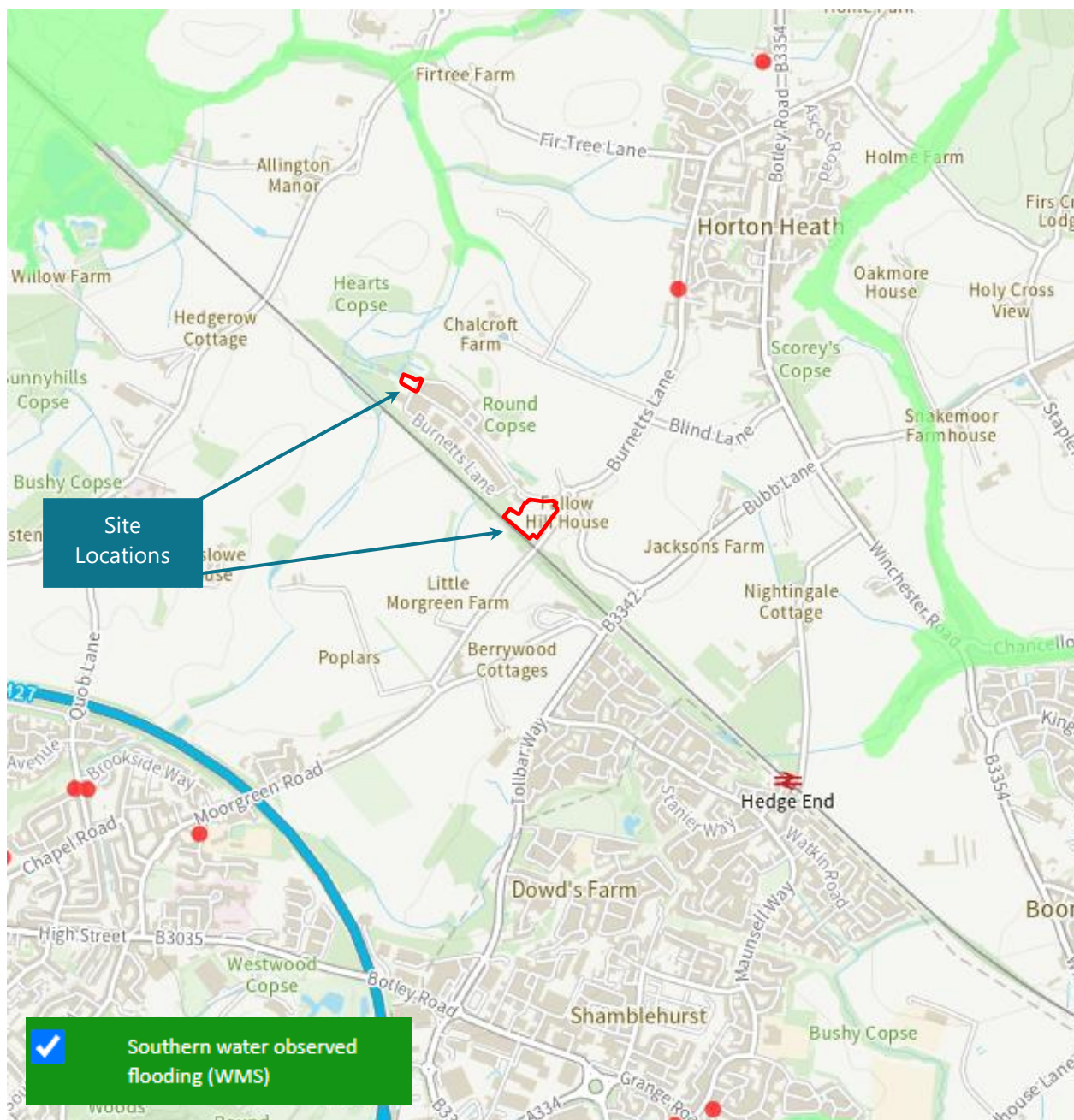
Environment Agency's Groundwater Vulnerability Zone Map

Both land parcels overlie a 'Medium' Groundwater Vulnerability Zone



Environment Agency's Online Groundwater Source Protection Zones Map

Both land parcels lie outside of all recorded Groundwater Protection Zones

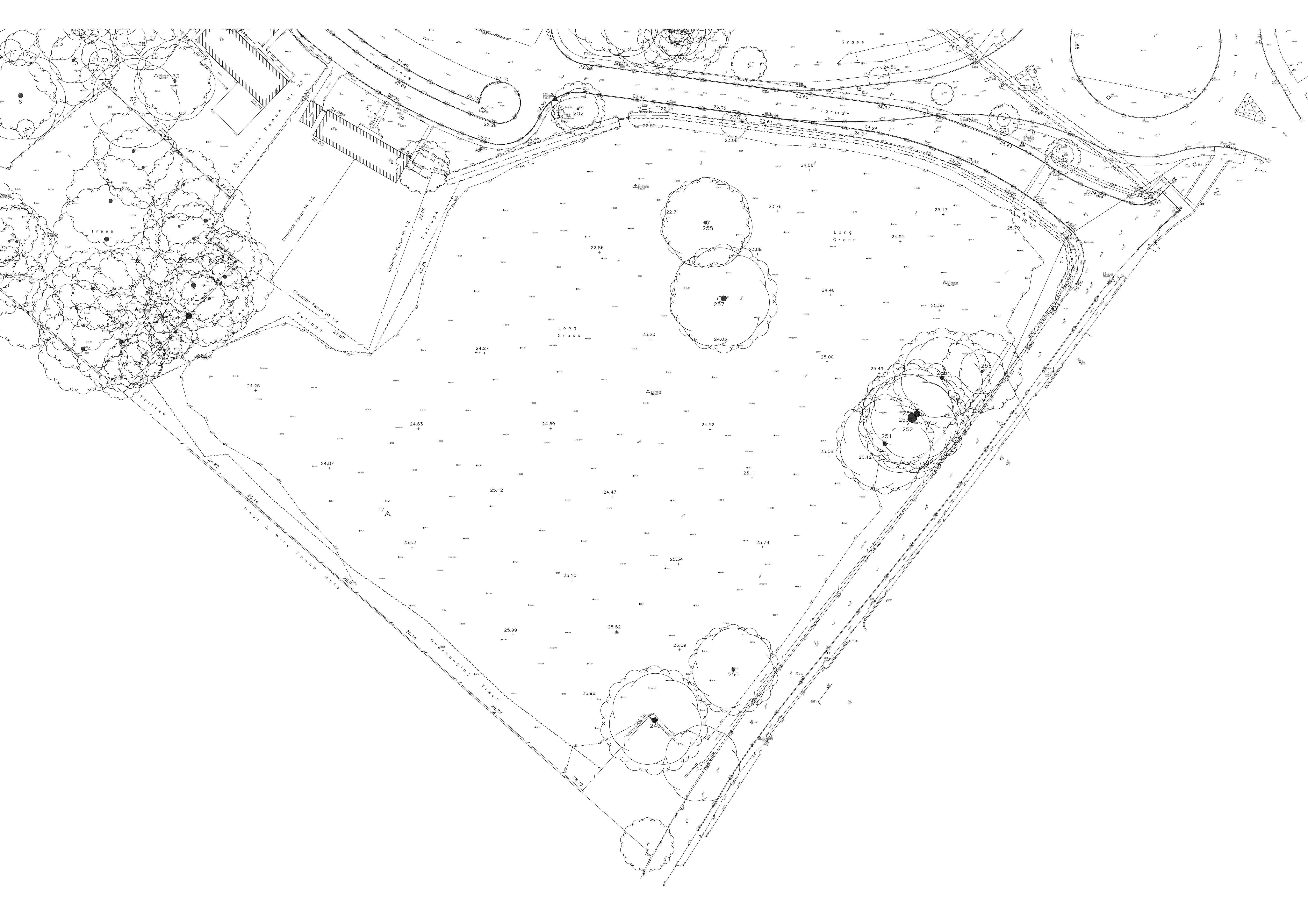


Extract from the PUSH Strategic Flood Risk Assessment map

Both parcels are removed from the nearest observed incident – over 1km away to the northeast

Appendix C

Topographic Survey





Appendix D

Proposed Scheme Drawings including Drainage Strategy Layout



Notes

This drawing is © Boyle & Summers and may not be reproduced, copied or altered in any way without written authority.

Other than for the purposes of planning, do not scale these drawings. Use written dimensions only. All dimensions to be checked on site prior to commencement of work.

Ordnance Survey Data

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Site and plot boundaries are shown indicatively only and subject to confirmation.

Area Schedule

New business starter and move-on units:
Gross plot area: 1.8ha / 4.45ac
Gross External Area (building footprints): 4,130sqm. / 44,454sqft.
Site coverage / plot ratio: approximately 25%
Gross Internal Area (building footprints): 3,823sqm. / 41,150sqft.
Allowance for mezzanine offices circa 5% of GIA: 198sqm. / 2,131sqft. (excluding farm shop)
Building height (to haunch): 6-8m (excluding farm shop)
Use class: E(g)(ii)(iii), B8, & sui generis
Car parking: 97 spaces (including 9no. accessible)

Detailed area breakdown by building: Gross Internal Areas
Farm Shop 327sqm. / 3,519sqft.
A 169sqm. / 1,819sqft.
B 362sqm. / 3,896sqft.
C 474sqm. / 5,102sqft.
D 913sqm. / 9,827sqft.
E 454sqm. / 4,886sqft.
F 723sqm. / 7,782sqft.
G 401sqm. / 4,316sqft.

Legend

- Approximate site area - 1.8ha
- Client ownership boundary
- Indicative acoustic fence
- Retained tree
- Root protection zone (RPZ)

Rev C 25-09-23 Amendments to the position and layout of buildings and associated parking & bin stores for the Farm Shop, Buildings A, B, C and G ER TB
Rev B 04-09-23 Minor amendments to indicative acoustic fence & existing trees & RPAs added to legend ER TB
Rev A 23-08-23 Amendments to layout (including relocating the farm shop access road 30m from the main site access, amends to the farm shop and associated parking and the addition of a new employment building) ER TB

Proposed Site

CBP - BSL - ZZ - XX - DR - A - 1501 - DF - C

August 2023

22093: Paddock Development

1:500 @ A1

Chalcroft Business Park

Drawn ER

Client: FIPWEL

Checked TB

Canute Chambers
Canute Road
Southampton
Hampshire
SO14 3AB

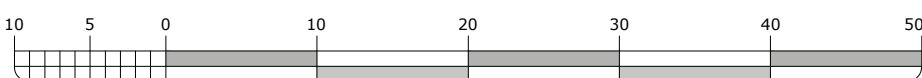
023 8063 1432

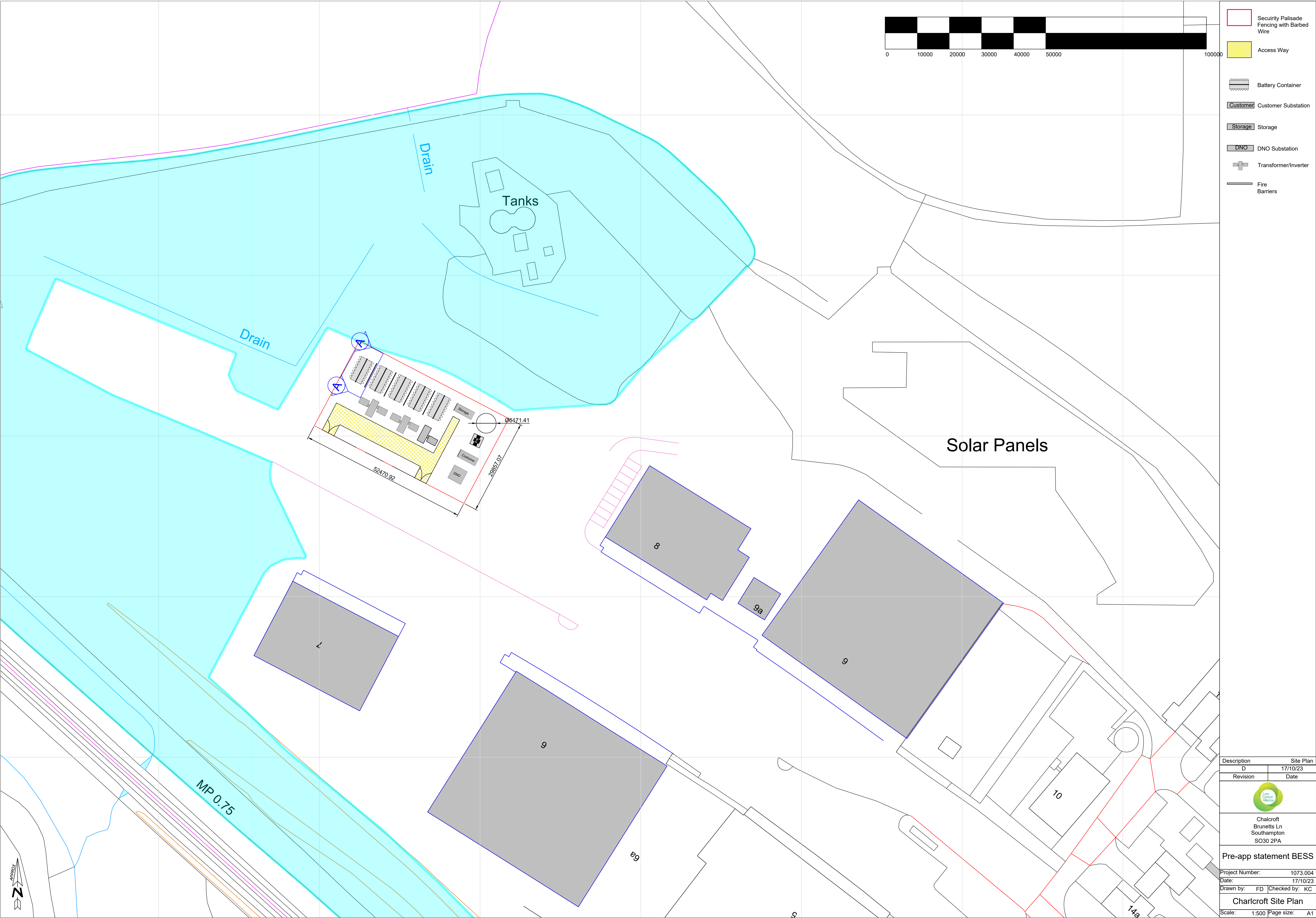
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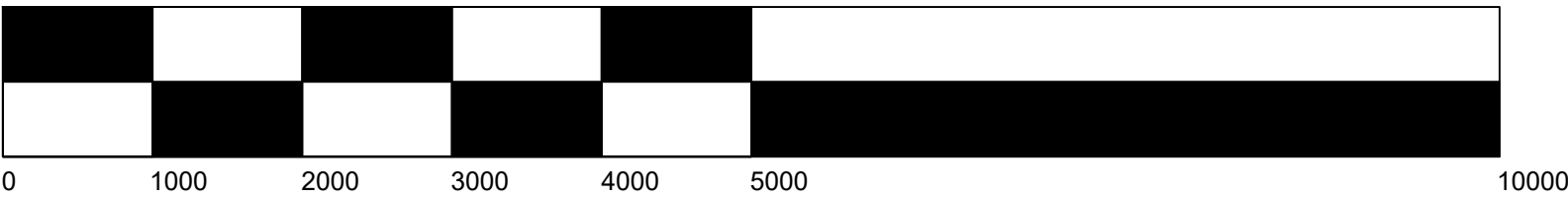
DRAFT





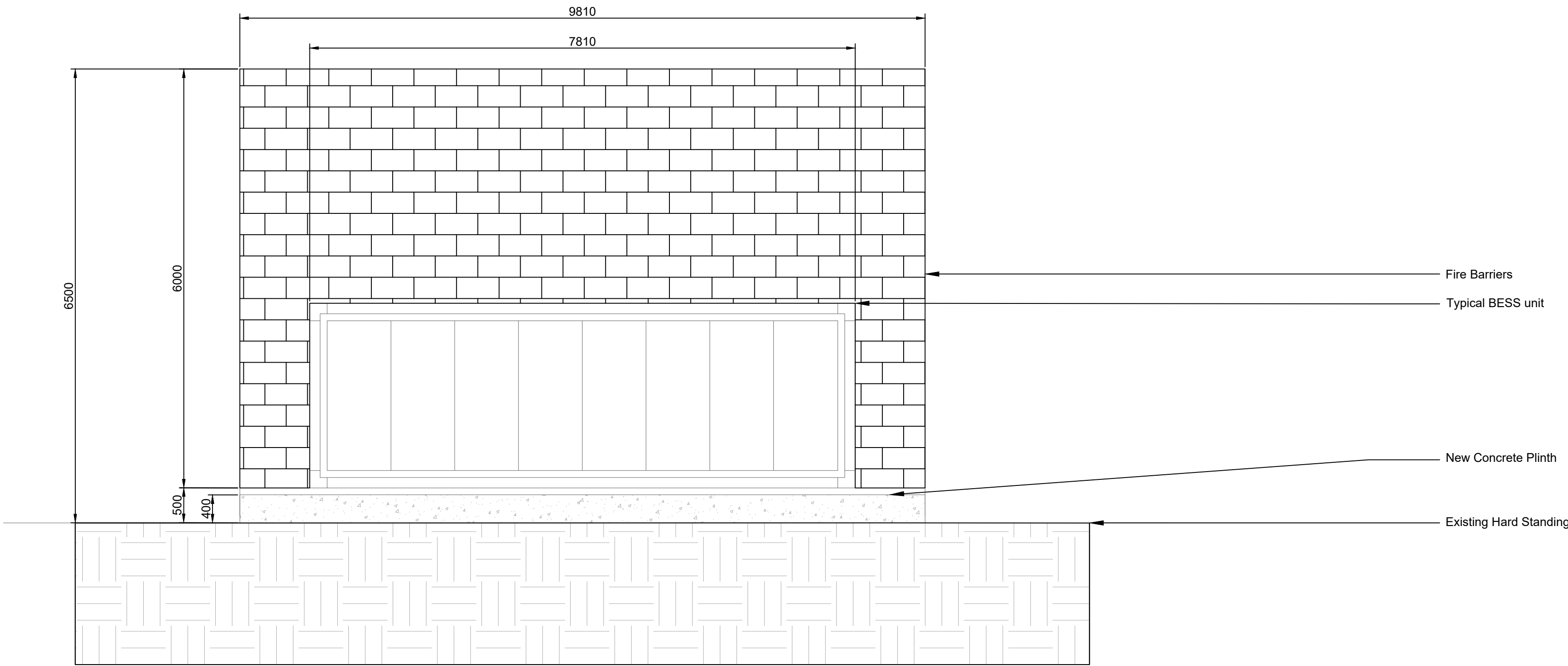
- Security Palisade Fencing with Barbed Wire
- Access Way
- Battery Container
- Customer Substation
- Storage
- DNO Substation
- Transformer/Inverter
- Fire Barriers

Description		Site Plan
D	Revision	17/10/23
	Date	
Chalcroft Brunetts Ln Southampton SO30 2PA		
Pre-app statement BESS		
Project Number:		1073.004
Date:		17/10/23
Drawn by:		FD [Checked by: KC
Chalcroft Site Plan		
Scale:		1:500 Page size: A1

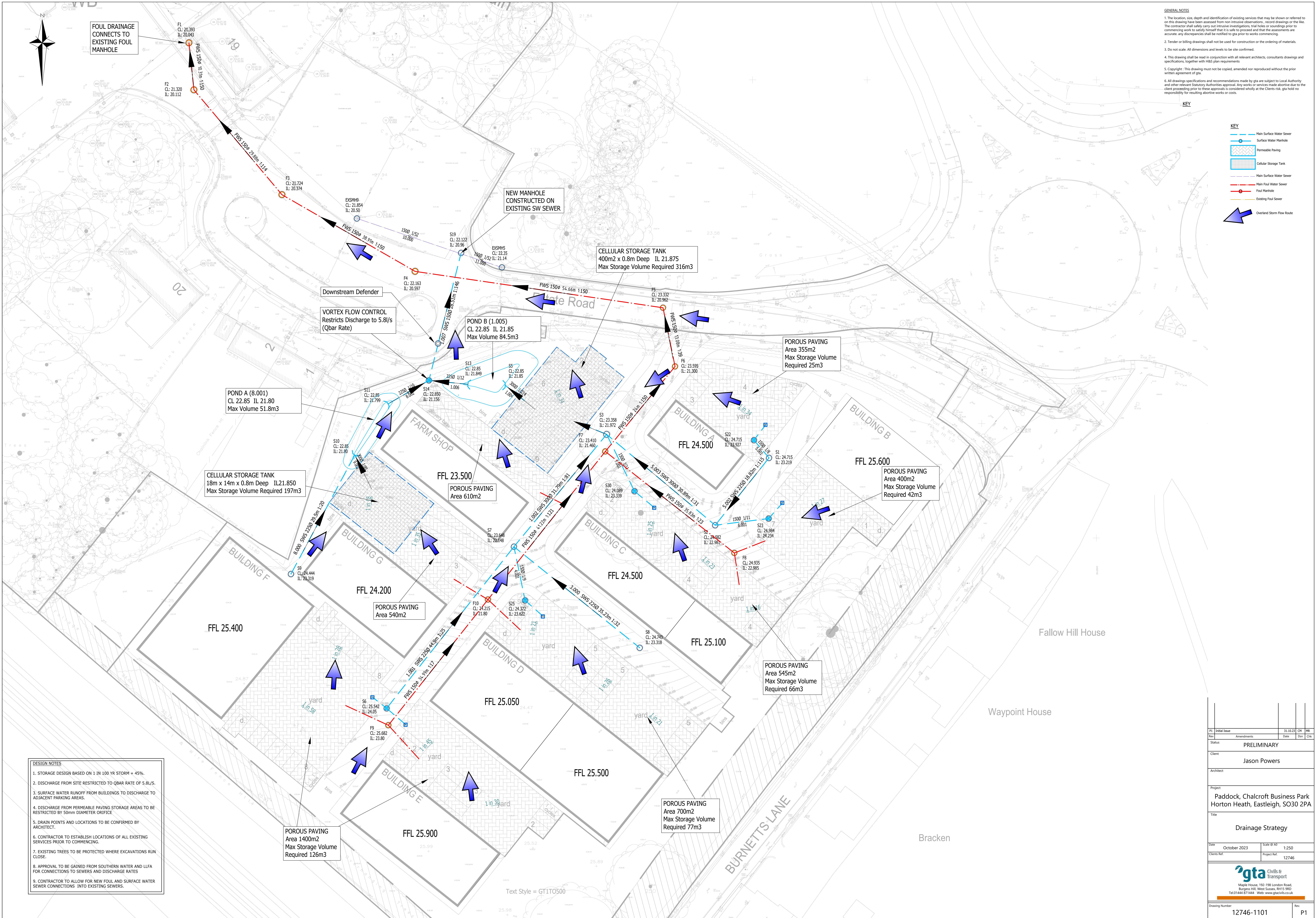


NOTES

Section AA refers to the drawing "Site Plan", and depicts a typical elevation view of a BESS system.



Description		Elevation A
E	Revision	17/10/23
	Date	
		
Chalcroft Brunetts Ln Southampton SO30 2PA		
Pre-app statement BESS		
Project Number:		1073.004
Date:		17/10/23
Drawn by:		FD [Checked by: KC
Foundation Site Plan		
Scale:		1:50 Page size: A1



GENERAL NOTES

1. The location, size, depth and identification of existing services that may be shown or referred to on this drawing have been assessed from non-intrusive observations, record drawings or the like. The contractor shall safely carry out any investigations, trial holes or soundings prior to commencing work to satisfy himself that it is safe to proceed and that the assessments are accurate. Any discrepancies shall be notified to gta prior to works commencing.
2. Tender or billing drawings shall not be used for construction or the ordering of materials.
3. Do not scale. All dimensions and levels to be site confirmed.
4. This drawing shall be read in conjunction with all relevant architects, consultants drawings and specifications, together with H&S plan requirements.
5. Copyright: This drawing must not be copied, amended nor reproduced without the prior written agreement of gta.
6. All drawings, specifications and recommendations made by gta are subject to Local Authority and other relevant Statutory Authorities approval. Any works or services made abortive due to the client proceeding prior to these approvals is considered wholly at the Client's risk. gta hold no responsibility for resulting abortive works or costs.

KEY

KEY

- Main Surface Water Sewer
- Surface Water Manhole
- Permeable Paving
- Cellular Storage Tank
- Main Foul Water Sewer
- Foul Manhole
- Existing Foul Sewer
- Overland Storm Flow Route

DESIGN NOTES

1. STORAGE DESIGN BASED ON 1 IN 100 YR STORM + 45%.
2. DISCHARGE FROM SITE RESTRICTED TO QBAR RATE OF 5.8L/S.
3. SURFACE WATER RUNOFF FROM BUILDINGS TO DISCHARGE TO ADJACENT PARKING AREAS.
4. DISCHARGE FROM PERMEABLE PAVING STORAGE AREAS TO BE RESTRICTED BY 50mm DIAMETER ORIFICE.
5. DRAIN POINTS AND LOCATIONS TO BE CONFIRMED BY ARCHITECT.
6. CONTRACTOR TO ESTABLISH LOCATIONS OF ALL EXISTING SERVICES PRIOR TO COMMENCING.
7. EXISTING TREES TO BE PROTECTED WHERE EXCAVATIONS RUN CLOSE.
8. APPROVAL TO BE GAINED FROM SOUTHERN WATER AND LLFA FOR CONNECTIONS TO SEWERS AND DISCHARGE RATES.
9. CONTRACTOR TO ALLOW FOR NEW FOUL AND SURFACE WATER SEWER CONNECTIONS INTO EXISTING SEWERS.

PI	Initial Issue	31.10.23	CH	NR
Rev	Amendments	Date	Dim	CHK
Status	PRELIMINARY			
Client	Jason Powers			
Architect				
Project	Paddock, Chalcraft Business Park Horton Heath, Eastleigh, SO30 2PA			
Title	Drainage Strategy			
Date	October 2023	Scale @ A0	1:250	
Client Ref		Project Ref	12746	
 Civils & Transport Maple House, 192-198 London Road, Burgess Hill, West Sussex, BN15 9BD Tel: 01444 871444 Web: www.gtacivils.co.uk				
Drawing Number	12746-1101			Rev: P1

Appendix E

MicroDrainage Calculation Sheets

GTA Civils Ltd		Page 1																								
Gloucester House 66a Church Walk Burgess Hill, BN43 6LB	12746 Chalcroft Greenfield runoff																									
Date 26/10/2023 File	Designed by MCR Checked by																									
XP Solutions																										
Source Control 2020.1.3																										
<u>ICP SUDS Mean Annual Flood</u> Input <table> <tr> <td>Return Period (years)</td> <td>100</td> <td>Soil</td> <td>0.450</td> </tr> <tr> <td>Area (ha)</td> <td>1.122</td> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SAAR (mm)</td> <td>800</td> <td>Region Number</td> <td>Region 7</td> </tr> </table> Results l/s <table> <tr> <td>QBAR Rural</td> <td>5.8</td> </tr> <tr> <td>QBAR Urban</td> <td>5.8</td> </tr> <tr> <td>Q100 years</td> <td>18.4</td> </tr> <tr> <td>Q1 year</td> <td>4.9</td> </tr> <tr> <td>Q30 years</td> <td>13.1</td> </tr> <tr> <td>Q100 years</td> <td>18.4</td> </tr> </table>			Return Period (years)	100	Soil	0.450	Area (ha)	1.122	Urban	0.000	SAAR (mm)	800	Region Number	Region 7	QBAR Rural	5.8	QBAR Urban	5.8	Q100 years	18.4	Q1 year	4.9	Q30 years	13.1	Q100 years	18.4
Return Period (years)	100	Soil	0.450																							
Area (ha)	1.122	Urban	0.000																							
SAAR (mm)	800	Region Number	Region 7																							
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Q100 years	18.4																									
Q1 year	4.9																									
Q30 years	13.1																									
Q100 years	18.4																									
©1982-2020 Innovyze																										

GTA Civils Ltd		Page 0
Gloucester House 66a Church Walk Burgess Hill, BN43 6LB	Chalcroft BuisinessPark Storm Network	
Date 31/10/2023 00:39 File 12746 STORM NETWORK.mdx	Designed by CM Checked by MR	
XP Solutions	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section	Type	Auto Design
1.000	5.522	0.973	5.7	0.106	5.00	0.0	0.600	o	300	Pipe/Conduit		
2.000	3.878	0.797	4.9	0.162	5.00	0.0	0.600	o	300	Pipe/Conduit		
1.001	44.896	1.827	24.6	0.042	0.00	0.0	0.600	o	225	Pipe/Conduit		
3.000	35.219	1.095	32.2	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit		
4.000	5.010	0.033	150.0	0.168	5.00	0.0	0.600	o	300	Pipe/Conduit		
4.001	11.973	1.325	9.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	11.97	5.01	25.023	0.106	0.0	0.0	0.0	6.64	469.5	3.4
2.000	11.98	5.01	24.847	0.162	0.0	0.0	0.0	7.17	506.9	5.3
1.001	11.33	5.30	24.050	0.310	0.0	0.0	0.0	2.65	105.4	9.5
3.000	11.42	5.25	23.318	0.000	0.0	0.0	0.0	2.32	92.1	0.0
4.000	11.85	5.07	23.655	0.168	0.0	0.0	0.0	1.28	90.6	5.4
4.001	11.71	5.12	23.622	0.168	0.0	0.0	0.0	3.37	59.6	5.4

GTA Civils Ltd		Page 1
Gloucester House 66a Church Walk Burgess Hill, BN43 6LB	Chalcroft BuisinessPark Storm Network	
Date 31/10/2023 00:39 File 12746 STORM NETWORK.mdx	Designed by CM Checked by MR	
XP Solutions	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section	Type	Auto Design
1.002	31.779	0.176	181.0	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit		
5.000	4.216	0.028	150.0	0.057	5.00	0.0	0.600	o	300	Pipe/Conduit		
5.001	5.091	0.633	8.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
5.002	18.813	0.163	115.3	0.024	0.00	0.0	0.600	o	225	Pipe/Conduit		
6.000	4.571	0.030	150.0	0.082	5.00	0.0	0.600	o	300	Pipe/Conduit		
6.001	11.755	1.103	10.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
5.003	30.888	1.009	30.6	0.025	0.00	0.0	0.600	o	225	Pipe/Conduit		
7.000	5.664	0.038	150.0	0.148	5.00	0.0	0.600	o	300	Pipe/Conduit		
7.001	13.813	1.217	11.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.002	10.43	5.75	22.148	0.507	0.0	0.0	0.0	1.17	82.4	14.3
5.000	11.87	5.05	23.955	0.057	0.0	0.0	0.0	1.28	90.6	1.8
5.001	11.81	5.08	23.927	0.057	0.0	0.0	0.0	3.58	63.2	1.8
5.002	11.24	5.34	23.219	0.081	0.0	0.0	0.0	1.22	48.4	2.5
6.000	11.86	5.06	24.265	0.082	0.0	0.0	0.0	1.28	90.6	2.6
6.001	11.71	5.12	24.234	0.082	0.0	0.0	0.0	3.10	54.9	2.6
5.003	10.80	5.55	23.056	0.188	0.0	0.0	0.0	2.37	94.3	5.5
7.000	11.83	5.07	23.377	0.148	0.0	0.0	0.0	1.28	90.6	4.7
7.001	11.65	5.15	23.339	0.148	0.0	0.0	0.0	3.01	53.1	4.7

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	19.426	0.097	200.3	0.073	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	5.346	0.025	213.8	0.103	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	8.118	0.001	8117.8	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
1.006	8.564	0.693	12.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.000	29.492	1.444	20.4	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit	
9.000	4.645	0.031	150.0	0.103	5.00	0.0	0.600	o	300	Pipe/Conduit	
9.001	4.225	0.050	84.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.001	13.282	0.076	174.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.002	10.295	0.643	16.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	9.93	6.04	21.972	0.916	0.0	0.0	0.0	1.11	78.3	24.6
1.004	9.79	6.13	21.875	1.019	0.0	0.0	0.0	1.07	75.7	27.0
1.005	9.08	6.61	21.850	1.019	0.0	0.0	0.0	0.28	100.6	27.0
1.006	9.03	6.65	21.849	1.019	0.0	0.0	0.0	3.74	148.8	27.0
8.000	11.61	5.17	23.319	0.000	0.0	0.0	0.0	2.91	115.7	0.0
9.000	11.86	5.06	21.881	0.103	0.0	0.0	0.0	1.28	90.6	3.3
9.001	11.76	5.10	21.850	0.103	0.0	0.0	0.0	1.71	121.0	3.3
8.001	11.12	5.39	21.875	0.103	0.0	0.0	0.0	0.99	39.2	3.3
8.002	11.04	5.44	21.799	0.103	0.0	0.0	0.0	3.95	279.1	3.3

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.007	28.700	0.196	146.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
10.000	23.958	-0.460	-52.1	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
11.000	9.430	0.180	52.4	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.007	8.31	7.22	21.156	1.122	0.0	0.0	0.0	0.83	14.6«	27.0
10.000	6.45	9.31	20.500	0.000	0.0	0.0	0.0	0.09	1.6	0.0
11.000	11.74	5.11	21.140	0.000	0.0	0.0	0.0	1.39	24.6	0.0

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Online Controls for Surface Network 1 Orifice Manhole: S6, DS/PN: 1.001, Volume (m³): 2.6 Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 24.050 Orifice Manhole: S25, DS/PN: 4.001, Volume (m³): 1.3 Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 23.622 Orifice Manhole: S22, DS/PN: 5.001, Volume (m³): 1.3 Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 23.927 Orifice Manhole: S23, DS/PN: 6.001, Volume (m³): 1.3 Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 24.234 Orifice Manhole: S30, DS/PN: 7.001, Volume (m³): 1.4 Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 23.339 Hydro-Brake® Optimum Manhole: S14, DS/PN: 1.007, Volume (m³): 3.3 <table><tr><td>Unit Reference</td><td>MD-SHE-0107-5800-1400-5800</td><td>Sump Available</td><td>Yes</td></tr><tr><td>Design Head (m)</td><td>1.400</td><td>Diameter (mm)</td><td>107</td></tr><tr><td>Design Flow (l/s)</td><td>5.8</td><td>Invert Level (m)</td><td>21.156</td></tr><tr><td>Flush-Flo™</td><td>Calculated</td><td>Minimum Outlet Pipe Diameter (mm)</td><td>150</td></tr><tr><td>Objective</td><td>Minimise upstream storage</td><td>Suggested Manhole Diameter (mm)</td><td>1200</td></tr><tr><td>Application</td><td>Surface</td><td></td><td></td></tr></table> <table><tr><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td>Design Point (Calculated)</td><td>1.400</td><td>5.8</td><td>Flush-Flo™</td><td>0.411</td><td>5.8</td></tr></table>			Unit Reference	MD-SHE-0107-5800-1400-5800	Sump Available	Yes	Design Head (m)	1.400	Diameter (mm)	107	Design Flow (l/s)	5.8	Invert Level (m)	21.156	Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150	Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200	Application	Surface			Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.400	5.8	Flush-Flo™	0.411	5.8
Unit Reference	MD-SHE-0107-5800-1400-5800	Sump Available	Yes																																			
Design Head (m)	1.400	Diameter (mm)	107																																			
Design Flow (l/s)	5.8	Invert Level (m)	21.156																																			
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150																																			
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200																																			
Application	Surface																																					
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)																																	
Design Point (Calculated)	1.400	5.8	Flush-Flo™	0.411	5.8																																	
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Hydro-Brake® Optimum Manhole: S14, DS/PN: 1.007, Volume (m³): 3.3

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Kick-Flo®	0.856	4.6	Mean Flow over Head Range	-	5.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	0.600	5.6	1.600	6.2	2.600	7.7	5.000	10.6	7.500	12.8
0.200	5.3	0.800	5.0	1.800	6.5	3.000	8.3	5.500	11.0	8.000	13.2
0.300	5.7	1.000	5.0	2.000	6.9	3.500	8.9	6.000	11.5	8.500	13.6
0.400	5.8	1.200	5.4	2.200	7.2	4.000	9.5	6.500	12.0	9.000	14.0
0.500	5.8	1.400	5.8	2.400	7.5	4.500	10.0	7.000	12.4	9.500	14.3

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Storage Structures for Surface Network 1

Porous Car Park Manhole: S6, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	0.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	25.000	Depression Storage (mm)	5
Max Percolation (l/s)	388.9	Width (m)	20.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	70.0	Membrane Depth (mm)	0

Porous Car Park Manhole: S25, DS/PN: 4.001

Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	0.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	23.800	Depression Storage (mm)	5
Max Percolation (l/s)	194.4	Width (m)	10.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	70.0	Membrane Depth (mm)	0

Porous Car Park Manhole: S22, DS/PN: 5.001

Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	0.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	23.927	Depression Storage (mm)	5
Max Percolation (l/s)	98.9	Width (m)	20.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	17.8	Membrane Depth (mm)	0

Porous Car Park Manhole: S23, DS/PN: 6.001

Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30	Slope (1:X)	0.0
Membrane Percolation (mm/hr)	1000	Invert Level (m)	24.400	Depression Storage (mm)	5
Max Percolation (l/s)	111.1	Width (m)	20.0	Evaporation (mm/day)	3
Safety Factor	2.0	Length (m)	20.0	Membrane Depth (mm)	0

Porous Car Park Manhole: S30, DS/PN: 7.001

Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	2.0	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Porosity	0.30	Length (m)	54.5
Max Percolation (l/s)	151.4	Invert Level (m)	23.600	Slope (1:X)	0.0

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Porous Car Park Manhole: S30, DS/PN: 7.001

Depression Storage (mm) 5 Evaporation (mm/day) 3 Membrane Depth (mm) 0

Cellular Storage Manhole: S4, DS/PN: 1.004

Invert Level (m) 21.875 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	400.0	400.0	0.800	400.0	464.0	0.900	0.0	464.0

Tank or Pond Manhole: S13, DS/PN: 1.006

Invert Level (m) 21.850

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	31.3	0.200	49.5	0.400	70.5	0.600	94.0	0.800	120.0	1.000	148.2
0.100	40.0	0.300	59.7	0.500	81.9	0.700	106.7	0.900	133.9		

Cellular Storage Manhole: S21, DS/PN: 9.001

Invert Level (m) 21.850 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	252.0	252.0	0.800	252.0	303.2	0.900	0.0	303.2

Tank or Pond Manhole: S11, DS/PN: 8.002

Invert Level (m) 21.800

Tank or Pond Manhole: S11, DS/PN: 8.002

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	14.6	0.200	26.7	0.400	39.7	0.600	53.7	0.800	68.5	1.000	84.3
0.100	20.5	0.300	33.1	0.500	46.6	0.700	61.0	0.900	76.3	1.050	88.3

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
 Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
 Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 6 Number of Storage Structures 9 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 439758 114798 SU 39758 14798 Cv (Summer) 0.750
 FEH Rainfall Version 2013 Data Type Point Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
 DTS Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 45

Surcharged Flooded

PN	Depth (m)	Volume (m ³)	Flow / Overflow Cap. (l/s)	Maximum Vol (m ³)	Status
1.000	-0.248	0.000	0.07	0.067	OK
2.000	-0.109	0.000	0.06	0.266	OK
1.001	0.761	0.000	0.05	16.983	SURCHARGED
3.000	-0.225	0.000	0.00	0.000	OK
4.000	-0.095	0.000	0.15	0.286	OK
4.001	0.087	0.000	0.04	12.991	SURCHARGED
1.002	-0.224	0.000	0.15	0.103	OK
5.000	-0.220	0.000	0.16	0.108	OK
5.001	-0.089	0.000	0.02	6.605	OK
5.002	-0.183	0.000	0.08	0.052	OK

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	Surcharged		Flooded		Flow / Overflow (l/s)	Maximum Vol (m³)	Status
	Depth (m)	Volume (m³)	Flow / Cap.	Volume			
6.000	-0.130	0.000	0.17			0.236	OK
6.001	0.050	0.000	0.04			4.439	SURCHARGED
5.003	-0.177	0.000	0.10			0.094	OK
7.000	-0.023	0.000	0.20			0.390	OK
7.001	0.164	0.000	0.06			9.387	SURCHARGED
1.003	-0.153	0.000	0.24			0.669	OK
1.004	-0.064	0.000	0.22			90.706	OK
1.005	-0.418	0.000	0.05			0.656	OK
1.006	0.033	0.000	0.07			11.971	SURCHARGED
8.000	-0.225	0.000	0.00			0.000	OK
9.000	-0.100	0.000	0.04			0.279	OK
9.001	-0.069	0.000	0.03			55.757	OK
8.001	-0.019	0.000	0.06			0.563	OK
8.002	-0.014	0.000	0.01			7.349	OK
1.007	0.791	0.000	0.41			2.260	SURCHARGED
10.000	-0.150	0.000	0.00			0.000	OK
11.000	-0.150	0.000	0.00			0.000	OK

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
 Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
 Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 6 Number of Storage Structures 9 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 439758 114798 SU 39758 14798 Cv (Summer) 0.750
 FEH Rainfall Version 2013 Data Type Point Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
 DTS Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 45

Surcharged Flooded

PN	Depth (m)	Volume (m ³)	Flow / Overflow Cap. (l/s)	Maximum Vol (m ³)	Status
1.000	-0.196	0.000	0.08	0.142	OK
2.000	-0.019	0.000	0.13	0.395	OK
1.001	0.851	0.000	0.05	54.973	SURCHARGED
3.000	-0.225	0.000	0.00	0.000	OK
4.000	0.005	0.000	0.49	0.430	SURCHARGED
4.001	0.187	0.000	0.05	34.184	SURCHARGED
1.002	-0.129	0.000	0.11	0.283	OK
5.000	-0.180	0.000	0.33	0.165	OK
5.001	-0.038	0.000	0.03	12.107	OK
5.002	-0.156	0.000	0.20	0.092	OK

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	Surcharged		Flooded		Flow / Overflow (l/s)	Maximum Vol (m³)	Status
	Depth (m)	Volume (m³)	Flow / Cap.	Volume			
6.000	-0.056	0.000	0.25			0.343	OK
6.001	0.124	0.000	0.05			13.530	SURCHARGED
5.003	-0.153	0.000	0.23			0.149	OK
7.000	0.087	0.000	0.42			0.547	SURCHARGED
7.001	0.274	0.000	0.07			27.545	SURCHARGED
1.003	0.038	0.000	0.28			2.518	SURCHARGED
1.004	0.127	0.000	0.27			164.279	SURCHARGED
1.005	-0.225	0.000	0.06			1.058	OK
1.006	0.225	0.000	0.11			25.745	SURCHARGED
8.000	-0.225	0.000	0.00			0.000	OK
9.000	0.096	0.000	0.06			0.560	SURCHARGED
9.001	0.127	0.000	0.03			103.150	SURCHARGED
8.001	0.182	0.000	0.05			0.973	SURCHARGED
8.002	0.185	0.000	0.02			15.301	SURCHARGED
1.007	1.075	0.000	0.41			2.667	SURCHARGED
10.000	-0.150	0.000	0.00			0.000	OK
11.000	-0.150	0.000	0.00			0.000	OK

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
 Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
 Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 6 Number of Storage Structures 9 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 439758 114798 SU 39758 14798 Cv (Summer) 0.750
 FEH Rainfall Version 2013 Data Type Point Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
 DTS Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 2, 30, 100
 Climate Change (%) 0, 0, 45

Surcharged Flooded

PN	Depth (m)	Volume (m³)	Flow / Overflow Cap. (l/s)	Maximum Vol (m³)	Status
1.000	-0.030	0.000	0.08	0.379	OK
2.000	0.146	0.000	0.14	0.632	SURCHARGED
1.001	1.017	0.000	0.06	124.771	FLOOD RISK
3.000	-0.225	0.000	0.00	0.000	OK
4.000	0.180	0.000	0.53	0.680	SURCHARGED
4.001	0.361	0.000	0.07	71.035	FLOOD RISK
1.002	0.275	0.000	0.12	1.697	SURCHARGED
5.000	-0.118	0.000	0.33	0.253	OK
5.001	0.059	0.000	0.04	22.726	SURCHARGED
5.002	-0.129	0.000	0.37	0.130	OK

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Gloucester House 66a Church Walk Burgess Hill, BN43 6LB	Chalcroft BuisnessPark Storm Network	
Date 31/10/2023 00:39 File 12746 STORM NETWORK.mdx	Designed by CM Checked by MR	
XP Solutions	Network 2020.1.3	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	Surcharged		Flooded		Maximum Vol (m³)	Status
	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)		
6.000	0.079	0.000	0.46		0.535	SURCHARGED
6.001	0.258	0.000	0.07		29.815	SURCHARGED
5.003	-0.127	0.000	0.39		0.206	OK
7.000	0.272	0.000	0.78		0.811	SURCHARGED
7.001	0.458	0.000	0.08		57.846	FLOOD RISK
1.003	0.442	0.000	0.30		4.178	SURCHARGED
1.004	0.531	0.000	0.27		315.313	FLOOD RISK
1.005	0.179	0.000	0.06		1.773	FLOOD RISK
1.006	0.630	0.000	0.11		68.232	FLOOD RISK
8.000	-0.225	0.000	0.00		0.000	OK
9.000	0.503	0.000	0.06		1.143	SURCHARGED
9.001	0.534	0.000	0.03		198.663	SURCHARGED
8.001	0.587	0.000	0.05		1.746	FLOOD RISK
8.002	0.589	0.000	0.02		40.010	FLOOD RISK
1.007	1.491	0.000	0.43		3.263	FLOOD RISK
10.000	-0.150	0.000	0.00		0.000	OK
11.000	-0.150	0.000	0.00		0.000	OK



Civil Engineering - Transport Planning - Flood Risk

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