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**Proposed Storage Yard
Keyline
Land at Harts Farm Way
Havant
Hampshire**

Flood Risk Assessment

**Revision 0: March 2021
R-FRA-22227-01-0**

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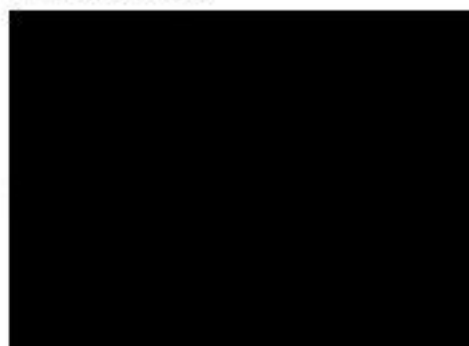
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Contents

1.0	Introduction.....	5
1.1	Background.....	5
1.2	Objectives.....	5
1.3	Reference documents	6
2.0	Description and history of the site and development proposals.....	7
2.1	Location and description of the site.....	7
2.2	History of the site	7
2.3	Proposed Development.....	9
2.4	Site topography	9
2.5	Existing drainage infrastructure	9
2.6	Geology of the site and ground investigation data	9
2.7	Development proposals and flood risk vulnerability	11
3.0	Flood risk	12
3.1	Fluvial / Tidal flooding	12
3.2	Flooding from surface water	14
3.3	Flooding from groundwater	15
3.4	Flooding from sewers.....	16
3.5	Flooding from reservoirs, canals and other artificial sources	16
3.6	Historic flooding	17
3.7	Flood risk vulnerability and flood zone compatibility	17
3.8	Flood compensation.....	17
3.9	Access and egress.....	17
4.0	Management of surface water.....	18
4.1	Current conditions.....	18
4.2	Surface water drainage outfalls	18
4.3	SUDS assessment.....	19
4.4	Surface water drainage strategy	19
4.5	Surface water drainage design and management	20
4.6	Existing run-off rates	20
4.7	Attenuation requirements	21
4.8	Overland flows.....	21
4.9	Foul water drainage strategy	21
5.0	Maintenance.....	22
5.1	Surface drainage maintenance.....	22
6.0	Summary and conclusions	23

Appendices

Appendix A	A
Location Plan	A
WEA drawing no. 22573-001 Rev.P2.....	A
Appendix B	B
Existing Site Plan.....	B
WEA drawing no. 22573-010.....	B
Appendix C	C
Topographical Survey	C
JPP drawing no. 22295Y-01	C
Appendix D	D
Proposed Site Plan.....	D
WEA drawing no. 22573-100 Rev.P2.....	D
Appendix E	E
Southern Water Asset Plan	E
Appendix F	F
Existing Keyline Site: Surface Water Drainage Strategy	F
JPP drawing no. KLHAV1YY-FRA03	F
Appendix G	G
Extract of Ground Investigation	G
Soiltechnics report ref. STN3703G-G01	G
Appendix H	H
Proposed Drainage Plan	H
JPP drawing no. 22573-200 Rev.P2	H
Appendix I	I
Greenfield Calculations	I
Appendix J	J
Attenuation Calculations.....	J

Figures

Figure 1.1 Site Location Plan	5
Figure 2.1 Aerial imagery dated 2005.	7
Figure 2.2 Aerial imagery dated 2016.	8
Figure 2.3 Aerial imagery dated 2019.	8
Figure 3.1 Flood Map for Planning (Rivers and Sea)	12
Figure 3.2 Risk of Flooding from Surface Water.....	14
Figure 3.3 Risk of Flooding from Reservoirs.....	16

1.0 Introduction

1.1 Background

1.1.1 This report is a Flood Risk Assessment which has been prepared by JPP Consulting Limited on behalf of Travis Perkins Ltd for a proposed storage yard alteration to the east of the existing Keyline unit. The benefit of this report is to our instructing Client.

1.1.2 The Keyline site is located at land off Harts Farm Way, Havant, as shown in Figure 1.1 below and enclosed in **Appendix A**. Havant is located to the north-east of Portsmouth and west of Chichester. The National Grid Reference for the site is E470640 N105925.



Figure 1.1 Site Location Plan

1.2 Objectives

1.2.1 The objective of this report is to advise interested parties regarding the potential risk of flooding and the management of surface water run-off arising from the proposals.

1.2.2 This report has been prepared to support a full planning application.

1.3 Reference documents

1.3.1 This report has been prepared with reference to the following publications:-

- Ministry of Housing, Communities and Local Government (July 2018), National Planning Policy Framework
- Ministry of Housing, Communities and Local Government (July 2018), Planning Practice Guidance 'Flood Risk and Coastal Change'
- Department for Environment, Food and Rural Affairs (March 2015), Non-statutory technical standards for sustainable drainage systems
- Environment Agency (September 2013), Climate Change Allowances for Planners: Guidance to support the National Planning Policy Framework
- Environment Agency (October 2013), Delivering benefits through evidence: Rainfall runoff management for developments
- HM Government (2010), The Building Regulations (2010), Drainage and Waste Disposal, Approved Document H, The NBS, Newcastle Upon Tyne
- Wilson, Bray, Cooper (2004), Sustainable drainage systems: Hydraulic, structural and water quality advice, C609, CIRIA, London
- Woods-Ballard et al (2015), The SUDS Manual, C753, CIRIA, London
- CIRIA Report C624 Development and flood risk
- National SUDS Working Group (2004), Interim Code of Practice for Sustainable Drainage Systems,
- Institute of Hydrology (1999), Flood Estimation Handbook, Institute of Hydrology, Wallingford
- BS EN 752:2008 Drain and sewer systems outside buildings. Hydraulic design and environmental considerations
- BS 8533:2011 Assessing and managing flood risk in development – Code of Practice
- CIRIA Report C635 Designing for exceedance in urban drainage – good practice

2.0 Description and history of the site and development proposals

2.1 Location and description of the site

2.1.1 The yard is located at the existing Keyline site, off Harts Farm Way, Havant, as shown in Figure 1.1 above and enclosed in **Appendix A**. The site is bound by the A27 to the north, and sits within the Harts Farm Way industrial estate (to the east, south and west).

2.1.2 The yard forms the eastern part of the wider Keyline site, with the recently constructed Keyline building located to the west.

2.2 History of the site

2.2.1 The existing site layout is shown on the plan enclosed in **Appendix B**, with additional information shown on the topographical survey enclosed in **Appendix C**. The area subject to the planning application forms part of the wider Keyline site, and is currently unsurfaced.

2.2.2 Aerial imagery dating back to 2005 shows that the site remained undeveloped between 2005 and 2016, see Figure 2.1 and Figure 2.2 below.

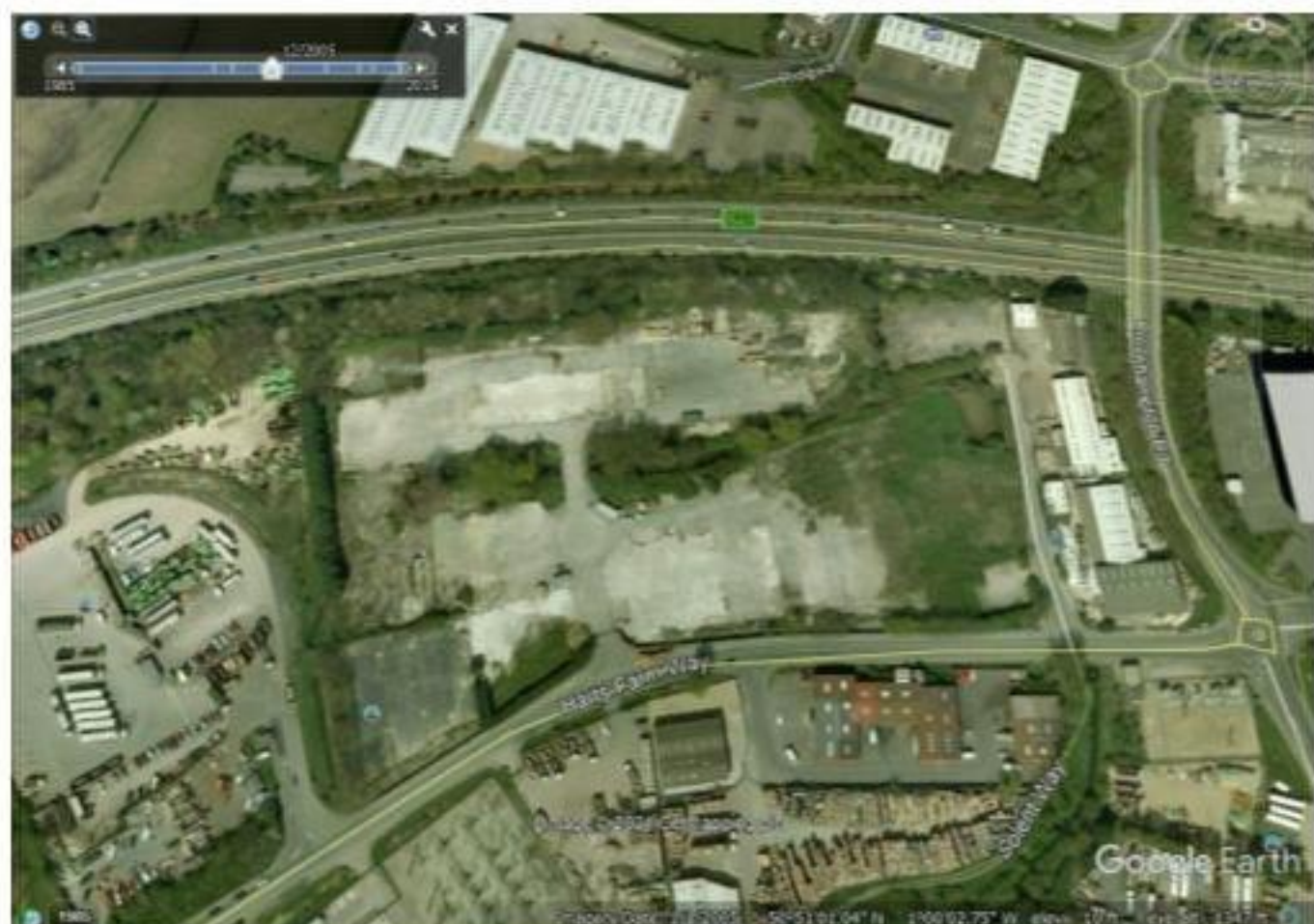


Figure 2.1 Aerial imagery dated 2005. Obtained: Google Earth Pro March 2021

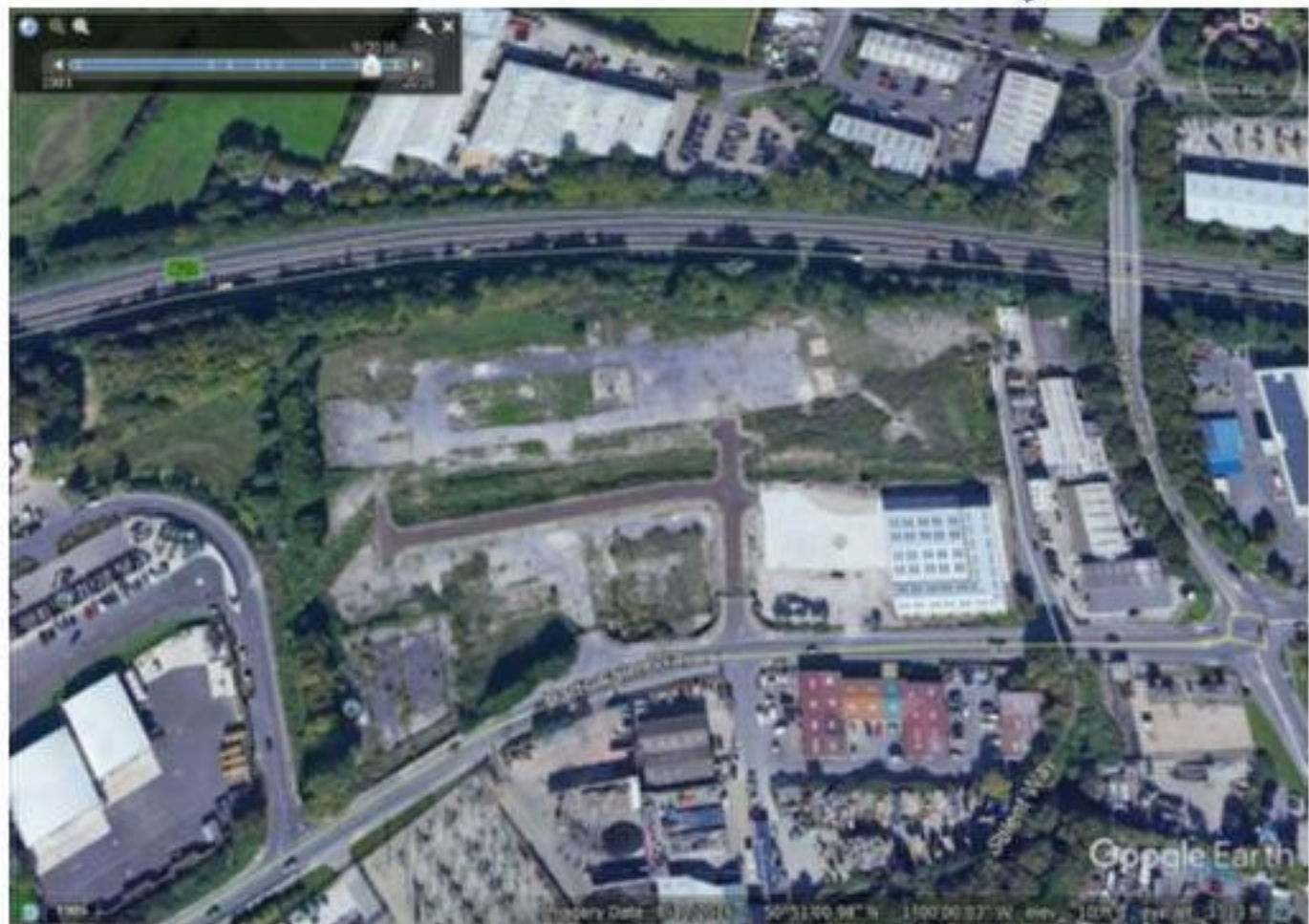


Figure 2.2 Aerial imagery dated 2016. Obtained: Google Earth Pro March 2021

- 2.2.3 Planning permission was granted in May 2017 (under Havant Borough Council planning reference APP/17/00075) for storage and distribution purposes with associated open storage, access and servicing arrangements and car park. Figure 2.3 below (dated 2019), shows the newly constructed Keyline building, which is located to the west of the proposed site.



Figure 2.3 Aerial imagery dated 2019. Obtained: Google Earth Pro March 2021

2.3 Proposed Development

- 2.3.1 The proposed development will comprise a formalised yard at the existing Keyline site, which will provide a new concrete surface. The proposed development layout is shown on the plan enclosed in **Appendix D**.

2.4 Site topography

- 2.4.1 The topographical survey is shown on the plan enclosed in **Appendix C**. The topographical survey indicates that site levels fall from the north-western corner at approximately 4.05m OAD down to approximately 3.80m AOD along the eastern boundary.
- 2.4.2 For context, levels increase to the west of the site, to approximately 4.30m in the vicinity of the existing Keyline buildings.
- 2.4.3 An existing watercourse (Brockhampton Stream) is located to the south of the site, which flows from east to west. The topographical survey indicates that this feature is approximately 1.2m to 1.5m in depth. The watercourse is culverted beneath the access road to the Keyline site.

2.5 Existing drainage infrastructure

- 2.5.1 Southern Water's asset plan is enclosed in **Appendix E**. The asset identifies that there are no adopted sewers within the site.
- 2.5.2 The topographical survey indicates that there are a number of existing manholes located within the wider Keyline site. These manholes are shown on the topographical survey enclosed in **Appendix C**. A single existing manhole is located within the application site boundary, in the south-western corner.
- 2.5.3 The surface water drainage strategy for the existing Keyline site, as prepared by JPP Consulting to support the original planning application, is shown on the plan enclosed in **Appendix F**. Surface water outfalls to the watercourse located to the south of the site.

2.6 Geology of the site and ground investigation data

- 2.6.1 Inspection of the geological maps shows that the superficial deposits at the site are Alluvium (Clay, Silt, Sand and Gravel) and River Terrace Deposits (undifferentiated). The bedrock geology which underlies the site is shown to be Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation.
- 2.6.2 A Ground Investigation (GI) has been undertaken by Soiltechnics, which included a site visit in September 2016. The fieldwork included trial pits TP01 to TP09 and boreholes DTS01 to DTS08 (using driven tube sampling equipment). Information regarding the encountered ground conditions (for the locations within the Keyline site boundary), as set out in the GI report extract enclosed in **Appendix G**, is summarised in Table 2.1:

Summary of ground conditions encountered at the site (locations within Keyline boundary)									
Ground Conditions	Depth (m)								
	TP01	TP02	TP03	TP04	TP05	TP06	TP07	DTS07/DP05	DTS08
Made Ground (base of strata)	1.40	1.70	2.00	1.75	1.80	1.45	1.80	2.00	1.70
Groundwater (initial strike)	2.15	1.90	2.15	2.00	2.30	2.00	2.15	N/A	N/A
Alluvium (termination depth)	2.80	2.60	2.60	3.50	3.20	3.00	2.60	4.00	3.00
Source: Geotechnical Investigation report by Soiltechnics (ref. STN3703G-G01)									

Table 2.1 Summary of ground conditions encountered at the site (locations within Keyline site boundary)

2.6.3 The groundwater observations from the trial pits and boreholes located within the Keyline site boundary are summarised in Table 2.1 above. Groundwater was encountered at depths ranging between 1.90m and 2.30m. In addition, the GI report confirms the following:

"Whilst groundwater was recorded to be standing at a depth as shallow as 1m, it is possible that permeable paving could be used, with any chamber sealed through Made Ground. In addition, Brockhampton Stream flows along the southern boundary of the site, it may be possible to discharge rainwater into the stream. This may be preferential to percolating through a permeable paving."

2.6.4 With regards to infiltration potential, the GI report states:

"Although, it is possible that the predominantly granular deposits of the Alluvium could dispose of stormwater using infiltration systems, laboratory testing undertaken on two groundwater samples indicates presence of contaminants above their respective guideline values. While the respective leachate testing did not show presence of contaminants which could potentially be derived from leachable concentrations within the Made ground deposits. Considering a worst-case scenario in which soakaways will discharge rainwater through Made Ground, this would promote leaching of chemical contaminants in the soil sufficient to cause concern. On this basis, the use of soakways systems would be only recommended if design allows for discharge within the naturally deposits Alluvium avoiding any discharge within the Made Ground deposits."

2.6.5 The base of any infiltration device should be located at least 1.0m above the groundwater level. This would locate the base of any infiltration device within the Made Ground, which is not considered advisable. Therefore, we would consider that infiltration is not viable.

2.7 Development proposals and flood risk vulnerability

2.7.1 With reference to Table 2 of the Flood Risk and Coastal Change Planning Practice Guidance (PPG) to the National Planning Policy Framework (NPPF), the proposed yard would be classed as Less Vulnerable development.

2.7.2 An extract from Table 2 of the PPG for Flood Risk and Coastal Change is replicated below in Table 2.2 with the proposed development type highlighted.

Flood Risk Vulnerability Classification	
Vulnerability	Development Types
Less Vulnerable	Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works, if adequate measures to control pollution and manage sewage during flood events are in place.
Source: Planning Practice Guidance – 2014	

Table 2.2

3.0 Flood risk

3.1 Fluvial / Tidal flooding

3.1.1 An extract of the Environment Agency's Flood Map for Planning (Rivers and Sea) is provided below in Figure 3.1.

3.1.2 The flood map was extracted from the GOV.UK website on 1st March 2021. The approximate application site boundary is shown by the yellow marker. The map indicates that the development site is located within Flood Zone 1 (Low Probability) and as such, the report considers the development to be in Flood Zone 1 and at a low risk of flooding from rivers or the sea.



Figure 3.1 Flood Map for Planning (Rivers and Sea)
Source: GOV.UK website – 1st March 2021

3.1.3 It should be noted that an Environment Agency designated Main River (Brockhampton Stream) runs adjacent to the site's southern boundary.

- 3.1.4 Table 3.1 below is a copy of Table 1 from Planning Practice Guidance for 'Flood Risk and Coastal Change' to the National Planning Policy Framework which defines Flood Zones. The proposed development, which is located within Flood Zone 1 is defined as having a less than 1 in 1,000 annual probability of river or sea flooding in any year.

Flood Zone Definitions	
Flood Zone	Definition
Zone 1: Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding.
Zone 2: Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
Zone 3a: High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.
Zone 3b: The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.
Source: Planning Practice Guidance - 2014	

Table 3.1

3.2 Flooding from surface water

- 3.2.1 An extract of the Environment Agency map 'Risk of Flooding from Surface Water' is provided below in Figure 3.2. The approximate application site boundary is shown in red. The site is shown to be located in an area of low (1 in 100 to 1 in 1000) and medium (1 in 30 to 1 in 100) risk of surface water flooding in a given year.
- 3.2.2 There are no new buildings associated with the proposals, which simply comprise an external yard area. The level of surface water flood risk is therefore considered acceptable.



Figure 3.2 Risk of Flooding from Surface Water
Source: GOV.UK website – 1st March 2021

- 3.2.3 It should be noted that this map is generated using a broad methodology applied at the national scale. The model utilises generalised information on infiltration, sewerage infrastructure, rainfall events and catchment topography to route rainfall over a ground surface model. As such, the analysis does not take account of site-scale factors / characteristics that may exert an influence upon surface water flood depths and extents. The map therefore only provides a guide regarding the areas that may be vulnerable to this source of flooding.

3.3 Flooding from groundwater

3.3.1 As set out in Section 2.6 above, the Ground Investigation report confirms groundwater inflows were observed in trial pits TP01 to TP09, and DTS01 to DTS07. Information regarding the encountered groundwater, as set out in the GI report extract enclosed in **Appendix G**, is provided above with additional information in Table 3.2 below.

Additional Groundwater Information (locations within Keyline boundary)			
Exploratory Point	Date of observation	Depth (m) below ground levels	Observations
TP01	16/09/16	2.15	Groundwater inflows from 2.15m. Groundwater level at 2.3m on completion.
TP02	16/09/16	1.9	Groundwater inflows from 1.9m. groundwater level at 1.9m on completion.
TP03	16/09/16	2.15	Groundwater inflows from 2.15m. Groundwater level at 2.25m on completion.
TP04	16/09/16	2.0	Groundwater inflows from 2.0m. Groundwater level at 2.8m on completion.
TP05	16/09/16	2.3	Groundwater inflows from 2.3m promoting collapse of trial pit from 1.8m
TP06	16/09/16	2.0	Groundwater seepages from 2.0m promoting collapse of trial pit.
TP07	16/09/16	2.15	Groundwater inflows from 2.15m. groundwater level at 2.2m on completion, collapse of trial pit from 1.8m.
DTS07	16/09/16	1.7	Groundwater strike at 1.75m
	30/09/16	1.05	Monitoring observation
	10/10/16	1.08	Monitoring observation
	28/10/16	2.65	Monitoring observation
DTS08	16/09/16	-	No groundwater observed on completion
	30/09/16	1.08	Monitoring observation
	10/10/16	0.73	Monitoring observation
	28/10/16	2.94	Monitoring observation

Source: Table 5.2.1 from Geotechnical Investigation report by Soiltechnics (ref. STN3703G-G01)

Table 3.2

3.3.2 We are not aware of any flooding on the site caused by groundwater. We would therefore consider the probability of flooding on the site from groundwater as low.

3.4 Flooding from sewers

- 3.4.1 Southern Water's asset plan is enclosed in **Appendix E**, which shows there are no assets within the site boundary.
- 3.4.2 We do not have any records of sewer flooding within the vicinity of the proposed development.
- 3.4.3 We, therefore, do not consider the risk of flooding from sewers to be a significant risk to the proposed development.

3.5 Flooding from reservoirs, canals and other artificial sources

- 3.5.1 We are not aware of any canals or artificial water sources that may result in flooding of this site.
- 3.5.2 The EA provides maps (<https://flood-warning-information.service.gov.uk/long-term-flood-risk/>) showing the area that may be affected by flooding as a result of a breach of a large, raised reservoir (i.e. capable of storing over 25,000 cubic metres of water above the natural level of any part of the surrounding land).
- 3.5.3 An extract of the Environment Agency map 'Risk of Flooding from Reservoirs' is provided below in Figure 3.3. It can be seen that the proposed development site, shown in red, is not at a risk of flooding from reservoirs.

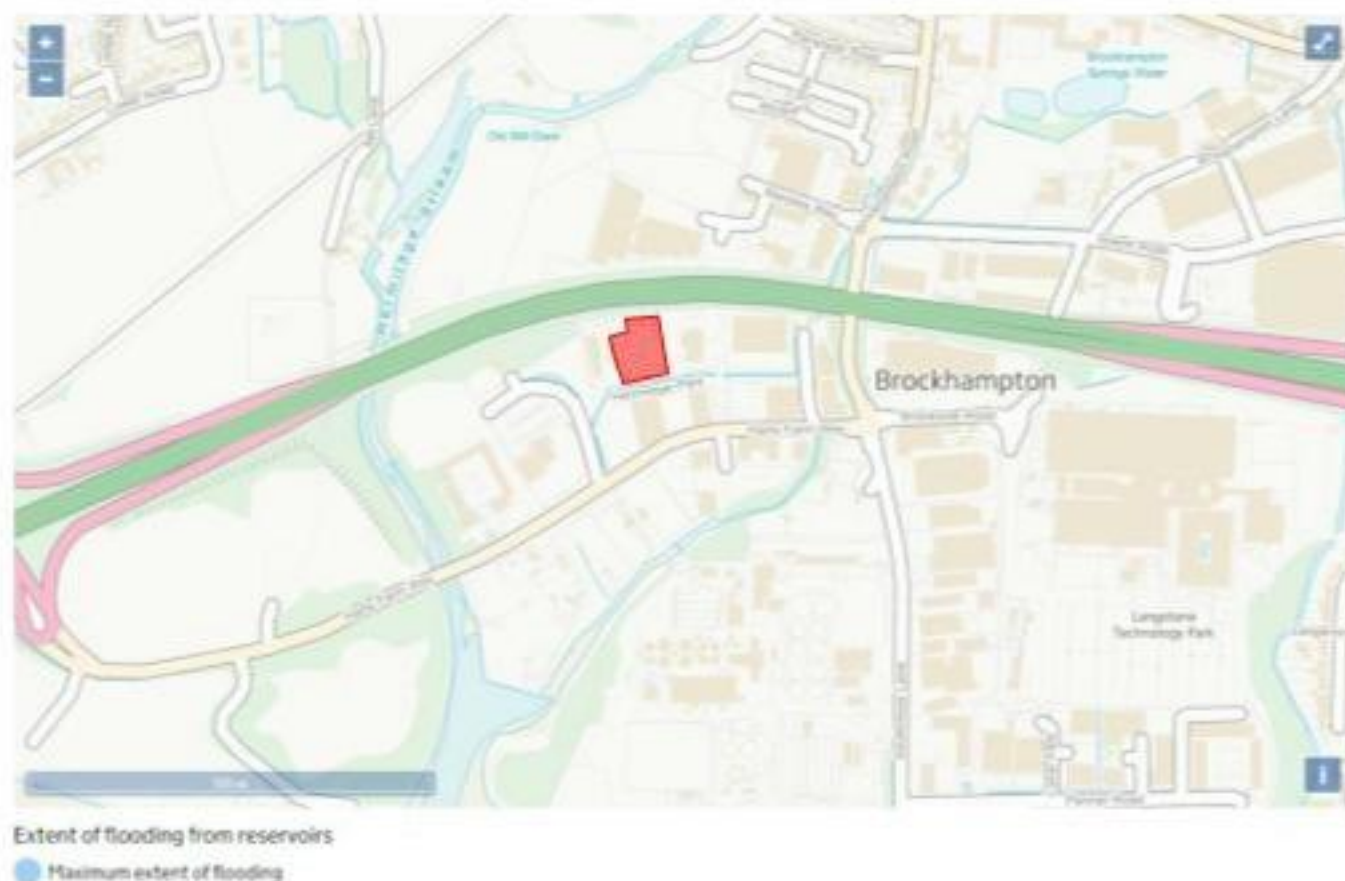


Figure 3.3 Risk of Flooding from Reservoirs
Source: GOV.UK website – 1st March 2021

- 3.5.4 It can therefore be concluded that the risk of flooding from reservoirs and other artificial sources is low.

3.6 Historic flooding

- 3.6.1 We are not aware of any history of flooding located within the site application boundary.

3.7 Flood risk vulnerability and flood zone compatibility

- 3.7.1 Based on the above assessment of the site being located within Flood Zone 1 and classified as a Less Vulnerable development, and with reference to Table 3.2 below (Planning Practice Guidance for 'Flood Risk and Coastal Change' to the National Planning Policy Framework, Table 3), the proposed development of this site would be considered "appropriate". A copy of Table 3 is presented below highlighting the above. Neither a sequential or exception test will be required.

Table 3 – Flood Risk Vulnerability and Flood Zone Compatibility					
Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatibility	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	X	Exception test required	✓
Zone 3b	Exception test required	✓	X	X	X
✓ = Development is appropriate			X = Development should not be permitted		
Source: Planning Practice Guidance - 2018					

Table 3.3

3.8 Flood compensation

- 3.8.1 Flood compensation measures will not be required for this site as it is located within Flood Zone 1.

3.9 Access and egress

- 3.9.1 Access and egress to and from this site in the event of flooding will continue to be via the existing access for the Keyline site, which will allow employees/visitors of the development to move to higher ground.

4.0 Management of surface water

4.1 Current conditions

- 4.1.1 The site is currently a brownfield site. In line with best practice guidance, the design of drainage will assume that the site is greenfield and allowable discharge rates will be calculated in line with this assumption.

4.2 Surface water drainage outfalls

- 4.2.1 It is a requirement of The Building Regulations (2010), Drainage and Waste Disposal, Approved Document H, to dispose of surface water collected by a development in accordance with the following, listed in order of priority:-

1. Infiltration systems where ground condition permit
2. To watercourses
3. To sewers

- 4.2.2 Each of these is considered separately below:

4.2.3 Infiltration systems

- 4.2.3.1 The geology of the site is described in Section 2.4 above. The Ground Investigation encountered granular deposits of the Alluvium which indicated the presence of contaminants.

- 4.2.3.2 The GI report notes that *"the use of soakways systems would be only recommended if design allows for discharge within the naturally deposits Alluvium avoiding any discharge within the Made Ground deposits."*

- 4.2.3.3 Further, it should be noted that the base of any infiltration device should be located at least 1.0m above the groundwater level. This would locate the base of any infiltration device within the Made Ground, which is not considered advisable. Therefore, infiltration techniques are not considered viable for the disposal of surface water from the site.

4.2.4 Watercourses / Main River

- 4.2.4.1 As set out in Section 3.1 above, Brockhampton Stream runs adjacent to the site's southern boundary. Therefore, surface water from the proposed development will drain to Brockhampton Stream. This is in accordance with the strategy introduced for the existing western part of the wider Keyline site.

4.2.5 Sewers

- 4.2.5.1 Draining the site via to an existing watercourse is a viable option therefore the use of surface water sewers will not be considered further.

4.3 SUDS assessment

4.3.1 We have considered the suitability of SUDS for use on the development site. The review is set out in below Table 4.1.

SUDS Assessment		
SUDS Technique	Suitability	Justification
Rain Water Harvesting	No	Not applicable for the development type.
Green Roofs	No	Not applicable for the development type - no new buildings proposed.
Infiltration	No	Underlying geology unviable
Filter Strips / Filter Drains	No	Underlying geology unviable and no open spaces.
Swales	No	No open spaces
Bioretention Systems	No	No open spaces
Trees	No	The development proposals simply comprise a new concrete surface - no new trees will be planted within the site boundary.
Pervious Pavements	Yes	Surface water attenuation will be provided within a permeable sub-base beneath the concrete yard.
Attenuation Tanks	No	Surface water attenuation will be provided within a permeable sub-base beneath the concrete yard.
Detention Basin	No	No open spaces. Surface water attenuation will be provided within a permeable sub-base beneath the concrete yard.
Ponds and Wetlands	No	No open spaces
Trapped Drainage	Yes	A bypass separator will be included within the drainage design, as shown on the plan enclosed in Appendix H .

Table 4.1

4.4 Surface water drainage strategy

4.4.1 Surface water discharge rates will be restricted to greenfield equivalent run-off rates to ensure that the rate of surface water run-off from the site does not increase as a result of the proposed development.

4.4.2 The proposed drainage strategy will provide attenuation within a permeable sub-base beneath the concrete yard, and a restricted outfall to the watercourse to the south of the site.

- 4.4.3 An indicative surface water layout plan is enclosed in **Appendix H**. The drawing shows that surface water can be accommodated on the site and the method of discharge on the basis that infiltration techniques are not viable. The detailed design parameters are described below.

4.5 Surface water drainage design and management

- 4.5.1 Proposals are to design the surface water drainage system to accommodate storms up to the 1 in 100 year event plus an allowance of 40% for climate change. Table 4.1 below is a copy of Table 2 from the Environment Agency's guidance 'Flood risk assessments: climate change allowances' to support the National Planning Policy Framework, which defines the climate change allowances.

Peak rainfall intensity allowance in small and urban catchments			
Allowance	'2020s' (2015 to 2039)	'2050s' (2040 to 2069)	'2080s' (2070 to 2115)
Upper end	+10%	+20%	+40%
Central	+5%	+10%	+20%
Source: Environment Agency - 2016			

Table 4.2

4.6 Existing run-off rates

- 4.6.1 To reflect the changes in the near surface geology across the site the greenfield run-off rates have been calculated. The method used to calculate the greenfield run off rates is the ICP SUDS and the calculations are presented in **Appendix I**.

- 4.6.2 The greenfield run off rate, for the application site, is:

Soil type	= 0.400 – obtained from the FEH parameters
SAAR	= 700mm – obtained from the FEH parameters
Urban	= 0.000
Region number	= 6
Proposed imp area	= 0.369ha
Q_1	= 1.1 l/s
Q_{bar}	= 1.3 l/s
Q_{30}	= 2.8 l/s
Q_{100}	= 4.0 l/s

- 4.6.3 The Q_{bar} equivalent rate for the proposed development is 1.3 l/s. A restriction of 1.3 l/s could potentially result in a small aperture at the outfall which could increase the risk of blockage. To reduce the risk of blockage, a minimum aperture size of 75mm will be used. As such, surface water will be restricted to a run-off rate of 2.5 l/s.

4.7 Attenuation requirements

4.7.1 Surface water will discharge into the watercourse to the south of the site and will be attenuated to the minimum viable run-off rate of 2.5 l/s. To achieve this, surface water will be attenuated within the permeable sub-base beneath the concrete yard to accommodate a 1 in 100 year event plus an allowance of 40% for climate change.

4.7.2 The proposed impermeable area of the development is 0.369 ha. Based on the proposed impermeable area and allowable discharge rate of 2.5 l/s, the storage requirement for the 1 in 100 year plus climate change event has been calculated utilising the following parameters. Full calculations are enclosed in **Appendix J**.

Rainfall profile	= Flood Estimation Handbook
Return period	= 100 year
Durations	= 60 to 10080 minutes
Climate change	= 40%
Drained area	= 0.369 ha
Limiting flow to watercourse	= 2.5 l/s
Control	= Vortex flow control
Total storage required	= 231m ³

4.7.3 The indicative surface water drainage layout incorporating the attenuation is shown on the plan enclosed in **Appendix H**.

4.8 Overland flows

4.8.1 Proposals are to design the surface water drainage to accommodate the 1 in 100 year storm event taking into account the predicted future effects of climate. Clearly, there is a risk of this storm event being exceeded, albeit this risk is considered very low. In such an event, the proposed drainage systems will become overwhelmed and overland flows could occur. Overland flows will be directed to follow the path that overland flows currently follow.

4.9 Foul water drainage strategy

4.9.1 There is no foul drainage associated with the proposals for the storage yard.

5.0 Maintenance

5.1 Surface drainage maintenance

- 5.1.1 The drainage system will be designed to minimise maintenance requirements, however, a full maintenance scheme will be established for those elements not being offered for adoption. The various areas will be maintained as set out in Table 5.1 below.

Maintenance Areas – Surface Water	
Aspect	Maintainer
Private Drains	Keyline - Travis Perkins
Adopted Sewers	Southern Water

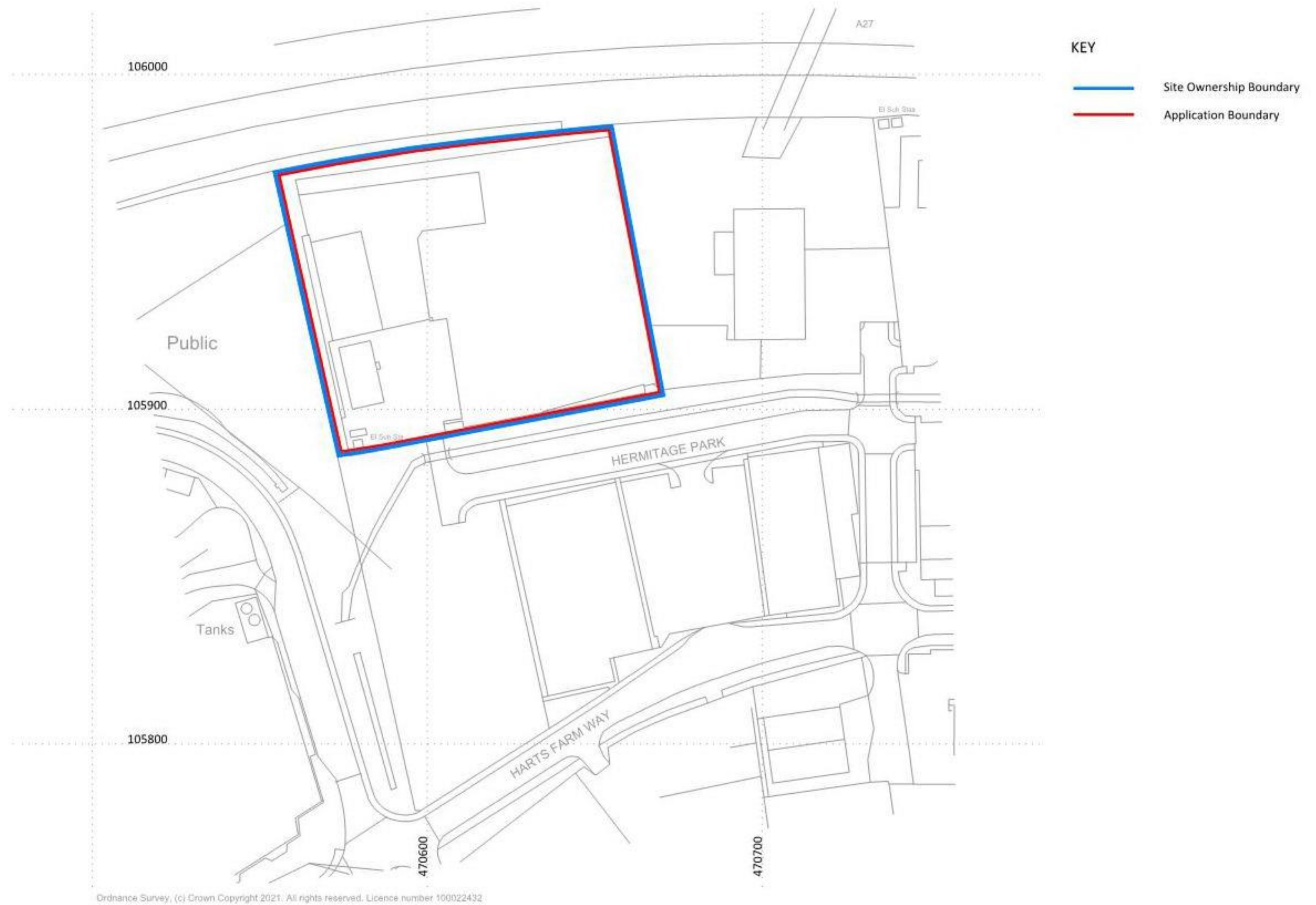
Table 5.1

6.0 Summary and conclusions

- 6.1 The yard is located at the existing Keyline site, off Harts Farm Way, Havant. The site is bound by the A27 to the north, and sits within the Harts Farm Way industrial estate (to the east, south and west).
- 6.2 The proposed development will comprise a formalised yard at the existing Keyline site, which will provide a new concrete surface.
- 6.3 The site is located within Flood Zone 1 and at a low risk of flooding from rivers and the sea. The site is shown to be at a low risk of flooding from surface water, groundwater, sewers and artificial sources such as reservoirs.
- 6.4 Surface water will discharge into the watercourse to the south of the site and will be attenuated to the minimum viable run-off rate of 2.5 l/s. Surface water will be attenuated within the permeable sub-base beneath the concrete yard to accommodate a 1 in 100 year event plus an allowance of 40% for climate change.
- 6.5 The proposed drainage strategy will provide attenuation within a permeable sub-base beneath the concrete yard, and a restricted outfall to the watercourse to the south of the site. A total volume of 231m³ of attenuation will be provided, sufficient to accommodate storms up to and including the 1 in 100 + 40% climate change event.
- 6.6 There is no foul water drainage associated with the proposals.
- 6.7 National, Regional and Local planning policy requires that:
- Development is directed to sites at the lowest probability of flooding;
 - Development accommodates the potential impacts of climate change;
 - Development should not be permitted if it would be at an unacceptable risk of flooding or create an unacceptable risk elsewhere; and
 - New development should facilitate safe access and exit during flood conditions.
- 6.8 The proposals for storage yard alteration at east of Keyline Unit are therefore fully compliant with policy in respect of development and flood risk, such that flood risk considerations do not constitute a barrier to the granting of planning consent.



Appendix A
Location Plan
WEA drawing no. 22573-001 Rev.P2



0 25 50 75 100 125m
Scale 1:1250 at A3

Rev P2 Application boundary amended. Issued for planning.
Rev P1 Issued for planning.

Drawn IH Checked SO 17.03.2021
Drawn IH Checked SO 26.02.2021

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- Interior Designers
- Project Management
- Employers Agent

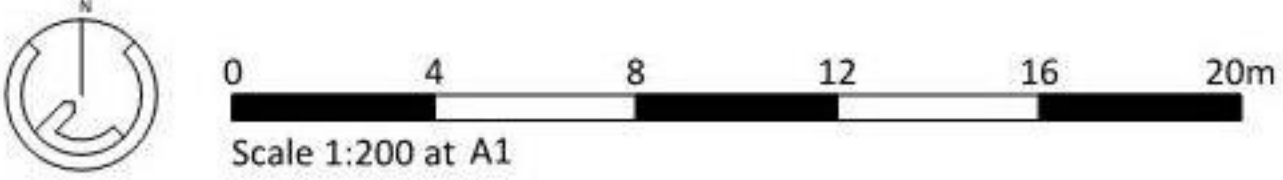
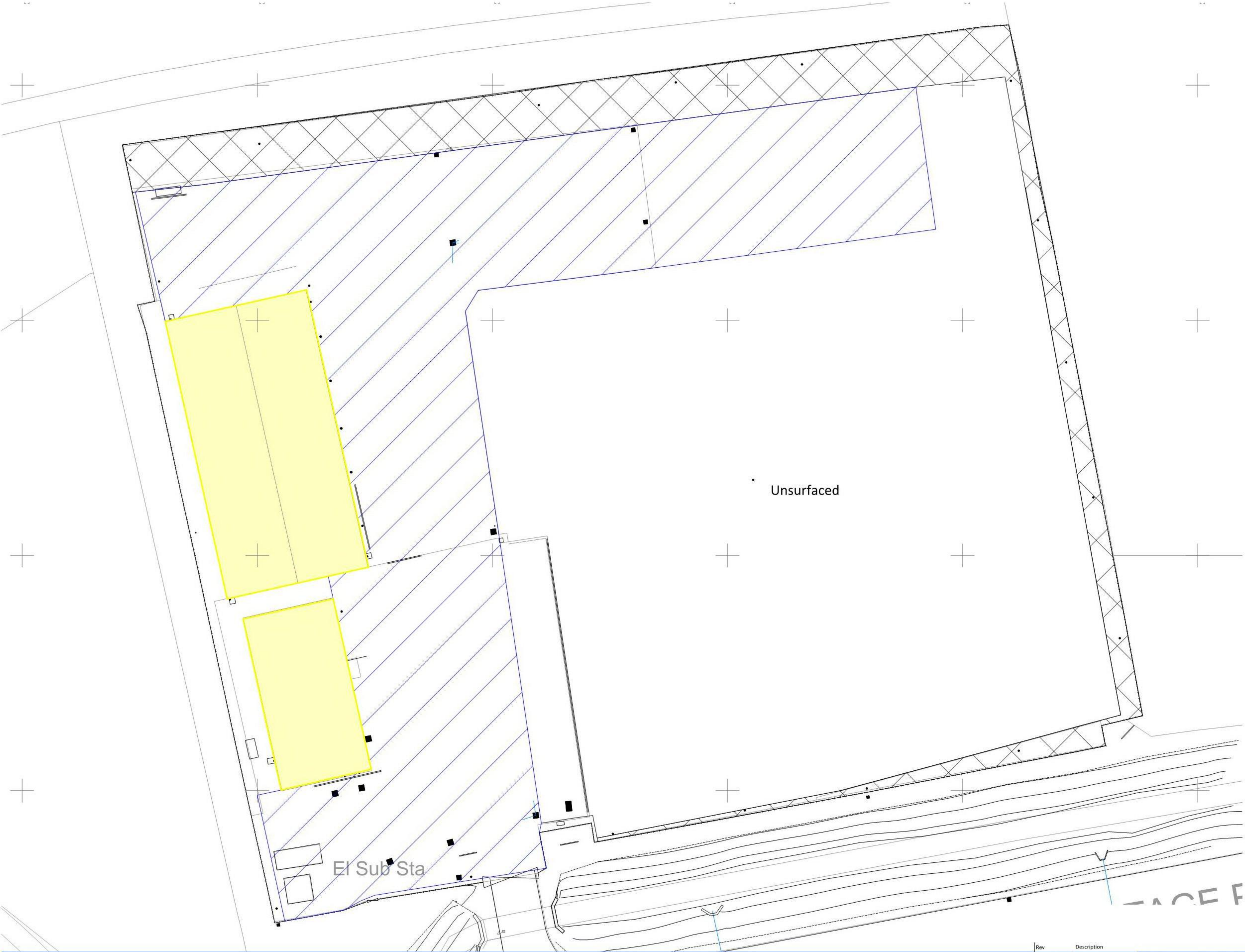
Drawn By: IH
Chkd By: PB
Scale @A3: 1:1250
Date: February 2021
Status: FOR PLANNING
Project No.: 22573

Client Travis Perkins
Project Keyline, Havant
Title Location Plan
Drawing No: 001

Revision: P2

WEA

Appendix B
Existing Site Plan
WEA drawing no. 22573-010

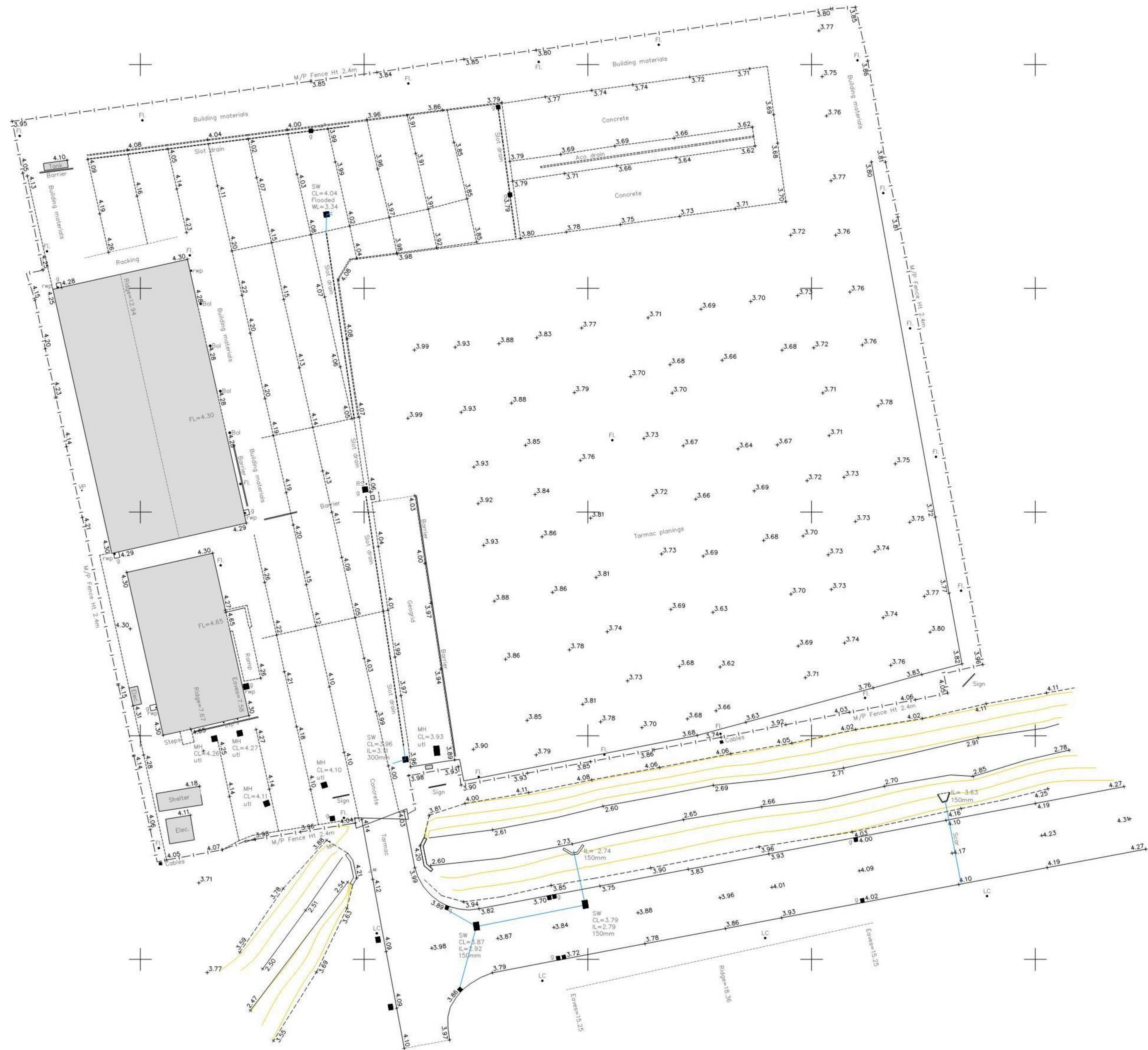


- KEY
-  Existing Concrete Pavement
 -  Verge
 -  Existing building

El Sub Sta

FACE F

Appendix C
Topographical Survey
JPP drawing no. 22295Y-01



General notes

Grid and levels have been aligned with OS National Grid OSG836 (15).
All dimensions and levels are in metres unless noted otherwise.
This plan should only be used for its original purpose. JPP accepts no
responsibility if supplied to any other party than the original client.

Monitoring Locations

STATION	EASTING	NORTHING	LEVEL
J1	470596.185	105968.107	4.000
J2	470600.705	105884.827	4.233

Key

AV	Air Valve	FL	Flood Light	P/R	Post & Rail Fence
Bol	Bollard	FW	Foul Water	P/W	Post & Wire Fence
BH	Borehole	g	Gully	RE	Rodding Eye
BL	Bed Level	GV	Gas Valve	RS	Road Sign
BT	BT Cover	HL	Height	rwp	Rainwater Pipe
CATV	Cable TV Cover	IC	Inspection Chamber	SV	Stop Valve
C/B	Close Boarded Fence	IL	Invert Level	svp	Soil & Vent Pipe
C/L	Chain Link Fence	I/R	Iron Railing	SW	Surface Water
CL	Cover Level	ko	Kerb Outlet	TL	Traffic Light
Col	Column	LP	Lamp Post	TP	Telegraph Pole
EI	Elec	MH	Manhole	TW	Top of wall
ER	Earth Rod	Mkr	Marker Post	utl	Unable To Lift
EP	Electricity Pole	O/H	Overhead	VP	Vent Pipe
FH	Fire Hydrant	PB	Post Box	WL	Water Level
FL	Floor Level	Po	Post	WM	Water Meter
				wo	Wash Out

Building		Bottom of Bank	
Control Station		Top of Bank	
Tree		Vegetation	
Bore Hole		Change of surface	
Gate		Fence	
		Contours	
		OH Telecom	
		OH Electric	

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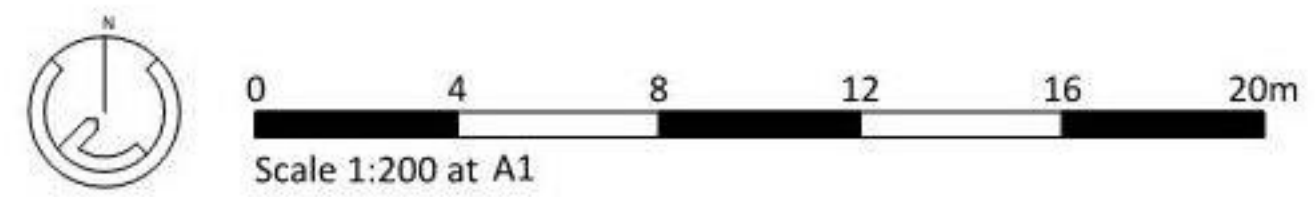
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- Infrastructure Design
- Structural Engineering
- Planning Services
- Geotechnical & Environmental
- Surveying
- Professional Advice

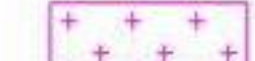
Drawn By:	JG	Client	Travis Perkins
Chkd By:	TB	Project	Keyline, Havant
Scale @ A1:	1:250	Title	Topographical Survey
Date:	11/1/21		
Status:	FOR INFORMATION		
Project No.:	22295Y	Drawing No:	01
		Rev:	

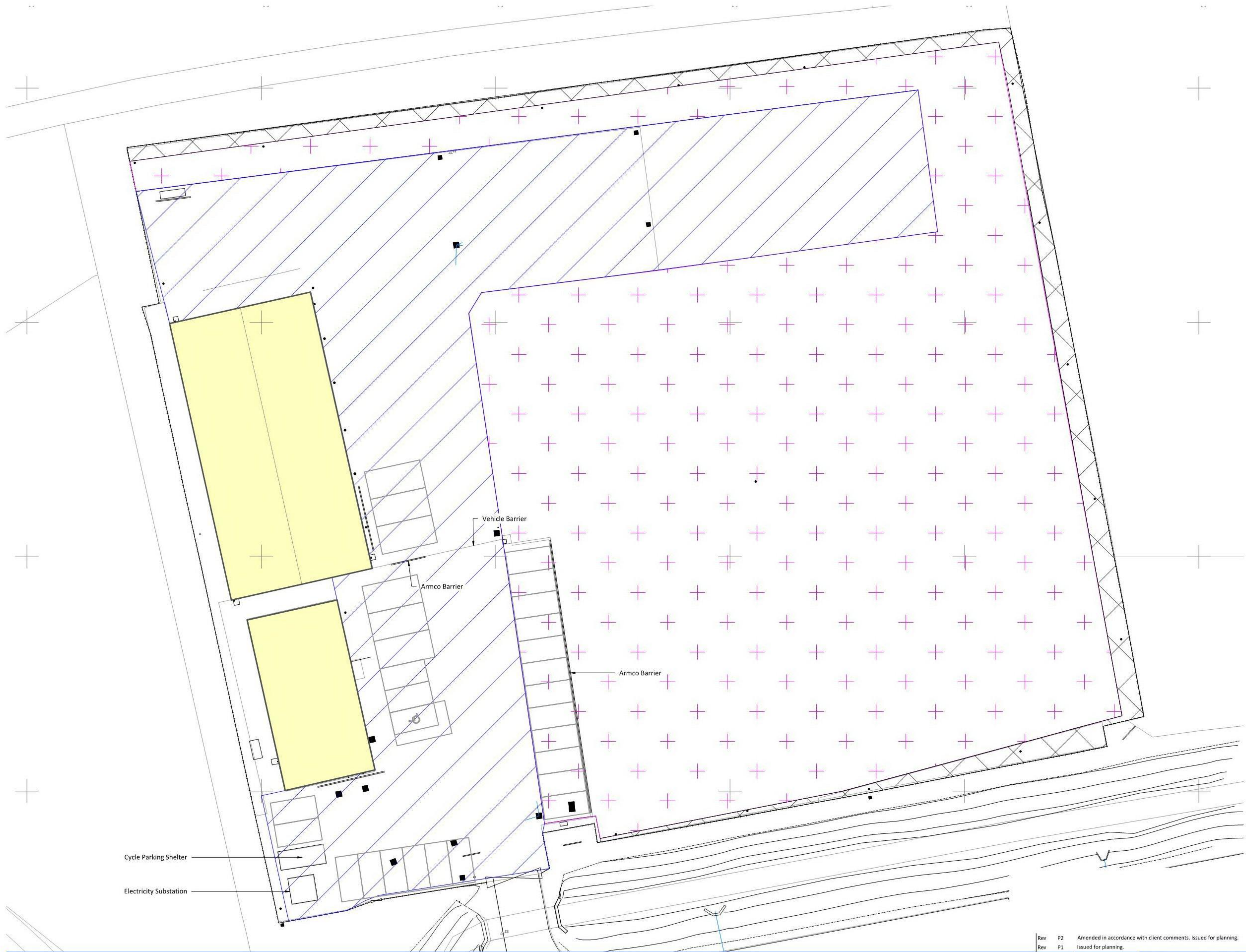


Appendix D
Proposed Site Plan
WEA drawing no. 22573-100 Rev.P2



KEY

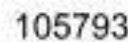
-  Existing Concrete Pavement
-  New Concrete Pavement
-  Verge
-  Existing building



Rev	P2	Amended in accordance with client comments. Issued for planning.				By IH	Checked SO	17.03.2021
Rev	P1	Issued for planning.				By IH	Checked SO	26.02.2021
Drawn By:	IH	Client Project Title FOR PLANNING	Travis Perkins			WEA		
Chkd By:	PB		Keyline, Havant					
Scale @ A1:	1:200							
Date:	February 2021							
Status:								
Project No.:	22573	Drawing No:	100	Revision:	P2			

**Appendix E
Southern Water Asset Plan**

106081



SU7005NE



Southern
Water

471051

SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape
0802X	4.75	3.44	150	VC	CIRC
6801X	3.64	-0.14	OTHER	CP	CIRC
6802X	3.69	-0.02	OTHER	CP	CIRC
7001X	5.8		600	UNK	CIRC
7004X	4.74	2.13	525	CI	CIRC
7801X	3.59		525	CI	CIRC
7802X	4.09	0.55	1650	CP	CIRC
7901X			600	UNK	CIRC
7902X	3.63	1.85	525	CI	CIRC
9851X			600	CP	CIRC
9852X			600	CP	CIRC
9853X			675	CP	CIRC
9854X			750	CP	CIRC

Node	Cover	Invert	Size	Material	Shape
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Node	Cover	Invert	Size	Material	Shape
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Node	Cover	Invert	Size	Material	Shape
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[illegible]

Drawn by: yadavsa

Title: 223329_Hermitage Park, Harts F

Date: 01/09/2016



Appendix F
Existing Keyline Site: Surface Water Drainage Strategy
JPP drawing no. KLHAV1YY-FRA03



KEY

- Site Boundary = 8,679m²
- Proposed Impermeable Area = 2,387m²
- Proposed Surface Water Drainage

NOTES

- Based on Travis Perkins drawing 'Keyline Havant-site2-feasibility' Revision 1.3, dated 13.10.2016.
- Outfall to watercourse will require permission from Environment Agency to contract the new outfall.
- It is assumed that Keyline have riparian rights to discharge to the watercourse.

Useable area = 1.9 acres
(subject to survey)

Concrete roadway(PAV 2)
880 sq m/
9 478 sq ft

Compacted
Stone Planings on sub base
4 959 sq m/
53 384 sq ft

TOTAL
SITE AREA
2.14 acres

Possible extension
0.097 acre
following reduction in trees
(subject to planning)

Concrete area 805 sq m/
8 667 sq ft

Tarmac area 714 sq m/
7 685 sq ft

Outfall to watercourse
IL = 2.72m

Hydrobrake limited
to 2.5 l/s

Surface Water Attenuation
Storage within permeable subbase
Climate change consideration = 40%
Drained area = 2,387m²
Area of permeable subbase = 1521.6m²
Void space = 30%
Depth of permeable subbase = 0.360m

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Client TRAVIS PERKINS

Project KEYLINE HAVANT
HARTS FARM WAY
HAVANT, HAMPSHIRE

Title PROPOSED SURFACE
WATER DRAINAGE
STRATEGY

Scale at A3 1:500	Drawn by KEN	Checked by MJA	Date 17.11.2016
Status FOR INFORMATION	Project ref KLHAV1YY	Drawing no. FRA03	Revision

Appendix G
Extract of Ground Investigation
Soiltechnics report ref. STN3703G-G01

soiltechnics

environmental and geotechnical consultants

Proposed industrial development
Harts Farm Way
Havant

Ground Investigation Report

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1 Executive summary

1.1 General

- 1.1.1 We recommend the following executive summary is not read in isolation to the main report which follows.

1.2 Site description, history and development proposals

- 1.2.1 The site is located within a commercial / business area towards the south-west of Havant. At the time of our investigation, the site comprised a disused open land with certain areas covered in concrete and hardstandings. In addition, Brockhampton stream was observed running alongside the southern boundary of the site into a general eastern to western direction.
- 1.2.2 A review of historical maps indicates the site remained mainly undeveloped until circa 1970s when the site is first time recorded as a council Depot. This former use of the site is recorded until 2000s after which the site has not records of usage.
- 1.2.3 We understand the scheme will comprise the construction of a new concrete hardstanding, light weight Tempa store, portacabins-type offices and external racking.

1.3 Ground conditions encountered

- 1.3.1 The exploratory excavations encountered Made Ground overlying Alluvium.
- 1.3.2 Based on groundwater observations in exploratory excavations, we consider it is unlikely that groundwater will be encountered in excavations extending to depths of up to 1.9m.

1.4 Foundation solution

- 1.4.1 The Alluvium are in our opinion capable of supporting the proposed buildings in spread type foundations with founding levels being located at the top of Alluvium deposits.
- 1.4.2 Proposed access road and associated hardstanding areas will be located at or about existing ground levels with formation located on Made Ground soils. A CBR design value of 3% has been derived from near surface soil conditions.

1.5 Chemical and gaseous contamination

- 1.5.1 In general the site is does not pose a risk to end users of the site or water receptors, however levels of lead and chromium in soil in trial pit TP06 and copper and zinc in groundwater (DTS07) were measured above their respective guideline values. Should these areas be covered in buildings or hardstanding then no further action is required. However, if the surface is unbound then remediation in the form of a capping layer is likely.
- 1.5.2 Based on gas monitoring completed to date the development does not require gas protective measures.
- 1.5.3 Barrier pipes for potable water may be required.

1.6 Landfill classification

- 1.6.1 Comparison of test data with landfill waste acceptance criteria indicates that Made Ground soils can be classified as **Stable non-reactive hazardous waste in non-hazardous landfill** for off-site disposal for landfill.
- 1.6.2 It is possible that these soils can be zoned by extra testing, thus potentially reducing the quantity of hazardous waste by re-classifying it as non-hazardous.
- 1.6.3 Alluvium can be classified as **inert waste** based on soils being of natural origin and unlikely to be affected by artificial contamination.

4 Fieldwork

4.1	General
4.2	Site restrictions
4.3	Exploratory trial pits
4.4	Driven tube sampling
4.5	Dynamic probing
4.6	Measurement of landfill type gases in gas monitoring standpipes
4.7	Sampling strategies

4.1 General

4.1.1 Fieldwork activities were carried out between 15th and 16th September 2016 and comprised of the following activities:-

- Excavation of nine exploratory trial pits
- Excavation of eight exploratory boreholes formed using driven tube sampling equipment
- Dynamic probing testing in five locations

4.1.2 The above mentioned exploratory locations were undertaken in the "Plot 4" area as well as adjacent areas to the east. The distribution of the exploratory points is presented in the following table;

Table location of exploratory points			
Exploratory point	Date of excavation	Western area- "Plot 4"	Eastern area
TP01	16/09/16	✓	
TP02			
TP03			
TP04			
TP05			
TP06			
TP07			
DTS05			
DTS06	15/09/16		
DTS07			
DTS08			
TP08			✓
TP09			
DTS01			
DTS02			
DTS03			
DTS04			

Table 4.1.2

- 4.1.3 The position of exploratory points relative to site development proposals is presented on Drawing 03. The position of exploratory points shown on these plans is approximate only and confirmation of these positions is subject to dimensional surveys, which is considered outside our brief. It should be noted that although some of the investigatory points are outside of the development area we have presented all data from the wider site.
- 4.1.4 The extent of fieldwork activities and position of exploratory points were determined by Soiltechnics in agreement with Travis Perkins plc.
- 4.1.5 Exploratory points were positioned to avoid known locations of underground services, to avoid possible location of proposed foundations but were also positioned to provide a reasonable coverage of the site. Prior to commencement of exploratory excavations an electronic cable locating tool was used to scan the area of the excavation. If we received a response to this equipment, then the excavation would be relocated.
- 4.1.6 All soils exposed in excavations were described in accordance with BS EN ISO 14688 *'Identification and Classification of soil'*.

4.2 Site restrictions

- 4.2.1 Care was taken to avoid buried services such as main sewers and electricity cables predominantly located to the east of the area denominated as "Plot 4".

4.3 Exploratory trial pits

- 4.3.1 Surface concrete/bituminous bound materials were initially broken out using hydraulic breaking equipment fixed to the rubber tyred excavator. Once broken, excavation continued using normal excavation techniques.
- 4.3.2 Trial pits TP01 to TP09 were excavated to a maximum depth of 3.5m. The excavations were backfilled with excavated material compacted using the back of the excavator bucket. Whilst we attempted to reinstate the excavation to its original condition the soils could not be fully compacted into the trial pit and thus the soils were left proud of the ground surrounding the pit to allow for short-term settlement of the backfill. A Geotechnical Engineer supervised the excavations.
- 4.3.3 Sampling and logging was carried out as trial pit excavations proceeded but were not entered at depths exceeding 1.2m, or where trial pit sides were deemed unstable. The density of granular soils encountered in excavations was gauged by the ease of excavation.

- 4.3.4 Soil samples for subsequent laboratory determination of concentration of chemical contaminants were taken from the sides of trial pits using clean stainless steel equipment and stored in new plastic containers, which were labelled and sealed. Samples from below access depth into trial pits were taken as a sub sample from soil contained in the excavator bucket, discarding any soil, which may have been in contact with the bucket. If as a consequence of visual or olfactory evidence, a sample was suspected to be contaminated by organic material, the sample was stored in an amber glass jar with a PTFE sealing washer.
- 4.3.5 Soil samples for subsequent classification laboratory testing were taken from the side of trial pits or from bulk samples taken from the excavator bucket. The sample was placed in a plastic bag and subsequently sealed and labelled. Samples for moisture content determination were placed in sealable tubs and appropriately labelled.
- 4.3.6 Sample sizes were appropriate for the laboratory test being considered.
- 4.3.7 A pocket penetrometer was used in the fine soils encountered. This tool is deemed to measure the apparent ultimate bearing capacity of the soil under test. The pocket penetrometer is calibrated in kg/cm^2 . The reading can be approximately converted to equivalent undrained shear strength by multiplying the results by a factor of 50. Pocket penetrometer testing was carried out in the sides of trial pits when access could be safely achieved otherwise testing was carried out on excavated intact clods. The results are reported in columns to the right of trial pit results. The pocket penetrometer is not covered by British Standards. This tool has the advantage that it can be used to determine the approximate in-situ undrained shear strength of stony cohesive soils.
- 4.3.8 A summary of pocket penetrometer results obtained from the fine soils encountered in exploratory excavations are presented in graphical format on Drawing 04.
- 4.3.9 Trial pit records are presented in Appendix C.

4.4 Driven tube sampling

- 4.4.1 Boreholes DTS01 to DTS08 were formed using driven tube sampling equipment. Driven tube sampling comprises driving 1m long steel sample tubes which are screw coupled together or coupled to extension rods and fitted with a screw on cutting edge. The sample tubes are of various diameters, generally commencing with 100mm and reducing, with depth, to 50mm and include a disposable plastic liner which is changed between sampling locations to limit the risk of cross contamination. On completion of excavation the liner containing the sample is cut open and the soil sample logged by a geo-environmental engineer.
- 4.4.2 Samples for determination concentration of chemical contaminants are taken from samples obtained in the disposable tubes as sub-samples using stainless steel sampling equipment.

- 4.4.3 In some locations, surface concrete was either broken out or cored prior to excavation of the borehole. The concrete surface was reinstated on completion.
- 4.4.4 A pocket penetrometer was used in the fine soils retrieved from the borehole. This tool is deemed to measure the apparent ultimate bearing capacity of the soil under test. The pocket penetrometer is calibrated in kg/cm². The reading can be approximately converted to an equivalent undrained shear strength by multiplying the results by a factor of 50. The results are reported on borehole records. The pocket penetrometer is not covered by British Standards.
- 4.4.5 A summary of pocket penetrometer results obtained from the fine soils retrieved from the boreholes are presented in graphical format on Drawing 04.
- 4.4.6 Combined gas and groundwater monitoring standpipes were installed in DTS02, DTS03, DTS07 and DTS08. The standpipes were installed following the recommendations of BS EN ISO 22475-1:2006 '*Geotechnical Investigation and Testing – Sampling methods and groundwater measurements – Part 1: Technical Principles for execution*' and BS8576:2013 '*Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)*'. Details of the standpipe installation are recorded on Drawing 05.
- 4.4.7 Water levels in the standpipes have been measured during a return visit to the site. The water level was measured using a measuring tape calibrated in 1mm intervals with an electronic end piece, which emits an alarm sound in contact with water. Water levels are measured from ground levels at the borehole position.
- 4.4.8 Records of boreholes formed using driven tube sampling techniques are presented in Appendix D.

4.5 Dynamic probing

- 4.5.1 Dynamic probing (DP) testing was carried out in five locations. Dynamic probing consists of driving a 50mm diameter, 90° cone into the ground, via an anvil and extension rods with successive blows of a freefall hammer. The number of blows required to drive the cone each successive 100mm (N₁₀) is recorded.
- 4.5.2 Dynamic probing was carried out following BS EN ISO 22476-2:2005 and the apparatus used was categorised as 'Super heavy' (DPSH-B) in accordance with the standard.
- 4.5.3 Dynamic probing data is presented in graphical format on Appendix E.

5 Ground conditions encountered

5.1	Soils
5.2	Groundwater
5.3	Evidence of contamination
5.4	Obstructions and instability

5.1 Soils

- 5.1.1 The exploratory excavations encountered a similar profile of soils considered to be Made Ground overlying Alluvium.
- 5.1.2 Made Ground was encountered in all locations and observed between depths of 0.75m to 2.0m and comprised a chaotic mixture of fine, coarse and chalk soils.
- 5.1.3 The coarse Made Ground soils comprised brown to dark brown and orange brown slightly clayey to clayey sand and gravel with occasional cobbles of brick and concrete and occasional boulders of concrete. Gravel consisted of flint, limestone, fragments of brick, concrete, occasional bituminous coated material, rare plastic, timber and metal.
- 5.1.4 The fine Made Ground soils comprised firm to stiff medium to high strength brown, dark brown and orange brown sandy gravelly to very gravelly clay. Gravels consisted of flint occasional limestone, chalk, and fragments of brick, concrete rare metal, timber and plastic. Occasional rootlets and roots (up to 50mm in diameter) and generally were observed throughout.
- 5.1.5 Made Ground deposits observed in exploratory locations TP01, TP05, TP02 and DTS06, DTS07 and DTS08 comprised a layer of chalk at depths in a range of 0.3m to 1.5m. The Chalky Made Ground deposits comprised medium strong white slightly sandy gravel and cobbles of angular chalk.
- 5.1.6 Alluvial deposits were encountered in all exploratory locations at depths below 1.4m Alluvial deposits comprised loose to dense light cream and orange brown slightly clayey slightly sandy gravel with local boulder-sized lenses of sandy gravelly clay observed at depths below 2m. Gravel consisted of fine to coarse angular to rounded flint and extended beyond the termination depths of the boreholes and trial pits.

5.1.7 The following table summarises the geology encountered;

Table summarising soil types				
Strata	Depth to top (m)	Depth to bottom (m)	Thickness (m)	Summary description
Made Ground	0.0m	1.3-2.0	1.3-2.0	Mixture of fine, coarse and chalky soils comprising anthropogenic fragments
Alluvium	1.3-2.0	Beyond depth of termination	N/A	Light cream clayey sandy gravels and cobbles of flint

Table 5.1.7

5.2 Groundwater

5.2.1 Groundwater inflows were observed in many of the exploratory excavations. A summary of our observations is tabulated below:

Table summarising groundwater observations			
Exploratory point	Date of observation	Depth (m) below ground levels	Observations
TP01	16/09/16	2.15	Groundwater inflows from 2.15m. Groundwater level at 2.3 on completion
TP02	16/09/16	1.9	Groundwater inflows from 1.9m. Groundwater level at 1.9 on completion
TP03	16/09/16	2.15	Groundwater inflows from 2.15m. Groundwater level at 2.25m on completion
TP04	16/09/16	2.0	Groundwater inflows from 2.0m. Groundwater level at 2.8m on completion
TP05	16/09/16	2.3	Groundwater inflows from 2.3m promoting collapse of trial pit from 1.8m
TP06	16/09/16	2.0	Groundwater seepages from 2.0m promoting collapse of trial pit.
TP07	16/09/16	2.15	Groundwater inflows from 2.15m. Groundwater level at 2.2m on completion promoting collapse from this depth.
TP08*	15/09/16	1.4	Groundwater inflows from 1.4m. Groundwater level at 2.0m on completion, collapse of trial pit from 1.8m
TP09*	15/09/16	1.1	Groundwater inflows from 1.1m. Groundwater level at 2.1m 5 minutes after completion, collapse of trial pit from 1.5m
DTS01*	15/09/16	1.25	Groundwater strike at 1.25m.
DTS02*	15/09/16	0.95	Groundwater strike at 0.95m
	30/09/16	1.93	Monitoring observation
	10/10/16	2.05	Monitoring observation
	28/10/16	1.56	Monitoring observation
DTS03*	15/09/16	1.25	Groundwater measured at 1.25m
	30/09/16	1.88	Monitoring observation
	10/10/16	1.98	Monitoring observation
	28/10/16	1.34	Monitoring observation
DTS04*	15/09/16	1.54	Groundwater strike at 1.54m remained stable on completion
DTS05	16/09/16	1.5	Groundwater strike at 1.5m, remained stable 5 minutes after completion
DTS06	16/09/16	1.8	Groundwater strike at 1.8m

Table summarising groundwater observations

Exploratory point	Date of observation	Depth (m) below ground levels	Observations
DTS07	16/09/16	1.7	Groundwater strike at 1.75m
	30/09/16	1.05	Monitoring observation
	10/10/16	1.08	Monitoring observation
	28/10/16	2.65	Monitoring observation
DTS08	16/09/16	-	No groundwater observed on completion
	30/09/16	1.08	Monitoring observation
	10/10/16	0.73	Monitoring observation
	28/10/16	2.94	Monitoring observation

Table 5.2.1

*Exploratory locations undertaken outside the proposed site boundaries

- 5.2.2 It should be noted that water levels will vary depending generally on recent weather conditions and only long term monitoring of levels in standpipes will provide a measure of seasonal variations in groundwater levels.

5.3 Evidence of contamination

- 5.3.1 During the excavation of our exploratory points, evidence of potential contamination was identified; however, specific contaminant observations are presented below;

Table summarising contamination observations

Exploratory point	Depth of contamination	Strata	Description
TP01	0.45-0.50	Made Ground	Greyish blue coloured sand and gravel soils which exposed a slight hydrocarbon contamination odour

Table 5.3.1

5.4 Obstructions and instability

- 5.4.1 No in-ground obstructions were identified during our site investigations. Generally trial pit excavations were terminated prematurely when excavations extended beyond the level of groundwater as it promoted the collapse of the pit. Where driven tube samplers encountered groundwater levels, the use of casing allowed drilling to achieve depths below groundwater table.

7.3 Influence of trees and other major vegetation

7.3.1 Soil classification and new foundation design

- 7.3.1.1 The results of plastic and liquid limit determinations performed on near surface samples of the Made Ground and Alluvium indicate the deposits vary between non-shrinkable to medium volume change potential when classified in accordance with National House Building Council (NHBC) Standards, Chapter 4.2. Adopting a worst case medium volume change then foundations taken down onto a depth of 0.9m will penetrate the zone of shrinkage and swelling caused by seasonal wetting and drying. Trees and other major vegetation extend this zone and will require deeper foundations. A good guide to this subject is provided in NHBC Standards, Chapter 4.2.

7.3.2 Tree species identification

- 7.3.2.1 There are a number of trees and other major vegetation at the site. We recommend a qualified Arboriculturist (listed in the Arboricultural Association Directory of Consultants – www.trees.org.uk) be appointed to determine the location, height (and mature height) and water demand of all trees/major hedgerows at the site, information, which will be necessary to design foundations in accordance with NHBC Standards, Chapter 4.2.

7.4 Service Trench Excavations

- 7.4.1 Generally, the sides of trench excavations will remain stable in the short term. As described in Section 7.2.10 above, groundwater will likely be encountered from 1.9m, with water standing around 1m based on return monitoring visits. Groundwater inflows will promote progressive instability in trench sides requiring continuous trench sheet piling to maintain an open excavation. We anticipate water will be controlled with nominal pumping techniques.
- 7.4.2 We recommend any trench excavation requiring human entry is shored as necessary to conform with current best practice, and accepted by the Health and safety Executive (HSE) and in particular, following guidance provided in the HSE publication 'Health and safety in construction (HSG 150)' (www.hse.gov.uk).

7.5 Infiltration Potential

7.5.1 Requirements for use of infiltration systems

- 7.5.1.1 It is a requirement under H3 (3) of the current building regulations to discharge stormwater collected by a development to soakaways as a priority (as opposed to water courses and sewers).

7.5.2 Contamination considerations

- 7.5.2.1 With reference to Environment Agency (EA) publication '*Groundwater protection: Policy and practice (GP3) Section G*, 2012, outside of SPZ1, the EA will support sustainable drainage systems for new discharges to ground. This is subject to an appropriate risk assessment to demonstrate that ground conditions are suitable and infiltration systems do not present an unacceptable risk of promoting mobilisation of contaminants or creating new pathways for contaminant migration.

7.5.3 Assessment following fieldwork investigations

- 7.5.3.1 Although, it is possible that the predominantly granular deposits of the Alluvium could dispose of stormwater using infiltration systems, laboratory testing undertaken on two groundwater samples indicates presence of contaminants above their respective guideline values. While the respective leachate testing did not show presence of contaminants which could potentially be derived from leachable concentrations within the Made ground deposits. Considering a worst-case scenario in which soakaways will discharge rainwater through Made Ground, this would promote leaching of chemical contaminants in the soil sufficient to cause concern. On this basis, the use of soakways systems would be only recommended if design allows for discharge within the naturally deposits Alluvium avoiding any discharge within the Made Ground deposits.
- 7.5.3.2 Whilst groundwater was recorded to be standing at a depth as shallow as 1m, it is possible that permeable paving could be used, with any chamber sealed through Made Ground. In addition, Brockhampton Stream flows along the southern boundary of the site, it may be possible to discharge rainwater into the stream. This may be preferential to percolating through a permeable paving.
- 7.5.3.3 If either of these solutions are sought, advice and permission from the Environmental Agency will be required.

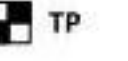
7.6 Pavement Foundations

- 7.6.1 It is anticipated that the proposed access road and associated hardstanding areas will be located at or about existing ground levels with formation located on Made Ground soils.
- 7.6.2 Equilibrium CBR (California Bearing Ratio) values (with reference to Transport and Road Research Laboratory (TRRL) Report LR1132 '*Structural design of Bituminous Roads*') are derived from knowledge of soil classification data (plasticity index for soils exhibiting cohesion (clay type) and particle size distribution for granular soils), the location of the water table pavement thickness, and weather conditions at the time of construction. It is anticipated that excavations to formation levels will encounter a mixture of both granular and cohesive soils. Granular soils will provide numerically high CBR values, but cohesive soils will typically provide significantly lower values. Assuming an average plasticity index of 30 for cohesive soils, a low water table, a 'thin' pavement the following equilibrium CBR values are derived for varying construction conditions.



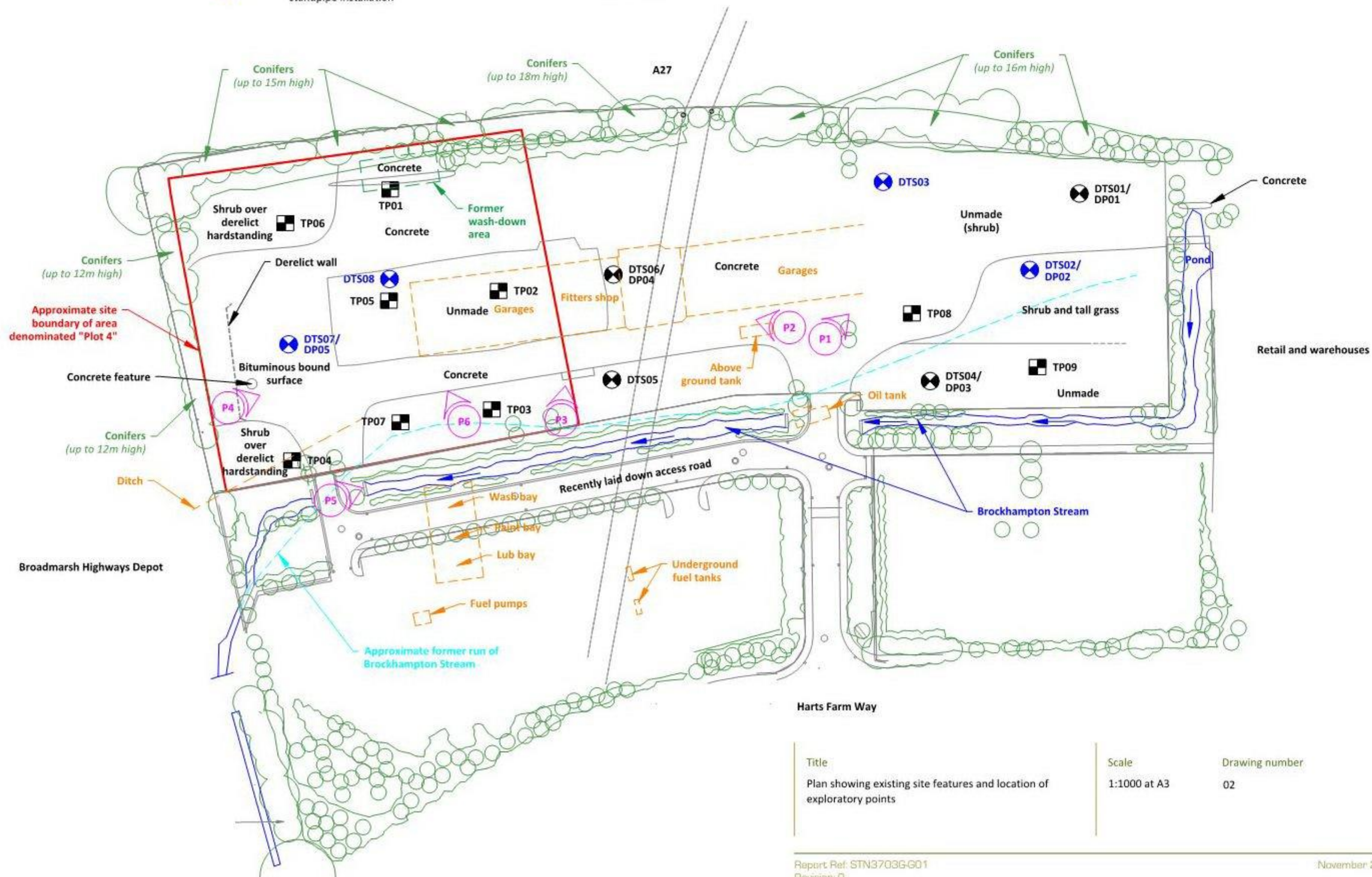
Key

-  DTS Approximate location of borehole formed by Driven Tube Sampling techniques
-  DTS/DP Approximate location of borehole formed by Driven Tube Sampling techniques and Dynamic Penetration testing
-  DTS Approximate location of borehole formed by Driven Tube Sampling techniques with standpipe installation

-  TP Approximate location of trial pit excavation
-  P1 Approximate location and orientation of photographic record
-  Approximate location of former features taken from a topographical survey dated October 2014

Notes

Base drawing provided by Travis Perkins



Title
Plan showing existing site features and location of exploratory points

Scale
1:1000 at A3

Drawing number
02



Key



Approximate location of borehole formed by Driven Tube Sampling techniques



Approximate location of borehole formed by Driven Tube Sampling techniques and Dynamic Penetration testing



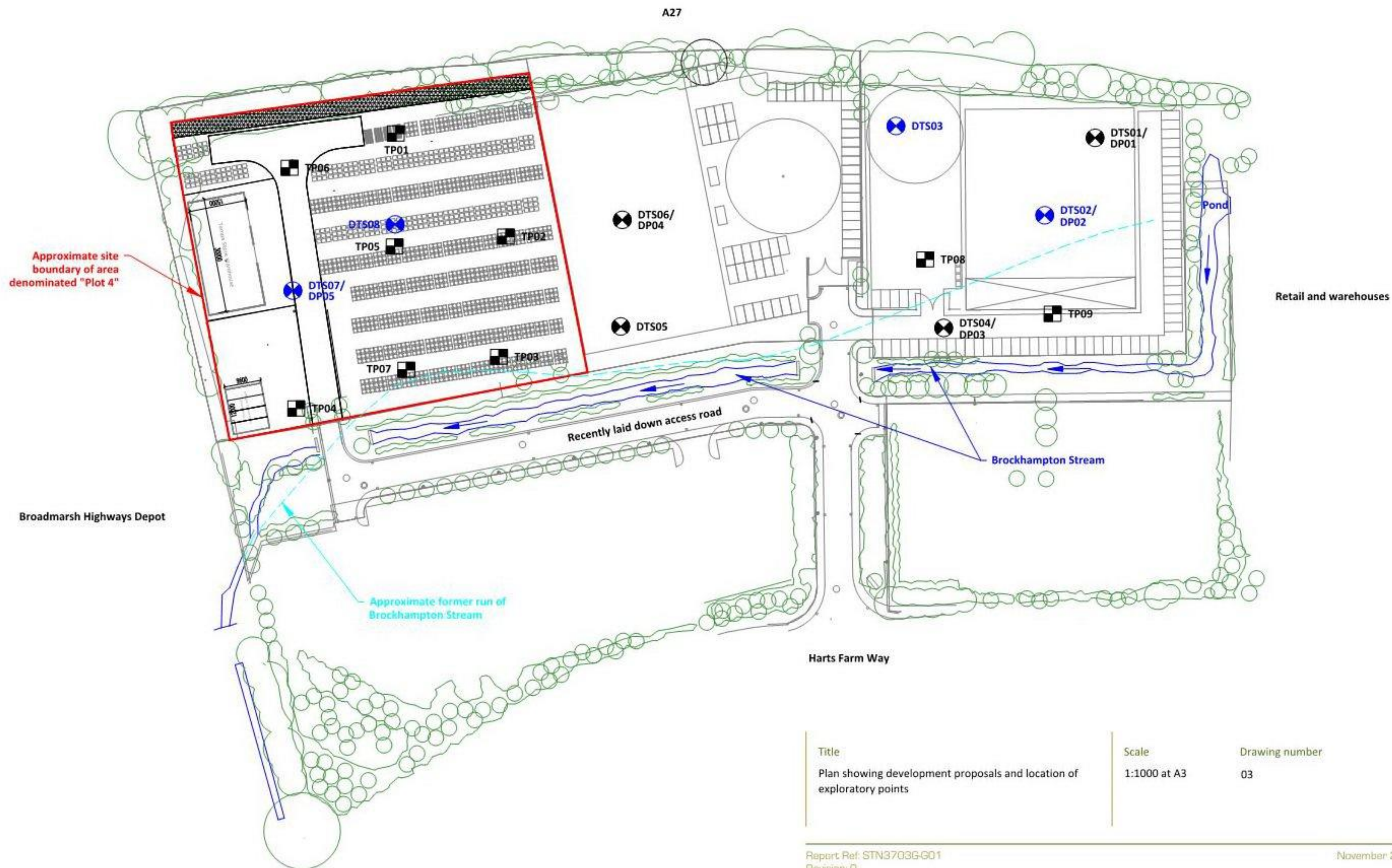
Approximate location of borehole formed by Driven Tube Sampling techniques with standpipe installation



Approximate location of trial pit excavation

Notes

Base drawing provided by Travis Perkins



Title
Plan showing development proposals and location of exploratory points

Scale
1:1000 at A3

Drawing number
03

DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS		SAMPLING		
				TYPE/DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
BITUMINOUS BOUND MATERIAL. (MADE GROUND)		0.10				0.20		D
Dense orange brown SAND and GRAVEL. Gravel consists of flint. Slight TPH odour noted. (MADE GROUND)								
<i>band of greyish blue SAND and GRAVEL on northern side of trial pit between 0.45m and 0.5m depth.</i>						0.50		ES
White mottled cream and orange brown slightly clayey slightly sandy GRAVEL. Gravel consists of chalk. Clasts are angular medium strong. (MADE GROUND)		0.55						
Stiff high strength dark brown to greyish brown slightly sandy gravelly CLAY. Gravel consists of flint and chalk. (MADE GROUND)		0.90		PP 1.00	PP=142	1.00		D
<i>becoming lighter in colour and very sandy from 1.2m depth.</i>				PP 1.20 PP 1.30	PP=117 PP=92			
Dense cream slightly clayey to clayey very sandy GRAVEL with occasional cobbles of flint. Gravel consists of fine to coarse angular to sub-rounded flint. (ALLUVIUM)		1.40				1.60		D
<i>becoming orange brown in colour from 2.25m depth.</i>								
TRIAL PIT TERMINATED AT 2.80m		2.80						

Notes: Collapse of trial pits sides by approximately 0.4m from 1.5m depth. Trial pit terminated at 2.8m due to collapse of sides promoted by groundwater inflows. Density of coarse soils gauged by the ease of excavation.

Ground level (mAOD)

Co-ordinates

Title

Surface breaking

470676, 105930

Trial pit record

Yes

Groundwater observations

Dimensions (W x L)

Date of excavation (range if applicable)

Appendix

Groundwater inflows at 2.15m depth.
Groundwater level at 2.3m upon completion.

0.60m x 2.30m

16/09/2016

C

Method of excavation

Location plan on drawing number

JCB 3CX

02

TP01

DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS		SAMPLING		
				TYPE/DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
Grass and construction debris onto dark brown slightly clayey very gravelly SAND. Gravel consists of brick, flint, concrete, occasional fragments of plastic, timber, charcoal and rare ash. (MADE GROUND)		0.30				0.10		D
						0.20		D
Cream to white slightly sandy GRAVEL. Gravel consists of chalk. Clasts are angular medium strong and very frequent cobbles of chalk (MADE GROUND)						0.60		B
Stiff dark brown slightly sandy gravelly to very gravelly CLAY. Gravel consists of fine to coarse angular to sub-rounded flint. (MADE GROUND)		1.30				1.40		B
Medium dense light greyish brown slightly clayey slightly sandy to sandy GRAVEL. Gravel consists of fine to coarse angular to sub-rounded flint. (ALLUVIUM)		1.70				2.00		B
						2.40		B
TRIAL PIT TERMINATED AT 2.60m		2.60						

Notes: Trial pit collapsed from 1.8m depth, widening pit by 0.3m each side. Unable to excavate further due to collapse promoted by groundwater inflows.

Ground level (mAOD)

Co-ordinates

Title

Surface breaking

470676, 105930

Trial pit record

No

Groundwater observations

Dimensions (W x L)

Date of excavation (range if applicable)

Appendix

Groundwater strike at 1.9m depth.

0.60m x 2.20m

16/09/2016

C

Groundwater level at 1.9m upon completion.

Method of excavation

Location plan on drawing number

JCB 3CX

02

TP02

DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS		SAMPLING		
				TYPE/DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
Gravels of flint, chalk, limestone and granite over brown mottled white slightly clayey SAND and GRAVEL with occasional rootlets up to 2mm in diameter. Gravel consists of flint, occasional brick, concrete, chalk, plastic and metal. (MADE GROUND)		0.60				0.10		D
						0.30		D
Firm high strength dark brown slightly sandy gravelly CLAY. Gravel consists of fine to coarse flint, occasional chalk and organic remains. Slight organic odour noted. (MADE GROUND)		1.30		PP 0.80	PP=75			
				PP 1.00	PP=83	1.00		D
Soft to firm light bluish grey sandy very gravelly CLAY. Gravel consists of fine to coarse angular to sub-rounded flint. (MADE GROUND)		2.00				1.80		B
						2.30		B
Medium dense light grey clayey very sandy GRAVEL. Gravel consists of fine to coarse flint. (ALLUVIUM)		2.60						
...becoming slightly sandy GRAVEL with occasional boulder-sized lenses of clayey gravelly sand from 2.5m depth.								
TRIAL PIT TERMINATED AT 2.60m.								

Notes: Unable to excavate further due to collapse of trial pit sides by 0.5m from 1.5m depth promoted by groundwater inflows.

Ground level (mAOD)

Co-ordinates

Title

Surface breaking

470649, 105913

Trial pit record

No

Groundwater observations

Dimensions (W x L)

Date of excavation (range if applicable)

Appendix

Groundwater at 2.25m depth upon completion, inflow from 2.15m depth.

0.60m x 2.40m

16/09/2016

C

Method of excavation

Location plan on drawing number

JCB 3CX

02

TP03

DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS		SAMPLING		
				TYPE/DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
Gravels of brick, concrete and flint onto BITUMINOUS BOUND MATERIAL. (MADE GROUND)		0.10						
Dark brown mottled brown and black slightly clayey SAND and GRAVEL with frequent cobbles and boulders of brick and concrete. Gravel consists of bituminous coated material, fragments of metal, plastic, flint, limestone and pottery. (MADE GROUND)		0.20				0.20		D
		0.30						D
		0.50						
Loose brown to light brown slightly clayey SAND and GRAVEL. Gravel consists of brick, concrete and flint. (MADE GROUND)		0.60						D
		1.40		PP 1.50 PP 1.50 PP 1.70	PP=58 PP=83 PP=75	1.50		D
Firm medium to high strength dark brown and dark grey slightly sandy gravelly CLAY with occasional rootlets up to 10mm in diameter. Gravel consists of fine to coarse flint. (MADE GROUND)		1.75				1.80		B
...roots up to 50mm in diameter between 1.7m and 2.2m depth.								
Medium dense to dense dark bluish grey slightly sandy to sandy clayey GRAVEL. Gravel consists of fine to coarse angular to sub-rounded flint. (ALLUVIUM)						2.20		B
...becoming lighter in colour from 1.9m depth.								
						3.20		B
...becoming white in colour from 3.0m depth.								
TRIAL PIT TERMINATED AT 3.50m		3.50						

Notes: Trial pit collapsed from 1.8m depth, widening pit by 0.3-0.4m each side

Ground level (mAOD)

Co-ordinates

470588, 105889

Title

Trial pit record

Surface breaking

Yes

Groundwater observations

Groundwater inflows 2.0m depth. Groundwater level at 2.8m upon completion.

Dimensions (W x L)

0.60m x m

Date of excavation (range if applicable)

16/09/2016

Appendix

C

Method of excavation

JCB 3CX

Location plan on drawing number

02

TP04

DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS		SAMPLING					
				TYPE/DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE			
Grass and construction debris onto dark brown slightly clayey gravelly SAND with roots up to 2mm in diameter. Gravel consists of flint, brick, concrete, occasional plastic and timber. (MADE GROUND)		0.40		PP 1.60	PP=67	0.10		D			
						0.20		D			
Medium dense to dense brown slightly clayey slightly sandy GRAVEL. Gravel consists of chalk and occasional fragments of brick. (MADE GROUND)		1.50				1.00		D			
						1.50		D			
Firm to stiff medium strength orange brown slightly sandy gravelly to very gravelly CLAY. Gravel consists of fine to coarse flint. (MADE GROUND)		1.80									
Medium dense to dense orange brown clayey very sandy GRAVEL with frequent cobbles of flint and occasional cobble to boulder-sized lenses of bluish grey clayey fine to medium sand. Gravel consists of fine to coarse flint. (ALLUVIUM)		3.20				2.50		B			
TRIAL PIT TERMINATED AT 3.20m											

Notes: Trial pit collapsed from 1.8m depth (due to groundwater inflows), widening pit 0.4m each side.

Ground level (mAOD)

Co-ordinates

Title

Surface breaking

470624, 105940

Trial pit record

No

Groundwater observations

Dimensions (W x L)

Date of excavation (range if applicable)

Appendix

Groundwater inflows from 2.3m depth.

0.60m x 2.20m

16/09/2016

C

Method of excavation

Location plan on drawing number

JCB 3CX

02

TP05

DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS		SAMPLING		
				TYPE/DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
Grass onto derelict BITUMINOUS BOUND MATERIAL. (MADE GROUND)		0.20				0.20		D
Loose dark grey mottled orange brown and black SAND and GRAVEL with rootlets up to 2mm in diameter. Gravel consists of bituminous coated material, flint, brick, rare fragments of plastic and metal. (MADE GROUND)		0.45				0.30		D
Firm to stiff dark greenish brown slightly sandy to sandy slightly gravelly CLAY. Gravel consists of fine to coarse flint. (MADE GROUND)				PP 0.60	PP=108			
				PP 0.80	PP=100	0.70		D
...becoming gravelly from 1.0m depth.				PP 1.20	PP=108	1.20		B
		1.45						
Medium dense to dense light grey to cream and orange brown clayey sandy GRAVEL with occasional boulder-sized lenses of firm orange brown sandy very gravelly clay. Gravel consists of fine to coarse angular to sub-rounded flint. (ALLUVIUM)						1.60		B
						2.60		B
TRIAL PIT TERMINATED AT 3.00m		3.00						

Notes: Trial pit collapsed due to groundwater seepage promoting instability from 1.8m depth, widening pit by 0.5m each side.

Ground level (mAOD)

Co-ordinates

Title

Surface breaking

470599, 105953

Trial pit record

Yes

Groundwater observations

Dimensions (W x L)

Date of excavation (range if applicable)

Appendix

Minor groundwater seepages from 2.0m depth.

0.60m x 2.60m

16/09/2016

C

Method of excavation

Location plan on drawing number

JCB 3CX

02

TP06

DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS		SAMPLING		
				TYPE/DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
Loose dark brown slightly clayey very gravelly SAND with rootlets up to 2mm in diameter and occasional boulders of concrete. Gravel consists of flint, brick, concrete, limestone and occasional bituminous coated material. (MADE GROUND)		0.10				0.10		D
		0.20				0.20		ES
		0.30				0.30		D
		0.50						
Firm to stiff dark brown sandy gravelly CLAY with occasional rootlets up to 5mm in diameter. Gravel consists of fine to coarse angular to sub-rounded flint. (MADE GROUND)		0.80				0.80		D
		1.40						
Soft very sandy very gravelly CLAY. Gravel consists of fine to coarse angular to sub-rounded flint. (MADE GROUND)		1.50				1.50		D
Medium dense light grey slightly clayey sandy GRAVEL. Gravel consists of fine to coarse angular to sub-rounded flint. (ALLUVIUM)		1.80						
		2.00				2.00		D
...becoming orange brown in colour from 2.4m depth.								
TRIAL PIT TERMINATED AT 2.60m		2.60						

Notes: Trial pit collapsed from 2.2m depth, widening pit by 0.4m each side. Trial pit terminated at 2.6m due to collapse promoted by groundwater inflows.

Ground level (mAOD)

Co-ordinates

Title

Surface breaking

470622, 105901

Trial pit record

No

Groundwater observations

Dimensions (W x L)

Date of excavation (range if applicable)

Appendix

Groundwater inflows from 2.15m depth.
Groundwater level at 2.2m upon completion.

0.60m x 2.50m

16/09/2016

C

Method of excavation

Location plan on drawing number

JCB 3CX

02

TP07

WELL	DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS				SAMPLING		
					TYPE/DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	FROM (m)	TO (m)	TYPE
	BITUMINOUS BOUND MATERIAL. (MADE GROUND)		0.10						0.20		D
	Light brown gravelly SAND. Gravel consists of sub-angular to rounded fine to coarse flint and bituminous coated material. (MADE GROUND)		0.50						0.60	0.90	D
	Dense white to light grey slightly sandy GRAVEL. Gravel consists of chalk. Clasts are fine to coarse angular medium strong with very frequent angular cobbles. (MADE GROUND)		0.95		PP 1.00	PP=50			1.10		D
	Firm medium strength dark brown slightly silty slightly sandy CLAY. Gravel consists of angular to rounded fine to coarse flint and occasional decaying organic material. (MADE GROUND)		1.50						1.50	1.60	D
	Stiff light brown and grey mottled orange brown slightly silty sandy very gravelly CLAY. Gravel consists of occasional chalk and angular to sub-rounded fine to coarse flint. (MADE GROUND)		1.80								
	Stiff light brown, light grey and white sandy gravelly CLAY. Gravel consists of angular to sub-rounded fine to coarse flint and rounded to sub-rounded fine to coarse chalk. (MADE GROUND)		2.00								
	Medium dense to loose light brown sandy clayey GRAVEL. Gravel consists of sub-angular to rounded fine to coarse flint and sub-rounded fine to medium chalk. (ALLUVIUM)		2.65								
	Firm brown sandy gravelly CLAY. Gravel consists of angular to sub-rounded fine to coarse flint and sub-rounded to rounded fine to medium chalk. (ALLUVIUM)		2.80								
	Loose to medium dense light brown sandy clayey GRAVEL. Gravel consists of sub-angular to rounded fine to coarse flint and sub-rounded fine to medium chalk. (ALLUVIUM)								3.40	4.00	D
	BOREHOLE TERMINATED AT 4.00m		4.00								

Notes: Borehole collapsed to 3.5m depth. Standpipe installed to 0.9m depth. Standpipe 1m above ground level. For dynamic probing, refer to DP05.

Ground level (mAOD)

Co-ordinates
470598, 105919

Title

Driven tube sampler borehole record

Surface breaking

Yes

Groundwater observations

Groundwater encountered at 1.75m depth.

Date of excavation (range if applicable)

16/09/2016

Appendix

D

Location plan on drawing number

02

DTS07

WELL	DESCRIPTION	LEGEND	DEPTH (m)	WATER STRIKE	TEST RESULTS				SAMPLING		
					TYPE/DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	FROM (m)	TO (m)	TYPE
	Brown gravelly SAND with rootlets up to 5mm in diameter. Gravel consists of brick, bituminous coated material, organic material, fabric sheeting and chalk. (MADE GROUND)		0.30						0.10		D
	[Dense] white to light grey slightly sandy GRAVEL. Gravel consists of chalk. Clasts are fine to coarse angular medium strong with very frequent angular cobbles. (MADE GROUND)		1.30						1.20		D
	Firm brown slightly sandy very gravelly CLAY. Gravel consists of angular to sub-rounded fine to coarse flint. (MADE GROUND)		1.70						1.50		D
	Light brown slightly sandy clayey GRAVEL in a clayey matrix. Gravel consists of angular to sub-rounded fine to coarse flint. (ALLUVIUM)		2.55								
	Firm orange brown slightly sandy gravelly CLAY. Gravel consists of sub-angular to sub-rounded fine to coarse flint and sub-rounded to rounded fine to medium chalk. (ALLUVIUM)		2.70								
	[Loose to medium dense] light brown clayey sandy GRAVEL. Gravel consists of angular to sub-rounded flint and sub-rounded fine to medium chalk. (ALLUVIUM)		3.00						2.90		D
	BOREHOLE TERMINATED AT 3.00m								2.90		D

Notes: Standpipe installed to 3m depth. Standpipe 0.93m above ground level. Density of coarse soils inferred from nearest dynamic probing.

Ground level (mAOD)

Co-ordinates
470636, 105946

Title

Driven tube sampler borehole record

Surface breaking

No

Groundwater observations

No groundwater encountered.

Date of excavation (range if applicable)

16/09/2016

Appendix

D

Location plan on drawing number

02

DTS08

Appendix H
Proposed Drainage Plan
JPP drawing no. 22573-200 Rev.P2



General notes

- All dimensions are in metres unless otherwise stated.
- All levels are in metres.
- This drawing is to be read in conjunction with all relevant Engineers and Architect's drawings, Specifications, Reports and Engineering Details.
- Do not scale from this drawing.

Drainage notes

The storm water drainage system has generally been designed not to flood for a 1 in 100 year event plus an allowance of 40% for climate change.

The location of existing drainage must be accurately located prior to commencement of any excavations, reducing levels or any other works which may affect drainage before those works commence.

All manhole covers within vehicular areas shall be F900. Existing manhole covers within vehicular areas shall be replaced with F900 covers where necessary and if the existing covers are damaged. Cover levels are to be adjusted to suit proposed levels. New manhole covers within non vehicular areas may be B125.

RWP's must have rodding access.

All connections from downpipes, gullies and linear drainage channels to be 1500 unless noted otherwise.

Linear drainage channels

Sumps shall be provided at outlet locations.

Covers/gratings shall be F900

Oil / petrol separator

The separator and tank shall be installed strictly in accordance with the manufacturers instructions.

The separator and tank shall meet the current environment agency guidelines PPG3. The choice of separator and tank shall be determined by the specialist supplier.

The separator and tank shall be bedded and surrounded in a minimum of 150mm thick concrete where ground water levels are below the level of the excavations to receive the separator. In excavations where ground water levels are higher than the base of the excavations then additional thickness of the concrete surround may be necessary to avoid flotation. The engineer shall be advised of water levels higher than the depth of the excavation to receive the separator to allow calculations to be effected to ensure flotation of the separator does not occur either during construction or whilst in service.

Vent pipes shall be as short as practicable and shall terminate not less than 2m above finished pavement level nor less than 1m above an openable window or other opening in a building within a horizontal distance of 3m or as shown on the drainage drawing.

The separator and tank shall be maintained strictly in accordance with the manufacturers instructions.

Health, Safety & The Environment

In accordance with the Construction (Design and Management) Regulations 2015, the designs and details on this drawing have been the subject of a Designers Risk Assessment, to identify risks in the construction, use, or demolition of the scheme.

It is not considered necessary for Designers to highlight obvious and/or common risks (such as deep excavations, manual handling and working around heavy plant) which Contractors should be familiar with, and be able to control by good management and site practice.

So far as is reasonably practicable, the risks inherent in the design have been eliminated. Where it has been considered that elimination of a risk (or part of a risk) is not reasonably practicable, it has been reduced.

Significant unusual residual risks are identified on the drawing by use of a Yellow Caution Marker, beside the measures which have been adopted to eliminate and/or reduce them.

Drawing Key

- Surface Water Drain
- Linear Drainage Channel - Qmax 225
- Proposed Level
- 1m wide - Type 1 subbase
- Permeable subbase laid to falls
- Top of capping layer/under side of permeable subbase

OPTION 1 PERMEABLE SUBBASE

Rev P2 Issued for planning.
Rev P1 Issued for planning.

By IH Checked PB 17.03.2021
By IH Checked PB 26.02.2021

Drawn By:	IH	Client	Travis Perkins
Chkd By:	PB	Project	Keyline, Havant
Scale @ A1:	1:200	Title	Proposed Drainage & Levels Option 1 - Permeable Subbase
Date:	February 2021		
Status:	FOR PLANNING		
Project No.:	22573	Drawing No:	200
Rev:	P2		



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- Infrastructure Design
- Structural Engineering
- Planning Services
- Geotechnical & Environmental
- Surveying
- Professional Advice



Appendix I

Greenfield Calculations

Smith Foster Ltd		Page 1
Branksome Park House Bourne Valley Road Poole BH12 1ED	Greenfield Runoff Rate Keyline, Havant	
Date 09/03/2021 8:02 AM	Designed by RS	
File 22316 - GREENFIELD RUNOFF RATE.SRCX	Checked by RS	
Micro Drainage	Source Control 2017.1	

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 700 Urban 0.000
Area (ha) 0.369 Soil 0.400 Region Number Region 7

Results 1/s

QBAR Rural 1.3
QBAR Urban 1.3

Q100 years 4.0

Q1 year 1.1
Q30 years 2.8
Q100 years 4.0

Appendix J

Attenuation Calculations

JPP Consulting Ltd		Page 1
Cedar Barn White Lodge Walgrave Northampton NN6 9PY		
Date 17/03/2021 15:38 File NETWORK.MDX	Designed by michael1 Checked by	
XP Solutions	Network 2016.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	550	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

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
S1.000	24.187	0.145	167.0	0.016	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	16.498	0.055	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	4.714	0.028	168.4	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	4.621	0.167	27.7	0.353	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	16.498	0.055	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	15.127	0.150	100.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL Σ (m)	I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	60.37	5.40	3.180	0.016	0.0	0.0	0.0	1.01	40.1	2.5
S1.001	58.99	5.70	2.960	0.016	0.0	0.0	0.0	0.90	63.8	2.5
S2.000	61.98	5.06	3.100	0.000	0.0	0.0	0.0	1.21	85.5	0.0
S2.001	61.86	5.09	3.072	0.353	0.0	0.0	0.0	3.00	212.0	59.1
S1.002	57.68	6.01	2.905	0.369	0.0	0.0	0.0	0.90	63.8	59.1
S1.003	57.02	6.17	2.850	0.369	0.0	0.0	0.0	1.57	110.7	59.1

JPP Consulting Ltd		Page 2
Cedar Barn White Lodge Walgrave Northampton NN6 9PY		
Date 17/03/2021 15:38 File NETWORK.MDX	Designed by michael1 Checked by	
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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	3.760	0.580	Open Manhole	1200	S1.000	3.180	225				
S2	3.650	0.690	Open Manhole	1200	S1.001	2.960	300	S1.000	3.035	225	
S4	3.650	0.550	Open Manhole	1200	S2.000	3.100	300				
S5	3.600	0.528	Open Manhole	1200	S2.001	3.072	300	S2.000	3.072	300	
S3	3.650	0.745	Open Manhole	1200	S1.002	2.905	300	S1.001	2.905	300	
								S2.001	2.905	300	
S3	3.650	0.800	Open Manhole	1200	S1.003	2.850	300	S1.002	2.850	300	
S	3.000	0.300	Open Manhole	0		OUTFALL		S1.003	2.700	300	

JPP Consulting Ltd		Page 4
Cedar Barn White Lodge Walgrave Northampton NN6 9PY		
Date 17/03/2021 15:38 File NETWORK.MDX	Designed by michael1 Checked by	
XP Solutions	Network 2016.1	

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.350		

JPP Consulting Ltd		Page 5
Cedar Barn White Lodge Walgrave Northampton NN6 9PY		
Date 17/03/2021 15:38 File NETWORK.MDX	Designed by michael1 Checked by	
XP Solutions	Network 2016.1	

Online Controls for Storm

Hydro-Brake Optimum® Manhole: S3, DS/PN: S1.003, Volume (m³): 2.0

Unit Reference	MD-SHE-0075-2500-1000-2500
Design Head (m)	1.000
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	2.850
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.5
Flush-Flo™	0.307	2.5
Kick-Flo®	0.627	2.0
Mean Flow over Head Range	-	2.2

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)
0.100	2.1	1.200	2.7	3.000	4.1	7.000	6.2
0.200	2.4	1.400	2.9	3.500	4.5	7.500	6.4
0.300	2.5	1.600	3.1	4.000	4.7	8.000	6.6
0.400	2.5	1.800	3.3	4.500	5.0	8.500	6.8
0.500	2.4	2.000	3.4	5.000	5.3	9.000	7.0
0.600	2.1	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.3	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	6.0		

JPP Consulting Ltd		Page 6
Cedar Barn White Lodge Walgrave Northampton NN6 9PY		
Date 17/03/2021 15:38 File NETWORK.MDX	Designed by michael1 Checked by	
XP Solutions	Network 2016.1	

Storage Structures for Storm

Porous Car Park Manhole: S4, DS/PN: S2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	36.5
Membrane Percolation (mm/hr)	1000	Length (m)	54.0
Max Percolation (l/s)	547.5	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	0
Invert Level (m)	3.100	Cap Volume Depth (m)	0.350

Cellular Storage Manhole: S5, DS/PN: S2.001

Invert Level (m)	2.800	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	3.6	0.0	0.501	0.0	0.0
0.500	3.6	0.0			

Porous Car Park Manhole: S3, DS/PN: S1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	22.0
Membrane Percolation (mm/hr)	1000	Length (m)	54.0
Max Percolation (l/s)	330.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	0
Invert Level (m)	2.905	Cap Volume Depth (m)	0.350

JPP Consulting Ltd		Page 7
Cedar Barn White Lodge Walgrave Northampton NN6 9PY		
Date 17/03/2021 15:38 File NETWORK.MDX	Designed by michael1 Checked by	
XP Solutions	Network 2016.1	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 3
 Number of Online Controls 1 Number of Time/Area Diagrams 0
 Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+0%	100/120 Winter				3.213
S1.001	S2	360 Winter	1	+0%	100/60 Winter				3.011
S2.000	S4	60 Winter	1	+0%					3.102
S2.001	S5	15 Winter	1	+0%	100/15 Summer				3.195
S1.002	S3	360 Winter	1	+0%	100/60 Summer				3.011
S1.003	S3	360 Winter	1	+0%	30/120 Winter				3.008

PN	US/MH Name	Surcharged		Flooded		Pipe		Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	
S1.000	S1	-0.192	0.000	0.05		1.9	OK	
S1.001	S2	-0.250	0.000	0.01		0.3	OK	
S2.000	S4	-0.298	0.000	0.00		0.1	OK	
S2.001	S5	-0.177	0.000	0.35		35.4	OK	
S1.002	S3	-0.195	0.000	0.04		2.3	OK	
S1.003	S3	-0.142	0.000	0.02		2.3	OK	

