

**LAND AT DAPPERS LANE, ANGMERING,
WEST SUSSEX BN16 4EW**

PROPOSED RESIDENTIAL DEVELOPMENT

Flood Risk Assessment

Prepared on Behalf of
Persimmon Homes

D1260/FRA 1.4

September 2020

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Proposed Residential Development

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1 INTRODUCTION

1.1 Background

- 1.1.1 RGP Design Ltd (RGPD) is instructed by Persimmon Homes to prepare a Site-Specific Flood Risk Assessment (FRA) to support a planning application for a residential development in relation to the Land at Dappers Lane, Angmering, West Sussex BN16 4EW.
- 1.1.2 This FRA has been undertaken in accordance with Planning Practice Guidance: Flood Risk and Coastal Change and National Planning Policy Framework Section 14.
- 1.1.3 The proposed development will involve the construction of 84 No. residential properties, hard landscaping including estates roads inclusive of both private and shared parking areas, and soft landscaping.
- 1.1.4 In preparing this report, RGPD has referred to the following documents and information:
- Arun District Council (ADC) and West Sussex County Council (WSCC) Drainage Records
 - British Geological Survey (BGS) Geology Maps and Records
 - EEG (Ultraflow) Drainage Investigation Surveys
 - Environment Agency Flood Maps for Planning
 - LEAP Environmental Geotechnical Investigation
 - Long Term Flood Risk Information – Flood Risk from Rivers or the Sea Map
 - Long Term Flood Risk Information – Flood Risk from Surface Water Map
 - Long Term Flood Risk Information – Flood Risk from Reservoirs Map
 - Midland Survey Ltd. Topographical Survey
 - Southern Water Public Sewer Records
 - WSCC Strategic Flood Risk Assessment (SFRA)
- 1.1.5 This document has been prepared to assess if the proposed development is suitable for the site and confirms if mitigation is required to ensure that flood risk is not increased, and that the proposed development remains safe during its design life.
- 1.1.6 This report has been prepared for the benefit of the named Client only.

1.2 Site Location and Description

- 1.2.1 The proposed development site measures 3.70Ha in size, and incorporates land to the west of Dappers Lane, Angmering, West Sussex which is currently occupied by grazing horses. The site is bound to the south by properties located in Garden Close and Woodlands Close – beyond an existing (unnamed) ordinary watercourse. The watercourse has a small section which is culverted, however sections of 'open ditch' remain. To the west, the site is abutted by a public footpath, beyond which St. Margaret's Church of England Primary School can be found (access to which can be achieved off of Arundel Road). Herons Farm is located immediately to the north-east, whilst an area of woodland is present beyond the northern boundary.
- 1.2.2 A site location plan has been included within this report (**PL100 - 'Site Location Plan'**).
- 1.2.3 A site-specific topographical survey has been undertaken at the site, by Midland Survey Ltd. dated March 2017.
- 1.2.4 The topography of the site is demonstrated as lying between 19.41m AOD and 29.41m AOD, generally falling from north-east to south-west, as demonstrated on drawing **PL101 - 'Existing Contours'**.
- 1.2.5 The watercourse running adjacent to the southern boundary of the site, as referred to within 1.2.1, has been confirmed to be flowing in a westerly direction, towards Arundel Road. The watercourse has been confirmed to be culverted from the rear garden of No. 4 Garden Close (225mm dia.), outfalling to a manhole located in Arundel Road.
- 1.2.6 At present, the site is fully permeable, with no impermeable areas of hardstanding.

1.3 Ground Conditions

- 1.3.1 LEAP Environmental Ltd. has been appointed by Persimmon Homes to undertake a 'Phase 1 Desk Study' and 'Phase 2 Intrusive Site Investigation' in relation to the site. The report (LP1877) is dated 14th May 2019.
- 1.3.2 The 'Phase 2 Intrusive Site Investigation' was instructed with the intention of establishing underlying geological conditions, confirming groundwater levels whilst allowing for a period of groundwater monitoring, as well as infiltration testing in accordance with BRE 365.
- 1.3.3 In total, 13 No. trial holes were excavated across the site, including 9 No. machine excavated trial pits to a depth of 3.00m, and 4 No. windowless sampler boreholes, each to a depth of 5.00m. The trial holes were located to provide 'general coverage' in view of the proposed development.
- 1.3.4 Prior to receipt of the geotechnical report prepared by LEAP Environmental Ltd. a review of the BGS online geology maps was undertaken in order to gain an understanding of the anticipated geology underlying the site.

- 1.3.5 The BGS 'Bedrock Geology Map' states bedrock geology to be 'London Clay Formation – Clay, Silt and Sand'.

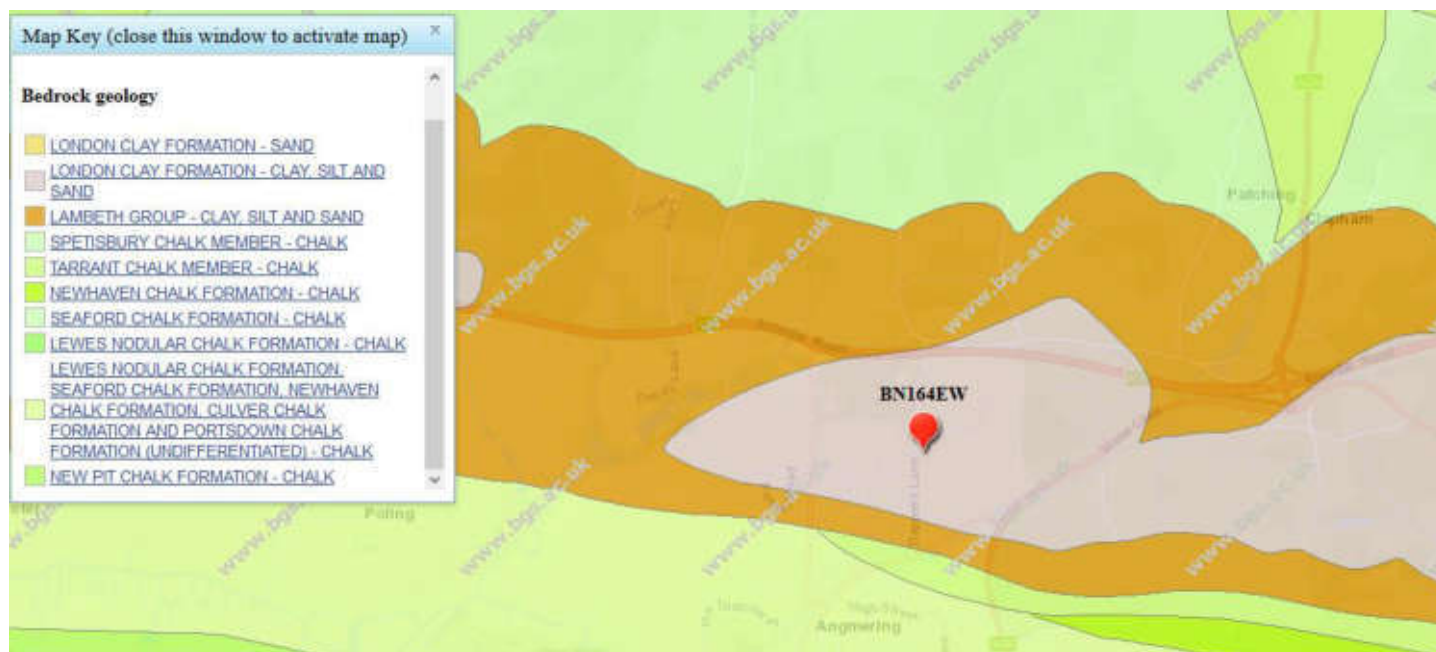


Figure 1. BGS – Bedrock Geology Map

- 1.3.6 The composition of superficial deposits is demonstrated as being variable. The BGS online geology maps indicate superficial deposits consisting of 'Alluvium – Clay, Sand and Peat', 'Alluvium – Clay, Silt, Sand and Gravel', as well as 'Head – Clay, Silt, Sand and Gravel'.

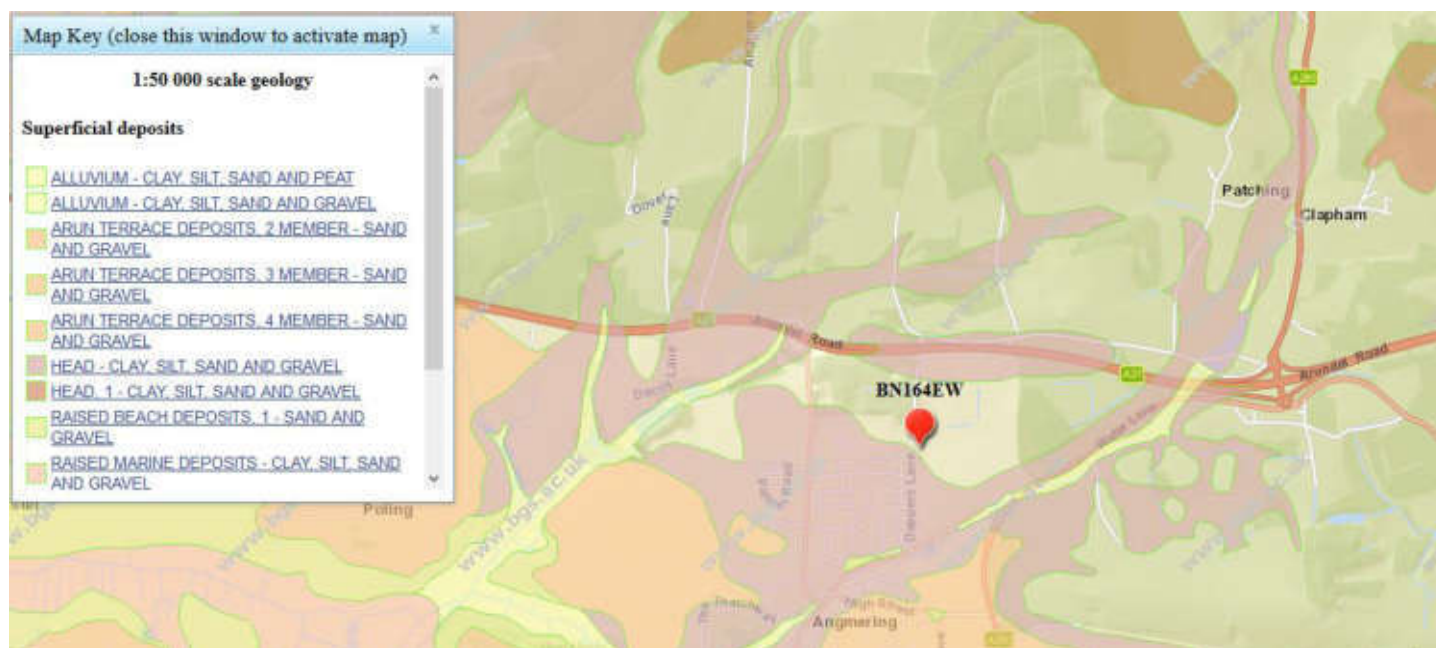


Figure 2. BGS – Superficial Deposits Map

- 1.3.7 The findings as identified within the Borehole and Trial Pit Logs associated with LEAP Environmental Ltd's 'Phase 2 Intrusive Site Investigation' are consistent with the anticipated geology as stated by the BGS, as per their published online geology maps. Full records of the Borehole and Trial Pit Logs provided by LEAP Environmental are contained within **Appendix C**.
- 1.3.8 To date, infiltration testing has been conducted at 2 No. locations on site – at HA1 and HA2, each to a depth of 1.00m below ground level (bgl) in accordance with BRE Digest 365. The results of these initial tests indicate poor infiltration capabilities of the underlying soils at the stated test depths, whereby compliant tests could not be concluded in view of the required methodology (sufficient falls in water

levels could not be recorded). In view of the results, infiltration rates of 6.94×10^{-8} (HA1) and 12×10^{-7} (HA2) have been confirmed.

- 1.3.9 Following discussions with ADC, additional infiltration testing was deemed to be required at the site, in view of the proposed site arrangement, and SuDS features, subject to a period of groundwater monitoring.
- 1.3.10 Additional groundwater monitoring was undertaken between the months of November 2019 and January 2020, further details of which can be found, below, in **1.4 'Groundwater'**.
- 1.3.11 A plan demonstrating the additional testing requested can be found within **Appendix D**.

1.4 Groundwater

- 1.4.1 LEAP Environmental Ltd's 'Phase 2 Intrusive Site Investigation' extended to include groundwater monitoring, at four locations – WS1, WS2, WS3 and WS5.
- 1.4.2 The current groundwater monitoring results were collected from March (4th) to May (13th) 2019, and therefore do not cover the 'peak' winter seasonal groundwater period expected by ADC and WSCC.
- 1.4.3 LEAP Environmental Ltd state in their report that, for the current period of groundwater monitoring, groundwater levels ranged from between 0.14m and 1.04m bgl over the majority of the monitoring period. Detailed groundwater monitoring results are confirmed in the table, below;

Monitoring well	Depth to groundwater (mbgl)					
	01/03/2019	18/03/2019	01/04/2019	15/04/2019	29/04/2019	13/05/2019
WS1	5.33	0.39	0.65	0.79	1.02	1.73
WS2	5.02	0.35	0.73	0.78	0.90	1.77
WS3	4.98	0.56	0.82	0.92	1.04	1.61
WS5	Dry	0.14	0.60	0.90	1.02	2.14

- 1.4.4 As confirmed in 1.3.9, ADC requested additional groundwater monitoring on site, in view of the proposed site arrangement, and associated SuDS features.
- 1.4.5 Additional groundwater monitoring has been undertaken by LEAP Environmental, between the months of November 2019 and January 2020, as agreed with ADC. The results of this additional monitoring is confirmed in the table, below;

Monitoring well	Depth to groundwater (mbgl)		
	29/11/2019	17/12/2019	06/01/2020
WS1	0.36	0.25	0.00
WS2	0.48	0.20	0.40
WS3	2.24*	0.60	0.35
WS101	0.15	0.20	0.15
WS102	0.15	0.20	0.15

*Baled dry on 29th November 2019

- 1.4.6 Based upon the additional groundwater monitoring undertaken between November 2019 and January 2020, ADC confirmed that no additional groundwater monitoring would be required beyond this, and further infiltration testing would also not be required.
- 1.4.7 A plan demonstrating the locations of the existing groundwater monitoring wells can be found within **Appendix C** of this report, along with relevant extracts of the LEAP Environmental report.
- 1.4.8 A further plan, demonstrating the additional groundwater monitoring locations requested by ADC, can be found in **Appendix D**.

- 1.4.9 Information obtained from WSCC states that JBA groundwater mapping suggests the risk of groundwater flooding is 'negligible' – which does not concur with information obtained from other sources, such as the on-site groundwater monitoring and anecdotal information obtained further to independent site visits, as advised by the current landowner.
- 1.4.10 Mapping managed by MAGIC (magic.defra.gov.uk) provides geographic information concerning the natural environment from across government. This mapping tool has been referred to in order to confirm whether the site is located within either any groundwater source protection zones or groundwater vulnerability zones.
- 1.4.11 The Aquifer Designation Map (Bedrock) confirms that the site is situated within a 'Unproductive' Aquifer, as demonstrated in **Figure 3**. This refers to bedrock geology that does not exhibit permeability or provide groundwater storage or supply.

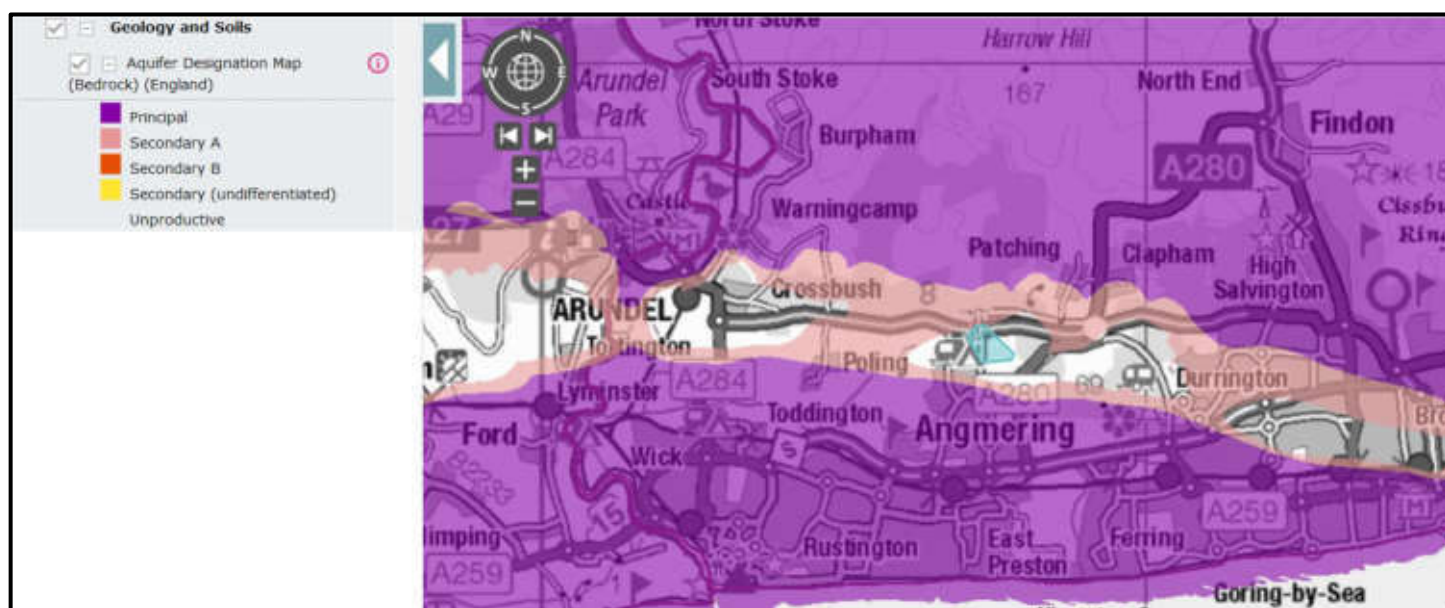


Figure 3. Bedrock Aquifer Designation Map

- 1.4.12 The Aquifer Designation Map (Superficial Drift) suggests that the site is located within a 'Secondary (undifferentiated)' aquifer. This indicates that it has not been possible to attribute either a category A or B rock type, and that variable characteristics of rock type exist, which are only likely to have a 'minor' value.

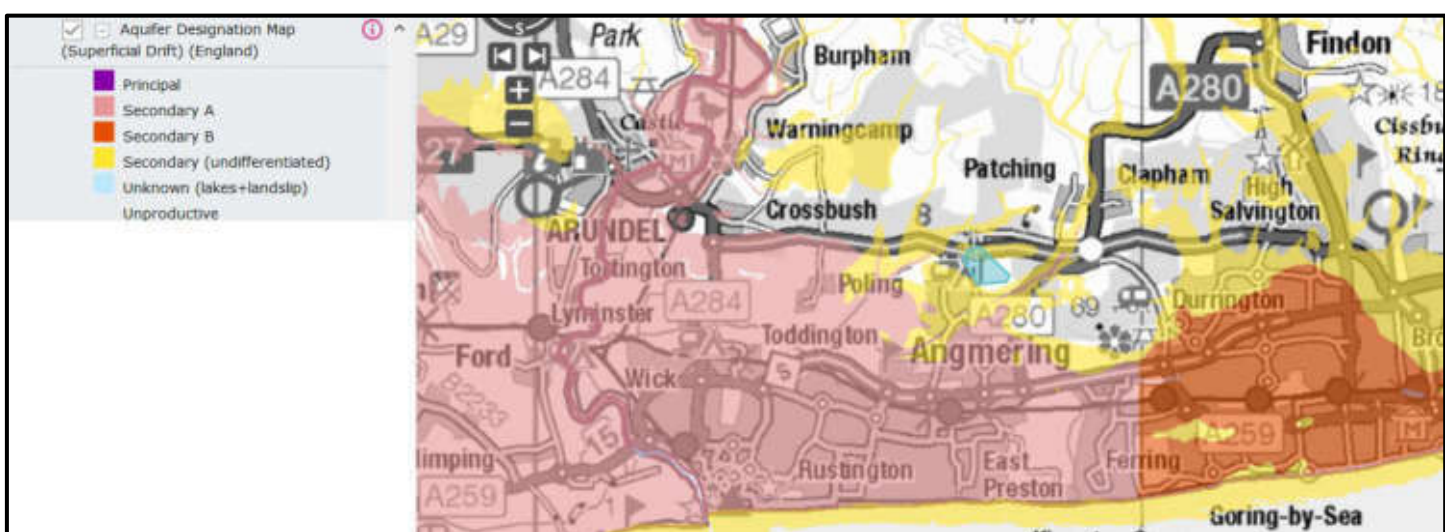


Figure 4. Superficial Drift Aquifer Designation Map

1.4.13 The Groundwater Vulnerability Map indicates that the site is located within a 'Minor Aquifer High' (south and south-western extents), a 'Minor Aquifer Intermediate' (south-eastern extents) and a 'Minor Aquifer Low' (all other areas) Groundwater Vulnerability Zones.

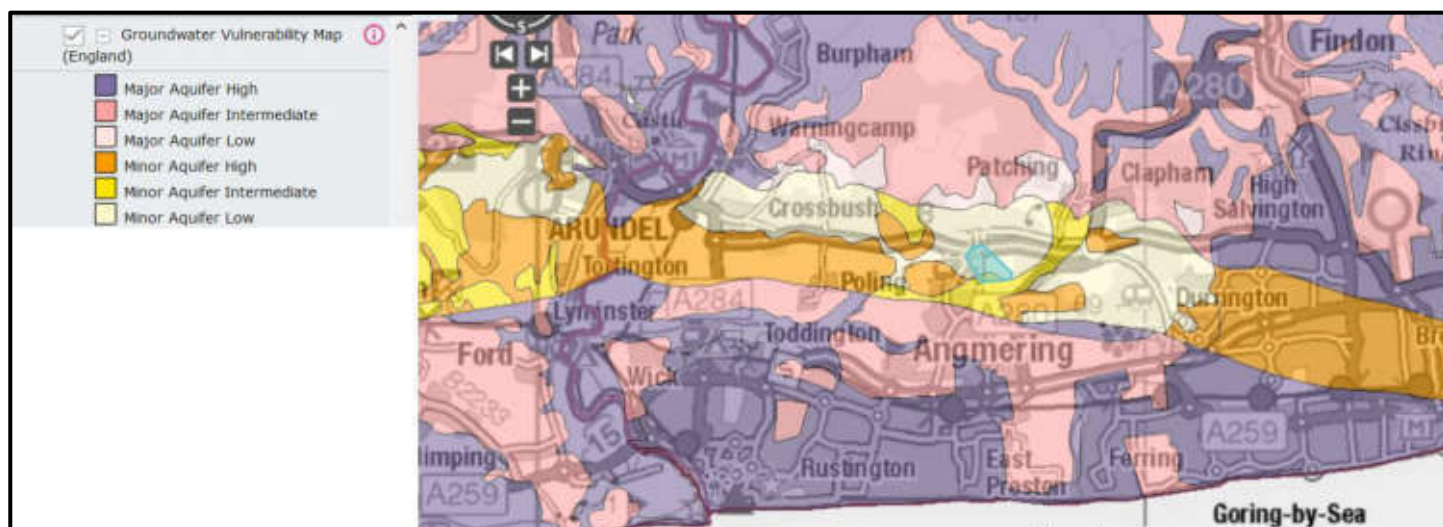


Figure 5. Groundwater Vulnerability Map

1.4.14 The site is not indicated as falling within any classified Groundwater Source Protection Zones, as demonstrated by **Figure 6**, below.



Figure 6. Groundwater Source Protection Zones

1.5 Existing Drainage

1.5.1 The existing drainage infrastructure supporting the site and the surrounding area has been identified following review of the topographical survey conducted on site by Midland Survey Ltd, ADC and WSCC records, Southern Water public sewer records as well as intrusive CCTV investigation undertaken by EEG (Ultraflow).

1.5.2 Surface Water:

- The Southern Water public sewer records indicate that there are no public surface water sewers located within the vicinity of the site.

- It is believed that surface water run-off generated by the site currently discharges to the existing watercourse(s) located to the south/south-west of the site, via naturally occurring overland flow routes. The unnamed watercourse located adjacent to the southern boundary of the site consists of sections which are both culverted as well as 'open ditch' and is understood to flow in a westerly direction.
- The unnamed watercourse referred to above has been confirmed to outfall to a culverted watercourse, where the head of the run has been located within the rear garden of No. 4 Garden Close. This culverted watercourse has been fully surveyed by EEG (Ultraflow) and is confirmed as outfalling to a public highway drainage/historic culverted watercourse located in Arundel Road, to the west of the site. This culvert measures 225mm in diameter.
- The CCTV investigation undertaken by EEG (Ultraflow) has identified issues with this culvert, including blockages (some of which have been cleared to allow the full length of culvert to be surveyed), breach, and displaced joints.
- ADC has confirmed that there are known historic problem with this system, in particular where is it culverted through Furzefield Close.
- The greenfield run-off rate (Qbar) has been calculated to be 13.6l/s (Q1 = 11.5l/s, Q30 = 30.8l/s and Q100 = 43.3l/s)
- The greenfield run-off volume is calculated to be 896.636m³ (37.60%) (based on FEH, SPR of 37%).

1.5.3 Foul Water:

- The Southern Water public sewer records indicate that there are existing public foul water sewers located to the south of the site, located in Garden Close. This sewer is stated as being a 150mm dia. public foul water sewer of vitrified clay construction, flowing in a westerly direction along Garden Close, before heading south towards Chantryfield Road. At this point, the sewer connects with another public foul water sewer (also 150mm dia.) which flows westerly towards Arundel Road.
- EEG (Ultraflow) has identified additional foul water sewers within Pine Trees Close, to the west of the site. A 150mm dia. foul water sewer has been identified, which flows in a southerly direction, towards Chantryfield Road.
- Following to additional investigation by EEG (Ultraflow) a further public foul water sewer has been identified in Arundel Road (as also demonstrated on the Southern Water public sewer records), flowing in a southerly direction. This sewer has been confirmed to be a 150mm dia. sewer, with a recorded depth of 1.30m at manhole 7002.

1.5.4 Highway Drainage:

- There is existing positive drainage infrastructure which currently serves Dappers Lane. WSCC has confirmed that existing highway gullies exist on both the eastern and western edge of carriageway on Dappers Lane, whilst additional gullies are also located within the neighbouring roads, including Woodlands Close and Garden Close, both to the south of the site. The current outfall location of this system has not been confirmed, however.

- ADC has confirmed that there is a fragmented drainage system in Dappers Lane, and that overland flows which use this road as a conduit have contributed towards historical flooding in Dappers Lane, as well as in Angmering Village.

1.5.5 ADC and WSCC drainage records and correspondence can be found within **Appendix F** and **H**.

1.5.6 EEG (Ultraflow) drainage investigation records can be found within **Appendix E**.

1.5.7 The Southern Water public sewer records can be found within **Appendix B**.

2 PROBABILITY

2.1 Sources of Information

2.1.1 The NPPF requires that all sources of flooding are considered being Tidal, Fluvial, Pluvial, Groundwater, Sewers and Man-made reservoirs/canals.

2.1.2 The likelihood of the site flooding has been established by reviewing the following information:

- Environment Agency Flood Maps for Planning
- Long Term Flood Risk Assessment Surface Water Flood Risk Maps
- Long Term Flood Risk Assessment Reservoir Flood Risk Maps
- WSCC Strategic Flood Risk Assessment
- Consultation with ADC (Local Authority)
- Consultation with WSCC (Lead Local Flood Authority)
- Midland Survey Ltd. Topographical Survey

2.2 Flood Maps and Modelling

2.2.1 The Environment Agency's online Flood Maps for Planning show that the site is located fully within Flood Zone 1, as demonstrated in **Figure 7**. This is also confirmed by information and mapping obtained from ADC and WSCC, all of which is consistent.

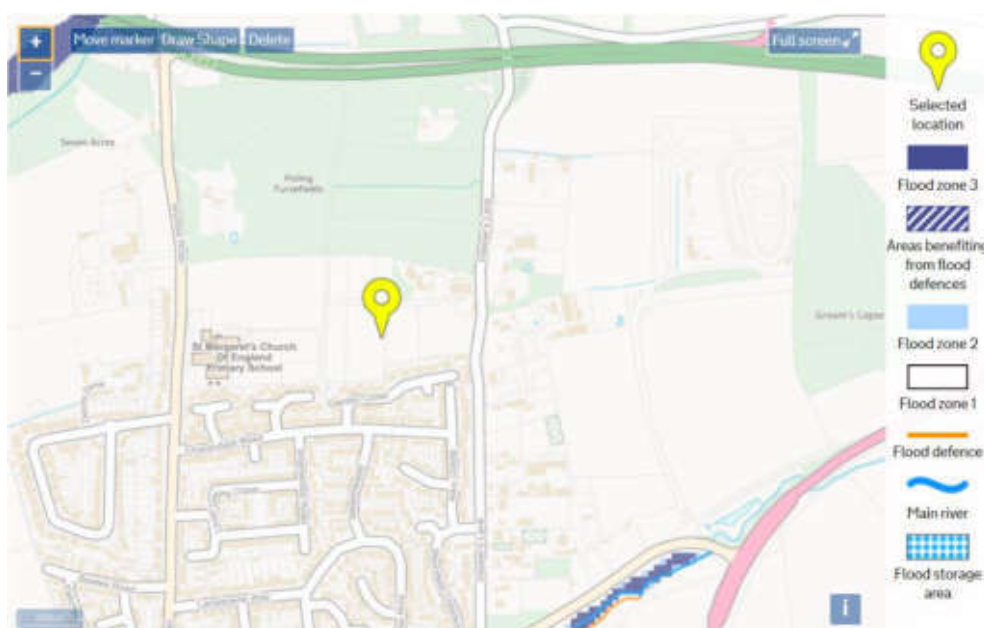


Figure 7 – Flood Maps for Planning (Gov.uk)

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
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. (Land shown in light blue on the Flood Map)
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. (Land shown in dark blue on the Flood Map)
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. (Not separately distinguished from Zone 3a on the Flood Map)

2.2.2 The Long-Term Flood Risk Map for Rivers or the Sea (**Figure 8**) demonstrates that the site is not deemed to be at risk of flooding from either of these sources.

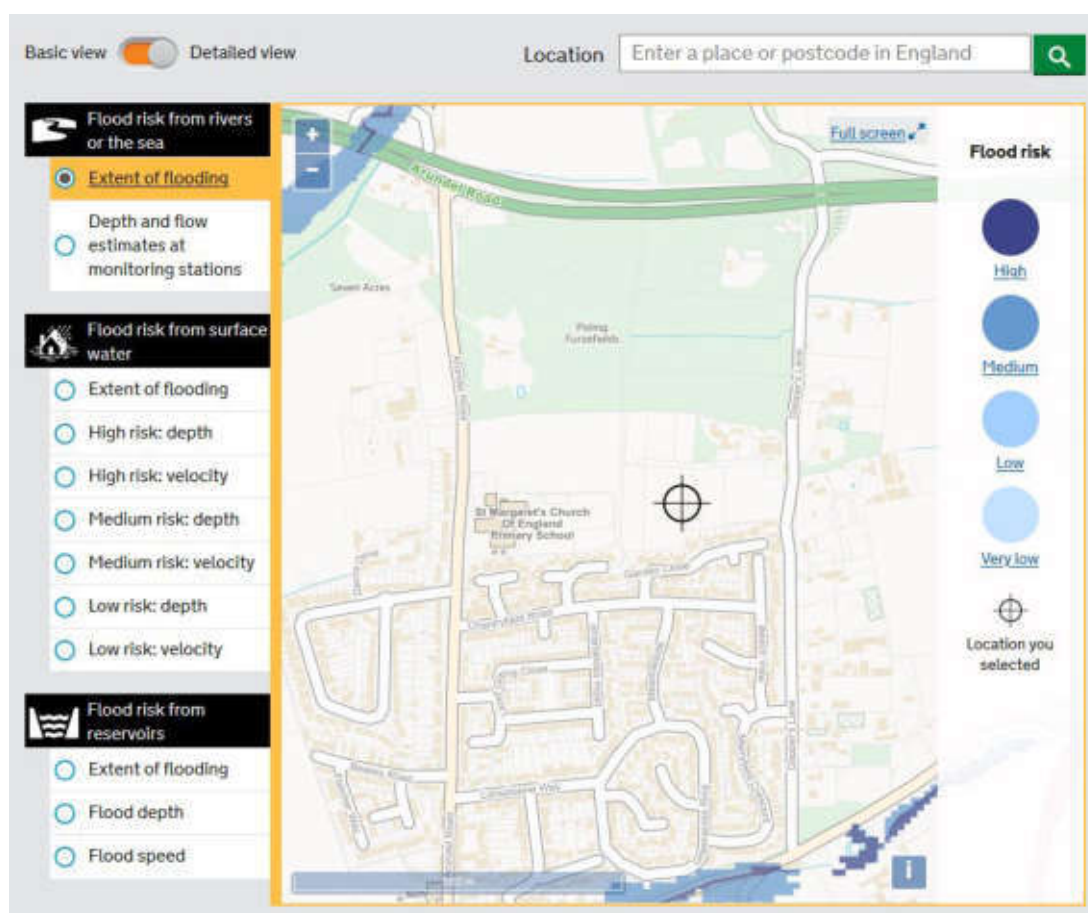


Figure 8. Long-Term Flood Risk Map (Rivers or the Sea)

2.2.3 The Long-Term Flood Risk Map for Surface Water (**Figure 9**) shows that the site is largely at 'Very Low' risk of surface water flooding. Small areas to the south-western corner as well as along the western boundary are shown as being at 'Low' risk of surface water flooding, whilst Dappers Lane is shown to range from 'Low' to 'High' susceptibility to surface water flooding. As stated in 1.5.4, this is owing to the fact Dappers Lane acts as a natural flow route for surface water. This information is consistent with that provided by WSCC.

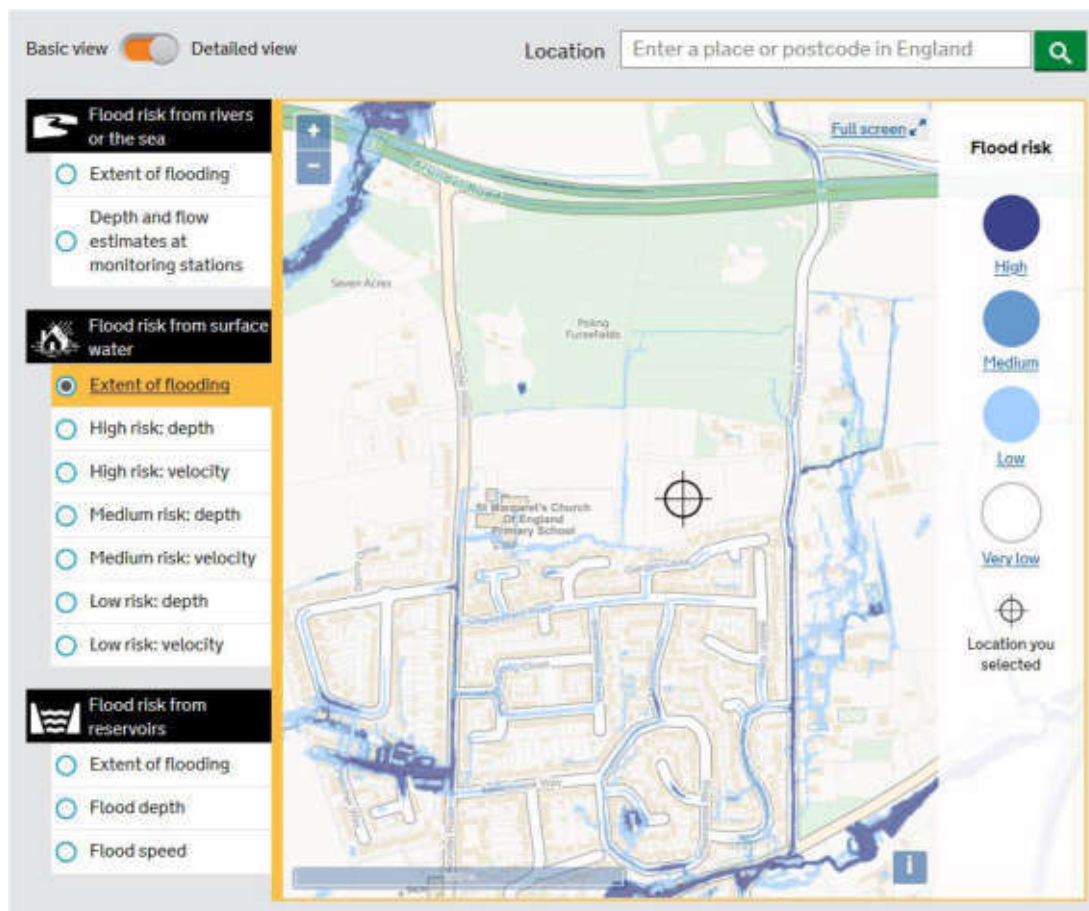


Figure 9. Long-Term Flood Risk Map (Surface Water)

- 2.2.4 In view of the potential areas stated to be at 'Low' risk of surface water flooding on site, 'Low Risk Scenario' Long-Term Surface Water Flood Map has been reviewed, in order to ascertain the likely depths of associated flooding in a 'Low' risk scenario.
- 2.2.5 The anticipated depth of surface water flooding in a 'Low' risk scenario is stated to be 'Below 300mm', as demonstrated in **Figure 10**, below.

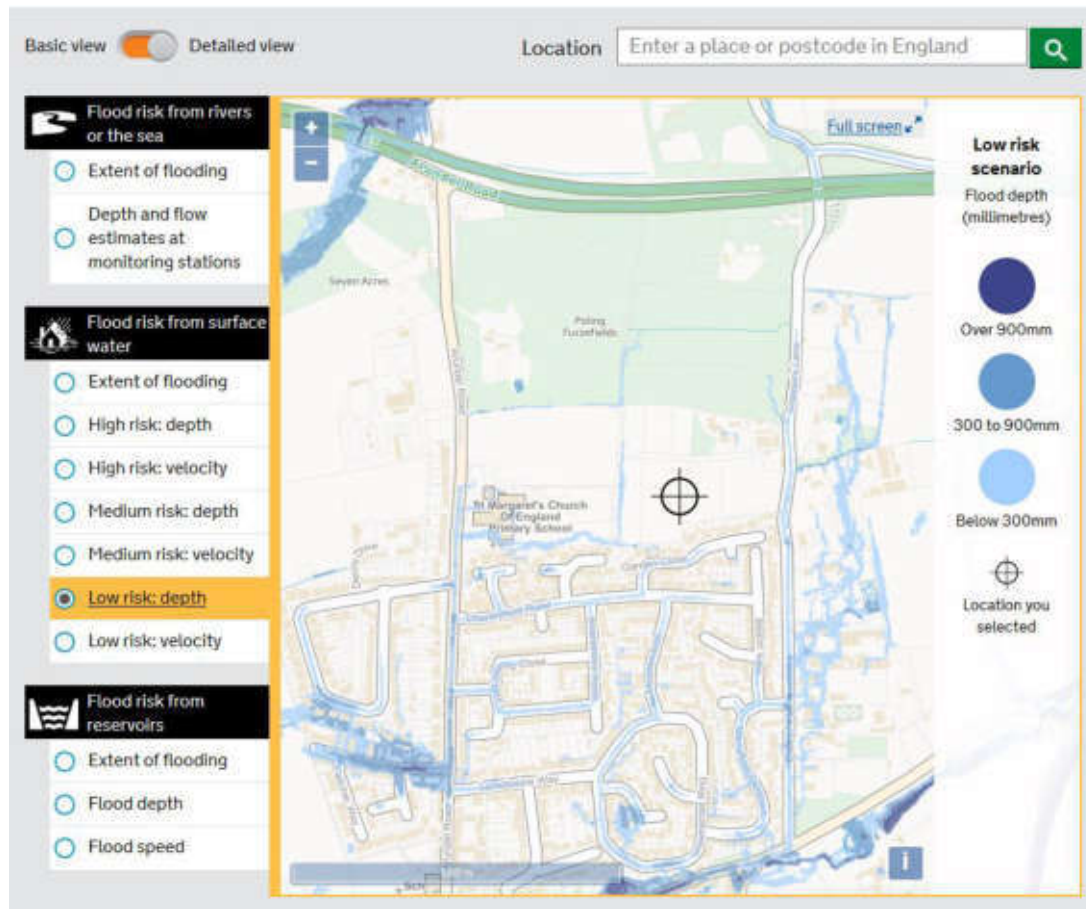


Figure 10. Long-Term Surface Water Flood Map – Low Risk Depths

2.2.6 The Long-Term Flood Risk Map for Reservoirs (**Figure 11**) demonstrates that the site is not stated to be at risk of flooding from such sources.

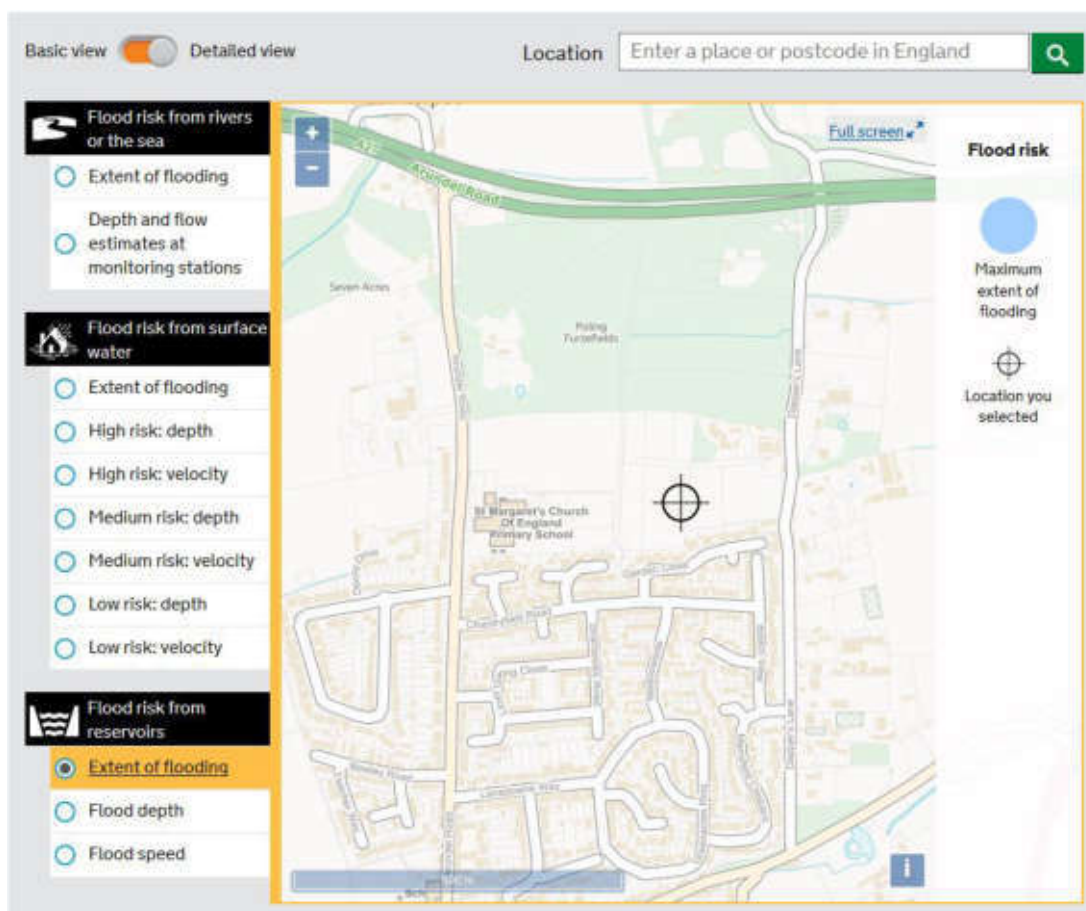


Figure 11. Long-Term Flood Risk Map - Reservoirs

2.3 Strategic Flood Risk Assessment

- 2.3.1 The site falls within the boundaries of West Sussex County Council (WSCC) and Arun District Council (ADC).
- 2.3.2 WSCC has published a Strategic Flood Risk Assessment, dated January 2010. In addition to this, WSCC has also published a Local Flood Risk Management Strategy (May 2014). Flood mapping and information obtained therein is consistent with other flood maps reviewed and detailed within this report. The site is not specifically referenced within the report.

2.4 Historic Flooding

- 2.4.1 ADC, WSCC and the Environment Agency have all confirmed that they are not aware of any historical flooding within the confines of the site. WSCC has advised, however that this may not mean that flooding has not occurred, simply it has not been reported to them as LLFA. It has been confirmed that Dappers Lane has experienced instances of flooding historically on more than one occasion. The Environment Agency is currently looking at historical flooding in Angmering Village as part of a study concerning The Black Ditch (Main River).

2.5 Summary of Flood Risk

2.5.1 The potential sources of flooding are:

Source of Flooding	Level of Risk
Rivers and Coastal	Very Low The site is located within Flood Zone 1 and is not indicated as being at risk from such sources of flooding. Long-Term Flood Maps (Rivers or the Sea) do not indicate a risk of flooding from either source.
Surface Water	Very Low to Low The Long-Term Flood Risk Maps (Surface Water) indicate the site to be, largely, at 'Very Low' risk of surface water flooding, although areas to the south and south-west of the site are indicated as being at 'Low' risk. In the 'Low' risk scenario, anticipated flood depths are stated to be 'Below 300mm'. Dappers Lane is indicated to be at increased risk of surface water flooding, however, this is not anticipated to have adverse effects upon the site, given the natural topography.
Groundwater	High JBA Groundwater Mapping provided by ADC and WSCC states that the risk of potential groundwater flooding is 'negligible'. On-site investigation and monitoring however contradicts this. Additional groundwater monitoring was undertaken between November 2019 and January 2020, confirming groundwater at ground level, or shallow depths (0.15m to 0.40m below ground level).
Sewers	Low No historic instances of sewer flooding have been identified, and no sewers are understood to exist within the bounds of the site.
Artificial Sources	None The site is not shown to be at risk of flooding due to artificial sources.

2.5.2 Groundwater flooding is indicated as being the most prevalent risk of potential flooding at the site, whilst, although stated as 'Very Low' to 'Low' risk, consideration should be given to towards potential surface water flooding.

2.5.3 Mitigation will need to be provided in view of all potential risks of flooding to ensure that the risk of flooding is not increased either on, or off site, as a result of the development.

2.5.4 The development should remain safe from all sources of flooding for its intended design life.

3 PROPOSED DEVELOPMENT

3.1 Description of Development

- 3.1.1 The proposed development will involve the construction of 84 No. residential properties, inclusive of hard landscaping in the form of estates roads - both private and shared parking areas, and soft landscaping, as demonstrated by the architectural development proposals contained within **Appendix A**.
- 3.1.2 The type of development falls within the 'More Vulnerable' classification (Flood Risk and Coastal Change Table 2) and is appropriate in Flood Zone 1 (Flood Risk and Coastal Change Table 3).

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	Exception Test Required	✓	✓	✓
Flood Zone 3a†	Exception Test Required †	✗	Exception Test Required	✓	✓
Flood Zone 3b*	Exceptions Test Required *	✗	✗	✗	✓*
✓ = Development is appropriate ✗ = Development should not be permitted					

- 3.1.3 The proposed development relates to land which is currently un-developed, with no existing areas of hardstanding impermeable areas. The proposed development involves the creation of new impermeable areas and will therefore increase the rate, and/or volume, of run-off generated by the site.
- 3.1.4 The post-development impermeable areas have been determined to be in the region of 15,758m² (1.58Ha).
- 3.1.5 The use of Sustainable Drainage System (SuDS) methods and techniques (where site conditions and constraints allow) within the bounds of the site (whilst adhering to the SuDS hierarchy as stated within Building Regulations (Part H) and The CIRIA SuDS Manual C753) will be used to provide a betterment of surface water run-off compared to the existing site.
- 3.1.6 The specific Surface Water and Foul Water drainage proposals are detailed in **Section 4** of this report.

4 PROPOSED DRAINAGE STRATEGY

4.1 Surface Water

4.1.1 The SUDS manual and Building Regulations set out a hierarchy of drainage methods to ensure that developments maximise the use of sustainable drainage techniques. The hierarchy favours infiltration methods of disposal over other methods such as watercourse and sewers, as detailed below;

- i. Utilise infiltration techniques
- ii. Attenuate rainwater in ponds or open water features for gradual release
- iii. Attenuate rainwater by storing in tanks or sealed water features for gradual release
- iv. Discharge rainwater direct to a watercourse
- v. Discharge rainwater to a surface water sewer/drain
- vi. Discharge rainwater to a combined sewer

SUDS Technique	Suitable	Comments
Living Roof	Yes	No initial constraints identified, although may not be suitable owing to client's preference and development proposals.
Basins and Ponds (such as Constructed Wetlands, Balancing Ponds, Detention Basins, Retention Ponds)	Yes	The associated land take of such features has been considered in the proposed site arrangement to allow for the inclusion of a SuDS pond.
Filter strips and swales	Yes	No current constraints have been identified which would limit the use of such techniques.
Infiltration Devices - Soakaways - Infiltration trenches and basins	No	Infiltration testing undertaken at the site indicates that the underlying geology would not be conducive in terms of allowing infiltration to occur at a rate which would mean infiltration methods and techniques are viable to support the development. Groundwater at depths ranging from ground level to 0.40m below ground level have also been recorded (further to monitoring between November 2019 and

		January 2020), which, in agreement with ADC, means infiltration is not viable at the site.
Permeable surfaces and filter drains - Gravelled areas - Porous block paving	Yes	As referred to above, ground conditions will impact the use of infiltration methods and techniques. Permeable paving is to be considered as a 'tanked' solution.
Tanked systems - Oversized pipes - Cellular tanks	Yes	These techniques could be utilised, however the LPA has stated a preference for more sustainable drainage methods and techniques to be implemented, adhering to the drainage hierarchy as outlined, above (4.1.1)

- 4.1.2 It is proposed that permeable paving will be introduced to provide high-level attenuation at the site – to support trafficked areas of the site, including private and shared parking areas. In view of the groundwater monitoring undertaken, permeable paving will be 'tanked' on site, as infiltration is not viable, and groundwater may otherwise inundate the available storage.
- 4.1.3 Wider attenuation will be provided on site in the form of a SuDs pond, which will be located to the south-west of the corner of the development. It is proposed that a connection to the watercourse which runs along the southern boundary of the site be will made as a means of connecting to the culverted watercourse to the south-west of the site. This watercourse has been confirmed as linking with the 225mm dia. culvert to the south-west of the site, where the head of the run has been identified within the grounds of No. 4 Garden Close. The culvert discharges to a highway drain in Arundel Road via an existing manhole. The existing watercourse will be improved – with the channel re-graded and re-defined in order to provide a greater ability to convey flows. The existing headwall to the culvert will be re-constructed as part of the wider works, in order to formalise and improve the existing arrangement. Following the additional groundwater monitoring undertaken on site, in agreement with ADC, it is proposed that the pond will be lined with an impermeable membrane/liner as so to avoid groundwater ingress and loss of available storage.
- 4.1.4 It has been identified that improvement works will be required in relation to the existing culvert, if a connection is to be utilised. This is owing to the fact that the CCTV survey conducted by EEG (Ultraflow) of the culvert and its connectivity has highlighted issues such as intruding masonry, breaches, as well as displaced joints and blockages. ADC has stated a programme of recommended works to repair the culvert, which will be fully assessed during detailed design stage.
- 4.1.5 A second proposal has been identified whereby a surface water sewer could be constructed through the grounds of St. Margaret's Church of England Primary School, to connect to the same manhole to which the existing culvert outfalls to. This option would require either third party consent from the school, and/or a Section 98 Sewer Requisition through Southern Water.
- 4.1.6 In view of the impermeable area at the site, and the existing greenfield run-off rates, the pond on site has been sized in order to provide attenuation as so that greenfield run-off rates will not be exceeded.
- 4.1.7 A pond to the order of 653m² (at base) with 1:3 sloping sides will be provided. The pond will also be lined to mitigate the risk of groundwater ingress.
- 4.1.8 Permeable paving covering a plan area totalling 3,500m² will provide an additional 'high level' volume

of storage, totalling 504m³ with a sub-base depth of 450mm and 32% voids.

- 4.1.9 Flows will be restricted as so not to exceed 13.6l/s (existing greenfield run-off rates), whilst a betterment is infact proposed (10.0l/s).
- 4.1.10 A connection to the open watercourse, and ultimately the culverted watercourse, will be subject to approval from ADC and WSCC, further to an Ordinary Watercourse Consent (OWC) application.
- 4.1.11 It is proposed that all captured run-off from the proposed areas of hardstanding will be accommodated within a design criteria of a 1-in-100-year storm event, inclusive of an allowance of 40% where climate change is concerned – without exceedance.
- 4.1.12 The strategy proposed will ensure that there is no increase in the rate of run-off leaving the site, therefore no increase in the risk of flooding.
- 4.1.13 A second option has been prepared whereby a new connection to the same outfall location in Arundel Road can be implemented, via a new (requisitioned) sewer through the ground of St. Margaret's Church of England Primary School. The principles in terms of storage provision and wider strategy will remain the same as with the 'primary' option.
- 4.1.14 The proposed surface water drainage strategies (Option 1 and Option 2) are demonstrated on drawings PL300 and PL301, included within this report.

4.2 Treatment

- 4.2.1 The use of permeable paving will ensure that run-off from the site receives a level of treatment required by the SuDS manual, with hydrocarbons being filtered by the aggregate and geotextile layers.
- 4.2.2 In accordance with the CIRIA SuDS Manual C753 regarding methods for managing pollution risks, the risk posed by surface water runoff to the receiving environment depends on the pollution hazard at the site (the source), SuDS treatment techniques (the pathway), and the sensitivity of the environment (the receptor).
- 4.2.3 The simple index approach considers whether SuDS techniques are appropriate for the site. The states that for SuDS components to deliver adequate treatment, the total pollution mitigation index for each contaminant type should equal or exceed the pollution hazard index.
- 4.2.4 The SuDS Manual outlines three categories of pollution hazard identification, which vary depending on proposed land use, which are as follows:
 - Total Suspended Solids (TSS).
 - Metals (M).
 - Hydrocarbons (H).
- 4.2.5 In accordance with C753 Table 26.2, the proposed land uses at the site are categorised as follows:
 - Residential Roofs – Very Low/TSS=0.2/M=0.2/H=0.05
 - Individual Property Driveways/Low Traffic Roads - Low/TSS=0.5/M=0.4/H=0.4

4.2.6 In accordance with C753 Table 26.3, the values of SuDS Mitigation indices are provided for permeable paving:

- Permeable Pavement – TSS=0.7/M=0.6/H=0.7
- Pond – TSS=0.7/M=0.7/H=0.5

4.2.7 As the pollution hazard index does not exceed any pollution mitigation index for any contaminant type, the proposed SuDS methods will provide sufficient treatment for the proposed development.

4.3 Foul Water Drainage

4.3.1 It is apparent that a connection to the existing public foul water sewer located in Garden Close, to the south of the site, is not viable, owing to any potential routing being restricted by existing development.

4.3.2 It is proposed that a connection will be made to the public foul water sewer located in Arundel Road, to the west of the site.

4.3.3 In order to establish a connection to the public foul water sewer located in Arundel Road, a route will need to be established through the grounds of St. Margaret's Church of England Primary School. It is recommended that the developer seeks to reach an agreement directly with the school, as a third-party landowner. Alternatively, a Section 98 Sewer Requisition could be implemented as a means of establishing the required connection.

4.3.4 Post development, there will be an estimated increase in peak foul water flows to 3.89l/s (based on Sewers for Adoption 7th Edition – 4000l/day).

4.3.5 Recent changes to infrastructure and connection charges (OFWAT Charging Rules) place the onus on the sewerage undertaker to reinforce their network should there no longer be sufficient capacity to serve the new development. Funding for this is provided by revised charging arrangements for infrastructure and connection charges for each dwelling constructed comprising a Network Reinforcement Charge and Site-Specific Charges. The revised charging arrangement (funded by the developer) covers alterations to the Existing Sewer Network and the sewerage undertaker remains responsible for the cost of reinforcing their Strategic Assets. The developer is responsible for connecting the development to the public sewer network.

4.3.6 The proposed foul water drainage strategy is demonstrated on drawings XXX and XXX, included within this report.

4.4 Climate Change

4.4.1 In February 2017 the Environment Agency updates the latest climate change allowances (available online at <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>), which supports the NPPF in making an allowance for climate change within flood risk assessment. The allowances provide predictions of anticipated change for peak river flow by river basin district and peak rainfall intensity.

4.4.2 The table below shows the anticipated changes in extreme rainfall intensity. For flood risk assessments, both the central and upper end allowances should be assessed to understand the range of impact.

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

- 4.4.3 Based on the latest allowances, an increase of 20% should be applied to peak rainfall to this development, with a review undertaken to determine the impact of a 40% increase.

4.5 Urban Creep

- 4.5.1 Based upon the assumption that there will be an urban creep on new developments through their lifetime, an allowance for potential urban creep should be considered.
- 4.5.2 In view of West Sussex County Council's 'Policy for the Management of Surface Water', dated 27th November 2018, an allowance of 8% has been included for the potential expansion of impermeable area(s) on site across the development's design life.

5 RESIDUAL RISK AND MITIGATION

5.1 Residual Risk

5.1.1 The following residual risks have been identified in relation to the proposed development:

- i. Extreme rainfall events that exceed the design criteria used for the drainage system causing surface water flooding.
- ii. Blockage/failure of the proposed drainage system causing flooding to the site.
- iii. Groundwater flooding to the site caused by groundwater levels exceeding the ground surface level.
- iv. Risk of surface water flooding.

5.2 Mitigation

5.2.1 Consideration has been taken to the residual risks stated in Section 5.1, and the following mitigation measures are proposed:

- The drainage strategy has been developed to capture run-off up to a 1 in 100-year critical rainfall event, with 40% allowance for climate change. However, should a more extreme rainfall event occur, there is the potential for the drainage system to be exceeded. In the event of exceedance, surface water run-off would follow the natural topography of the site – which falls, largely, from north/north-east to south/south-west. Improvements to the existing ditch(es) to the south of the site are proposed, which would see re-profiling and re-grading works undertaken. As a result of these works, an increased capacity within the channel will be provided which will assist in capturing exceedance flows and reducing the risk of flooding to the south of the site. On site level design will acknowledge the topography of the site and look to provide containment within the bounds of the site.
- The proposed drainage system will attenuate run-off up to the design event (1 in 100-year storm event, inclusive of an allowance of 40% for climate change). Blockage of drainage system components has the potential to cause flooding on the site. Surcharged flows will likely 'back-up' on site, ponding at lower-lying levels, however maintenance measures proposed in Chapter 8 will mitigate the risk of the system becoming blocked.
- Peak, seasonal groundwater levels (winter) have been confirmed at depths ranging from ground level to 0.40m below ground level. In view of such, it is proposed that finished floor levels should be set at least 300mm above existing ground level, in order to provide freeboard in view of current groundwater levels. Permeable paving will be tanked, whilst the proposed pond will be lined in order to ensure groundwater does not detract from the proposed level of storage of each.

- Long-Term Flood Risk Maps for surface water indicate that areas of the site are perceived to be at 'Low' risk of surface water flooding. The associated anticipated depths of flooding in a 'Low' risk scenario are stated to be 'Below 300mm'. This should be considered in view of level design, and the provision of finished floor levels.

6 SEQUENTIAL AND EXCEPTION TESTS

6.1 Sequential Test

- 6.1.1 The site is located fully within Flood Zone 1 and is deemed to be a 'Low' risk of flooding. In view of this, the application of the sequential test is not required.

6.2 Exception Test

- 6.2.1 The proposed development is appropriate for Flood Zone 1 and appropriate drainage measures have been proposed to ensure flood risk is not increased elsewhere. In addition, appropriate surface water flood risk mitigation measures have been proposed to prevent inundation from a surface water flood path during a storm event.
- 6.2.2 The application of the exception test is not required.

7 FLOOD RISK MANAGEMENT

7.1 Safe Access and Egress

- 7.1.1 The proposed development falls entirely within Flood Zone 1 and is expected to remain in that zone throughout its design life.
- 7.1.2 The site is confirmed as being at low risk of surface water flooding and, in view of such, the risk of access and egress being affected by flooding is low.
- 7.1.3 Dappers Lane has been confirmed as having experienced flooding historically and is demonstrated as being at 'Low' to 'High' risk of surface water flooding. The site itself is situated on land which is elevated higher than Dappers Lane, therefore the risk of flooding on site is unlikely, as confirmed by flood risk mapping reviewed.

8 MAINTENANCE

8.1 Proposed Maintenance Regime

8.1.1 Maintenance is required to ensure the long-term operational performance of the proposed surface water drainage system.

8.1.2 The drainage system has been designed to minimise maintenance requirements, however, a number of key tasks will need to be undertaken so that the system remains in optimal condition. These operations are summarised in the table below, along with the required frequency of works.

Drainage System feature	Proposed maintenance / remedial works	Required frequency of works
Pond	Inspection, vegetation clearance and additional clearing/cleansing of potential surface blockages	At least once a year
	Inspection and clearance of blockages	After major storm events
Inlet, Outfall & Existing Watercourse	Inspection, vegetation clearance and additional clearing/cleansing of potential outfall blockages	At least once a year
	Desilting	Year 1, Year 3, then every 5 years
Permeable Paving	Surface sweeping to reduce silt and debris accumulation.	Every 8 to 12 weeks
	Removal / management of weed growth	At least once a year
	Silt removal from permeable surfaces, possibly involving raking out of joints, redressing, removal and remedial works.	As required / to be specified by manufacturer
Diffuser units & catch pits, gully sumps and drains	Inspection and additional cleansing as required.	Annual
	Desilting	Year 1, Year 3, then every 5 years
Pipework	Jetting to clear blockages	As required

8.1.3 The responsibility of maintenance regime will be determined by the Developer, by agreed appointment.

Permeable Paving / Diffuser Units

8.1.4 The areas of permeable paving are designed to allow surface water run-off to percolate through the joints in the block paving surface course and into the sub-base below. The water is then collected and discharged into the positive drainage system.

8.1.5 As part of the permeable paving system, diffuser units are used to discharge surface water run-off from roof areas into the sub-base, as well as forming links between areas of permeable paving. These diffuser units are small heavy-duty cellular units which allow more efficient discharge of surface water into the sub-base base of the permeable paved areas.

8.1.6 The areas of permeable paving will require additional maintenance measures to ensure they operate as designed. Failure in carrying out this maintenance, could increase the risk of flooding. The additional measures are as follow:

- Periodic surface sweeping to reduce silt and debris accumulation. The permeable surfaces should be swept at least every 8 to 12 weeks with additional sweeps in the autumn to clear fallen leaves
- Removal / management of weed growth, as required. Typically, once or twice a year for regularly used areas
- Periodic silt removal from permeable surfaces as described by the manufacturer. If any areas are showing signs of ponding, they shall be dealt with by raking out the joints and redressing. The entire surface shall be monitored and when there are signs of excessive siltation resulting in poor drainage over the whole area, the blocks shall be taken up and a replacement of bedding layer and geotextile shall be undertaken
- Redressing of joints on the block paving as required
- Catchpits upstream of diffuser units, should be emptied and inspected on the same regime as all catchpits specified previously set out in this document

Ponds and Watercourses

- 8.1.7 It is important that the level of siltation within the pond is monitored and an appropriate programme is informed in order for this to be removed, as so not to reduce the volume of storage provided by the pond, which serves the development.
- 8.1.8 All inlets and outlets associated with the pond should also be monitored to ensure that blockages do not occur, which could increase the risk of flooding on site.
- 8.1.9 The Riparian Owner is responsible for the ongoing maintenance of any watercourse. As the existing watercourse to the south of the site is to be retained – and improved, Riparian ownership responsibilities should be adhered to. This is likely to include ensuring all sections of the watercourse are free-flowing and are also de-silted at periodic intervals. Failure to do so could result in an increased risk of flooding upstream and/or downstream of the site.

Flow Control Chambers/Devices

- 8.1.10 A flow control chamber (such as a HydroBrake or Crown Vortex Flow Control) or device is self-activating, relying on upstream hydraulic head to generate an air-filled vortex within the centre of the casing. Once the vortex is initiated water drains down through a small opening in the back of the device at the designed restricted flow rate.
- 8.1.11 The flow control device has two measures encase of emergency (i.e. blockage). The first is a door situated in the front of the unit itself, this can be operated from the surface by a release cable situated just under the manhole cover which closes under its own weight and does not require any mechanism to operate. The second is a high-level overflow pipe situated with the flow control manhole. Both measures allow the system to drain down freely, until the blockage can be cleared.
- 8.1.12 The flow control chamber will require additional maintenance measures to ensure it operates as designed. The additional measures are as follows:
- The sump within the flow control chamber should be monitored for build-up of silts and should be emptied, as a minimum, on the same regime as specified for catchpits previously within this document

- The drain down door located on the centre of the unit will require inspection and opening annually, to ensure it is operating as intended

8.1.13 Should infiltration not be viable further to additional groundwater monitoring and infiltration testing, and the permeable paving on-site is 'tanked' each area of permeable paving will be served by an orifice plate, restricting flows to the SuDS pond, and maximising upstream storage within the permeable paving provisions.

Remedial/Repair Actions

8.1.14 Significant storm events may cause considerable damage to SuDS and their associated components. As such, it may be necessary to inspect and carry out essential recovery works to return the feature to full working order.

8.1.15 Resetting of uneven blocks by lifting block area, removing bedding material and relaying to match original design are all actions which may need to be undertaken.

Accidental Spillages

8.1.16 It is not envisaged that any materials are to be stored onsite once the development has been completed, which could cause major spills and potential pollution issues within the drainage system. If this situation alters in the future consultation with a specialist will be required in order to confirm if any upgrades to the existing system are necessary.

8.1.17 Minor spillages of fuels and oils will be dealt with by the permeable paving and deep trapped gullies, by bio-degrading and collecting the hydrocarbons respectively.

Future Alterations to the Development

8.1.18 Any future alterations to the permeable paving should be confirmed by a specialist. Where possible any future services are to avoid being located through areas of permeable paving. If new services are required to run through areas of permeable paving, services should be installed below the depth of permeable paving with the permeable system reinstalled above.

9 OFFSITE IMPACTS

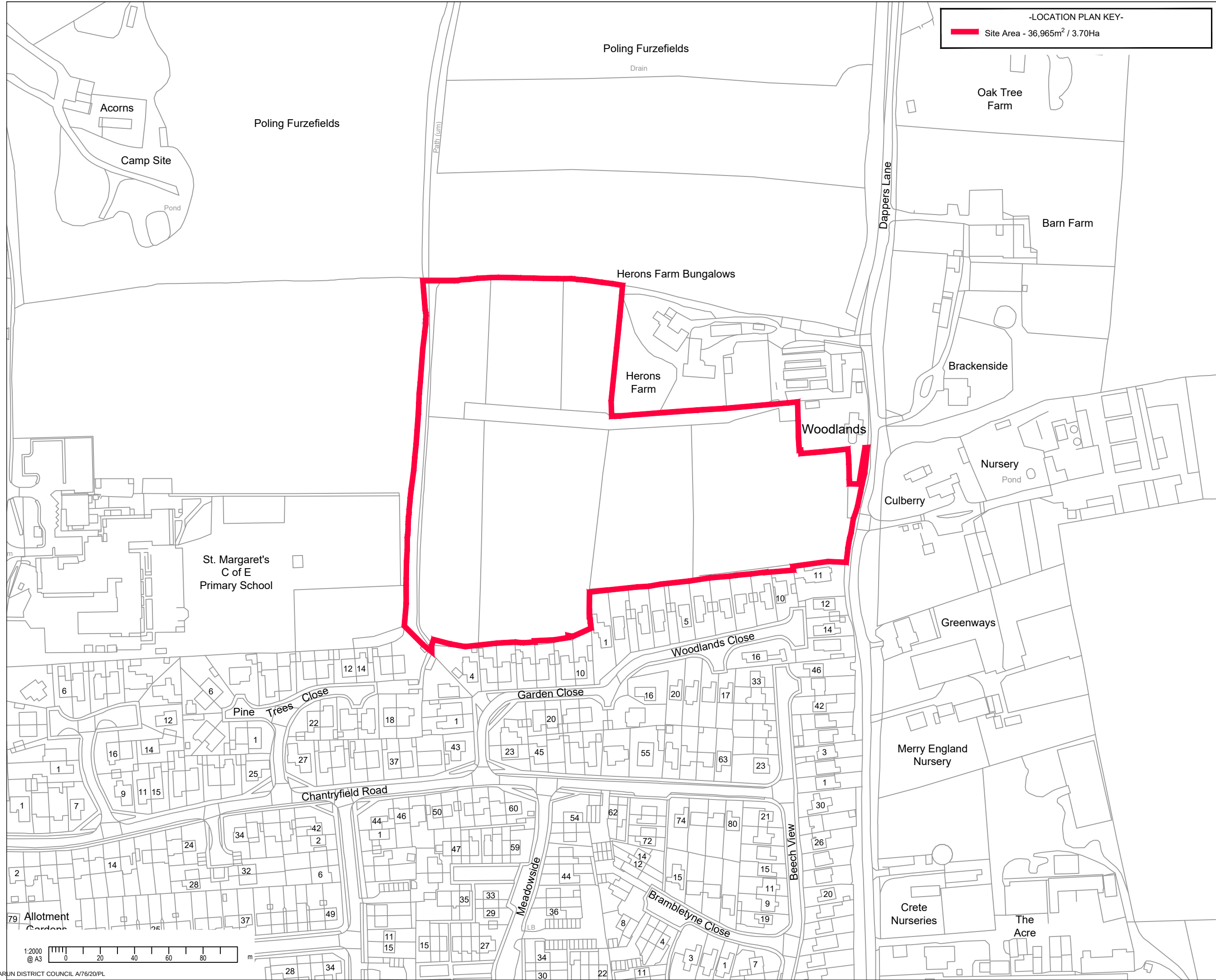
- 9.1.1 The proposed development will not result in any increase in run-off from the site, and therefore will not cause an increase in flood risk offsite.
- 9.1.2 Post development foul water flows will contribute an increase to the sewer network compared to the previous use – it is expected that the foul sewer flow will be 3.89l/s, however, as established in Section 4.3 (Foul Water Drainage) through development and infrastructure charges, Southern Water are responsible for ensuring that capacity exists within their network in order to support development.
- 9.1.3 The effects of climate change have been considered in the design of the proposed surface water drainage system, to ensure there is no off-site impact.

10 SUMMARY

- 10.1.1 This site-specific flood risk assessment is based on ADC and WSCC drainage records, BGS geology maps and records, on-site investigation conducted by EEG (Ultraflow), LEAP Environmental and Midland Survey Ltd, Long-Term Flood Risk Maps, Southern Water public sewer records and WSCC's Strategic Flood Risk Assessment.
- 10.1.2 The site is currently an undeveloped greenfield site with no existing hardstanding impermeable areas.
- 10.1.3 The proposed development will see an impermeable area totalling 15,758m² (1.58Ha).
- 10.1.4 Surface water run-off generated by the impermeable areas introduced further to development will be dealt with via sustainable means.
- 10.1.5 Additional groundwater monitoring between November 2019 and January 2020 has confirmed groundwater at depths ranging from ground level to 0.40m below ground level. Infiltration methods and techniques have therefore been deemed to be unviable.
- 10.1.6 Attenuation will be provided in the form of tanked permeable paving along with the provision of a pond (which will be lined in order to prevent groundwater ingress).
- 10.1.7 Flows off site will be restricted to mimic greenfield rates – although a betterment is proposed.
- 10.1.8 An Ordinary Watercourse Consent will be required for surface water flows to discharge to the existing ordinary watercourse located to the south of the site. This will also support the improvement works proposed in relation to the existing ditch(es).
- 10.1.9 Foul flows will discharge to the public foul water sewer located in Arundel Road, subject to Section 106 consent from Southern Water. A Section 98 Sewer Requisition may be required if third party agreement cannot be obtained from St. Margaret's Church of England Primary School.
- 10.1.10 Peak foul flows are anticipated to be in the region of 3.89l/s, based on Sewers for Adoption 7th Edition (4000l/day).
- 10.1.11 The development lies within Flood Zone 1 and it is expected to remain unchanged for the duration of the development's life expectancy.
- 10.1.12 The design criteria accommodates a 1 in 100-year storm event, inclusive of an allowance of 40% for climate change. Consideration has also been given to potential 'urban creep' across the design life of the development, to allow for increases in impermeable area and increased surface water run-off within the system.
- 10.1.13 The completion of the development will not increase flood risk on or offsite.
- 10.1.14 In conclusion, this development is suitable with regards to flood risk and surface water drainage.



DRAWINGS



NOTES

A3

1. This drawing is to be read in conjunction with all other RGP Design drawings, and with all relevant Architect's and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.

2. RGP Design accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.

3. Do not scale, work to figured dimensions only. All dimensions are in millimeters unless noted otherwise and all levels are in metres from the topographic survey datum.

4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain.

N

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		Original issue
Rev.	Date	Amendments

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Client

Persimmon Homes

Project

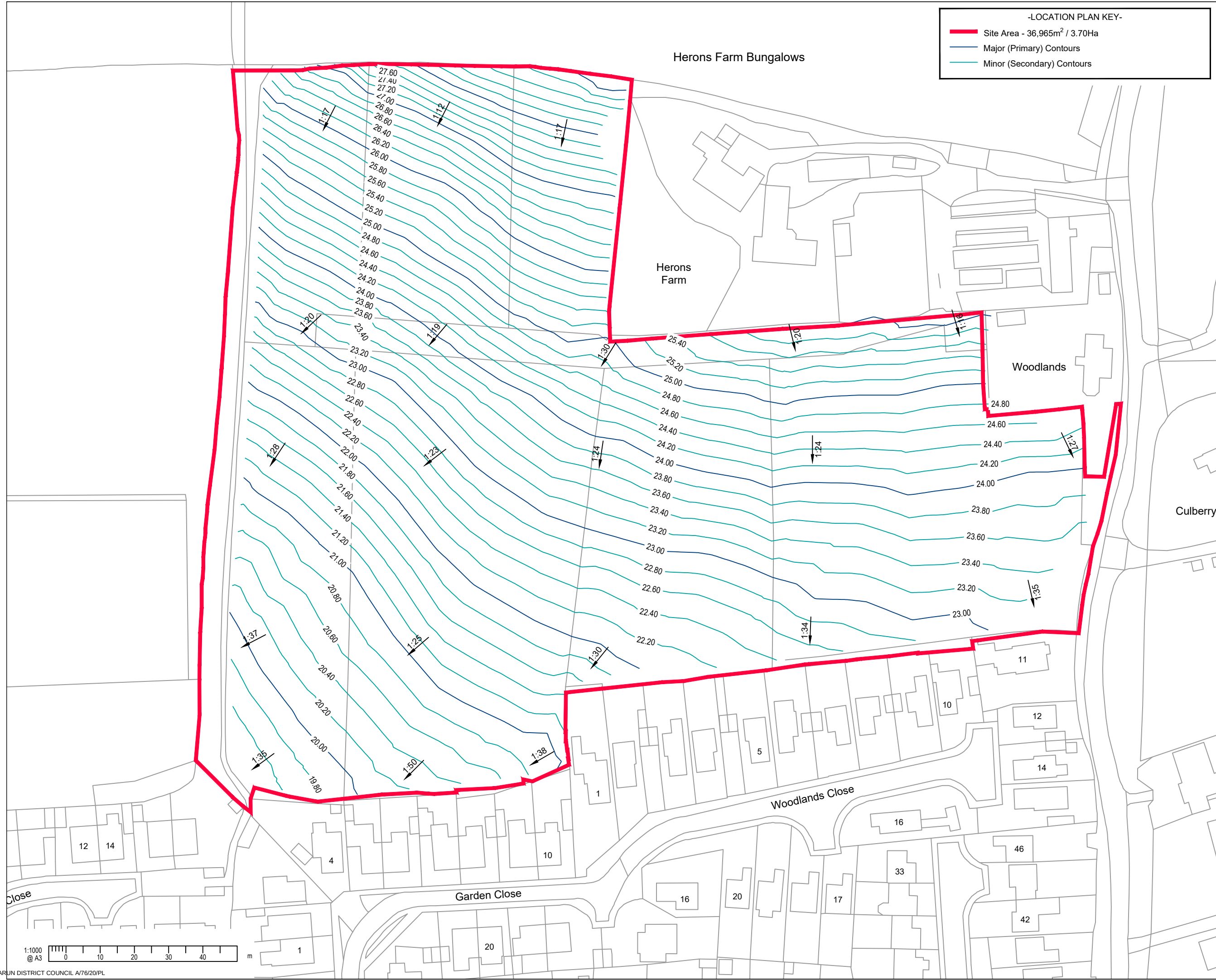
Land at Dappers Lane, Angmering, West Sussex BN16 4EW

Drawing Title

Site Location Plan

Scale	1:2000	Drawn By	SPB	Checked By	MJA	Approved By	MJA
Date	November 2019	Drawing No.	DI260-PL100		Rev.	-	

ARUN DISTRICT COUNCIL A/76/20/PL



-LOCATION PLAN KEY-

- Site Area - 36,965m² / 3.70Ha
- Major (Primary) Contours
- Minor (Secondary) Contours

NOTES

A3

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-	19/11/2019	Original issue
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Land at Dappers Lane,
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Drawing Title
Existing Contours

Scale 1:1000	Drawn By SPB	Checked By MJA	Approved By MJA
Date November 2019	Drawing No. DI260-PL101	Rev. -	



-IMPERMEABLE AREA KEY-

Existing Impermeable Area (0.00m² / 0.00Ha)

Proposed Impermeable Area (15,758m² / 1.58Ha)

NOTES

A3

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C	03/09/2020	Minor adjustment to layout
B	31/03/2020	Minor adjustment to layout
A	18/02/2020	Minor adjustment to layout
-	19/11/2019	Original Issue
Rev.	Date	Amendments



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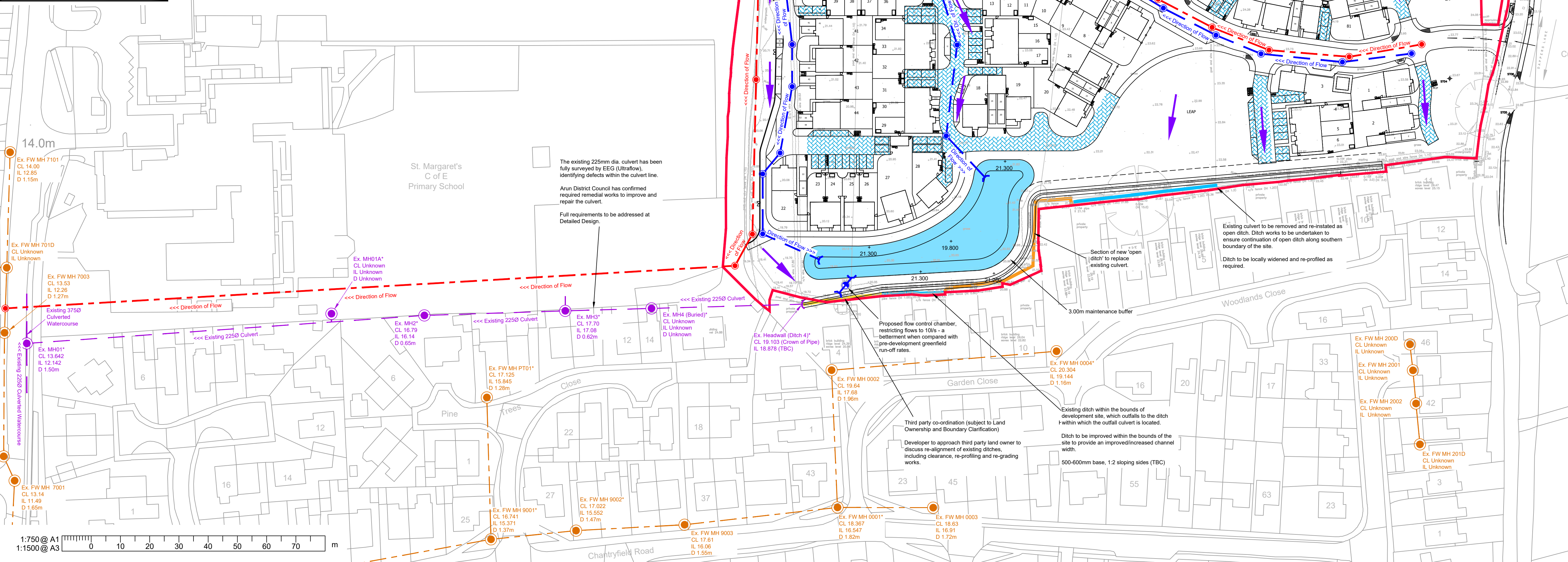
Project
Land at Dappers Lane,
Angmering, West Sussex BN16 4EW

Drawing Title
Impermeable Areas Comparison

Scale	1:1000	Drawn By	SPB	Checked By	MJA	Approved By	MJA
Date	November 2019	Drawing No.	DI260-PL200	Rev.	C		

- SURFACE WATER DRAINAGE-**
- Surface water disposal should be managed in view of the SuDS hierarchy;
 - Infiltration
 - Watercourse
 - Public Surface Water Sewer(s)
 - Preliminary infiltration test results indicate that infiltration is unlikely to be viable. In addition to this, initial groundwater monitoring results (March to May 2019) indicate groundwater at shallow depths.
 - Additional groundwater monitoring is to be conducted between November 2019 and March 2020, with readings to be assessed in January and February 2020 in order to verify whether additional infiltration testing will be required (subject to confirmation of 'peak' winter groundwater levels).
 - The surface water drainage strategy will utilise a connection to the 225mm dia. culverted watercourse located to the south-west of the site. The culvert has been fully surveyed by EEG (Ultraflow), whilst Arun District Council has been provided with the subsequent results, advising of necessary improvements and repairs to the culvert, should this connection be established.
 - The proposed improvements and repairs to the existing 225mm dia. culvert are to be fully evaluated at detailed design stage.
 - It is proposed that high level attenuated storage will be provided in the form of TANKED permeable paving (if infiltration is further proven to be unviable, owing to ground conditions and groundwater levels).
 - Permeable paving covering a plan area totaling 3,500m² will provide a volume of storage to the order of 504m³ (based on a 450mm sub-base, and 30% voids).
 - In addition to permeable paving, further attenuated storage will be provided in the form of a POND, which will be located to the south of the site.
 - The proposed attenuation pond has been sized to encompass 653m³ (base) with 1:3 sloping sides.
 - Flows will discharge from the attenuation pond to the open watercourse, located to the southern boundary of the site. Improvements to this section of watercourse are proposed as part of the overall development, including co-ordination with third party landowners downstream, where the existing headwall is located for the head of the culvert run.
 - Flows will be attenuated, to ensure that there is no increase in the rate of run-off leaving the site - greenfield run-off rates have been confirmed to be 13.6l/s, whilst it is proposed post-development flows will be restricted to 10l/s.
 - An Ordinary Watercourse Consent (OWC) application will need to be submitted to Arun District Council in order for flows to discharge to the open watercourse/culverted watercourse.
 - The surface water drainage strategy has been designed to accommodate a 1-in-100-year critical storm event, inclusive of an allowance of 40% where climate change is concerned.
 - An additional allowance has been made in view of Urban Creep, further to West Sussex County Council's 'Policy for the Management of Surface Water'.

- FOUL WATER STRATEGY-**
- Foul water disposal should adhere to the following hierarchy;
 - Public Sewer
 - Private Treatment Plant
 - Septic Tank and Drainage Field
 - Cesspool
 - It is proposed that foul flows generated by the proposed development will discharge to the public foul water sewer located in Arundel Road, to the west of the site.
 - A S106 application will be required in order to establish a connection, with approval from Southern Water, required.
 - Third party agreement will be required from St. Margaret's Church of England Primary School, as the proposed route of connection will cross third-party land.
 - Alternatively, a S98 Sewer Requisition will be required - and application for which would need to be submitted to Southern Water.
 - Post-development peak foul flows have been determined to be in the region of 3.89l/s (based on Sewers for Adoption, 4000l/day).



- DRAINAGE KEY-**
- Existing Foul Water Sewer
 - Existing Foul Water Manhole
 - Existing Culverted Watercourse
 - Existing Surface Water Manhole
 - Existing Headwall
 - Proposed Surface Water Sewer
 - Proposed Surface Water Manhole
 - Proposed Flow Control Chamber
 - Proposed Headwall
 - Proposed Attenuation Pond
 - Proposed Permeable Paving (TANKED)
 - Proposed Foul Water Sewer
 - Proposed Foul Water Manhole
 - Indicative Overland Flow Routes (Exceedance)

NOTES

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C	03/09/2020	Minor adjustment to layout	SPB	MJA
B	31/03/2020	Minor adjustment to layout	SPB	MJA
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-	21/11/2019	Original issue	SPB	MJA

Client: Persimmon Homes

Project: Land at Dappers Lane, Angmering, West Sussex BN16 4EW

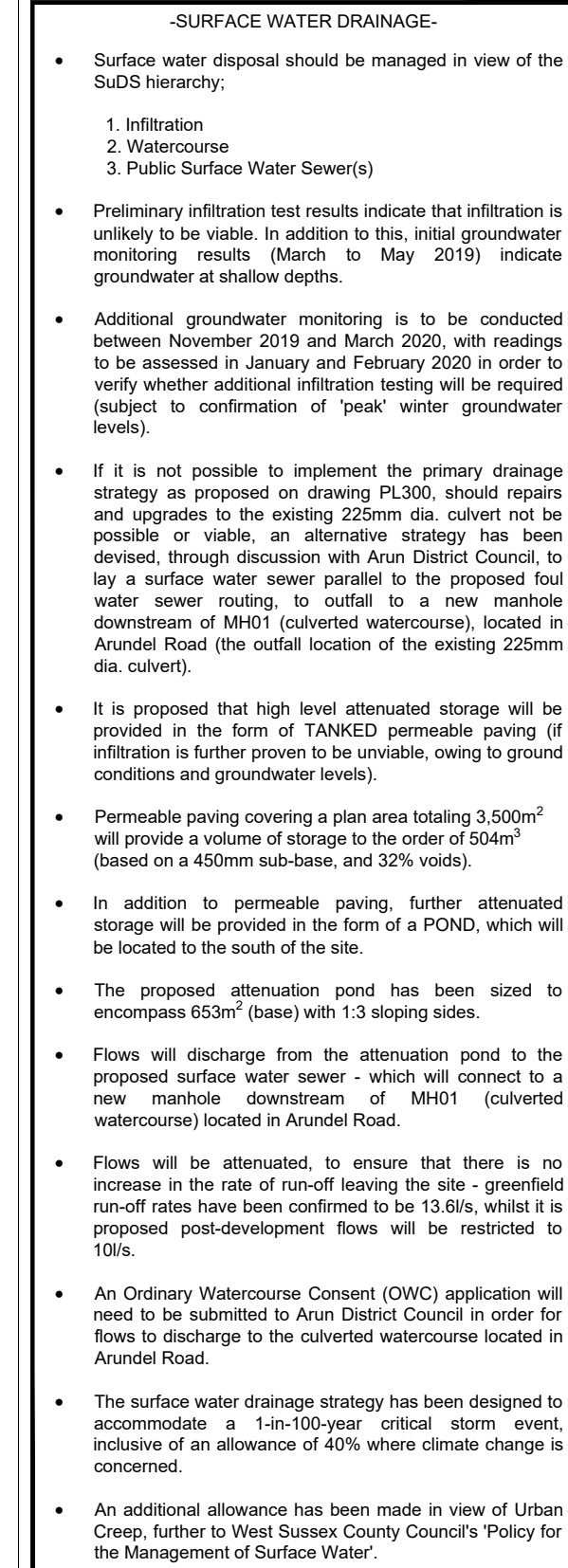
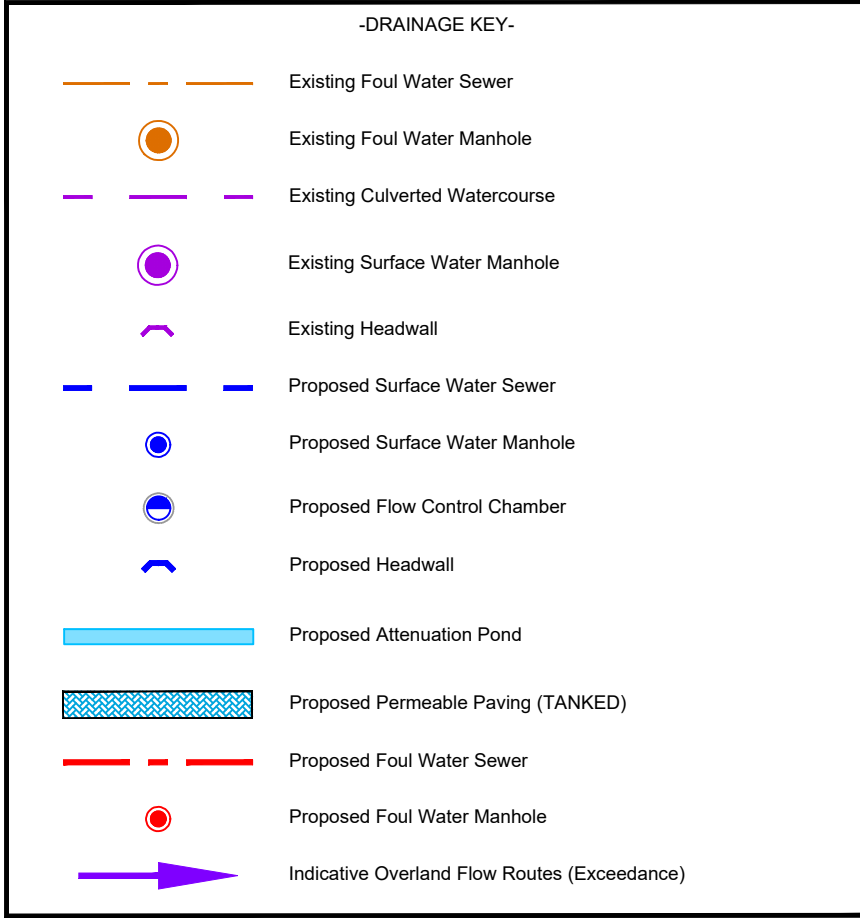
Drawing Title: Proposed Drainage Strategy

Scale	Drawn By	Checked By	Approved By
1:750	SPB	MJA	MJA

Date	Drawing No.	Rev.
November 2019	D1260-PL300	C

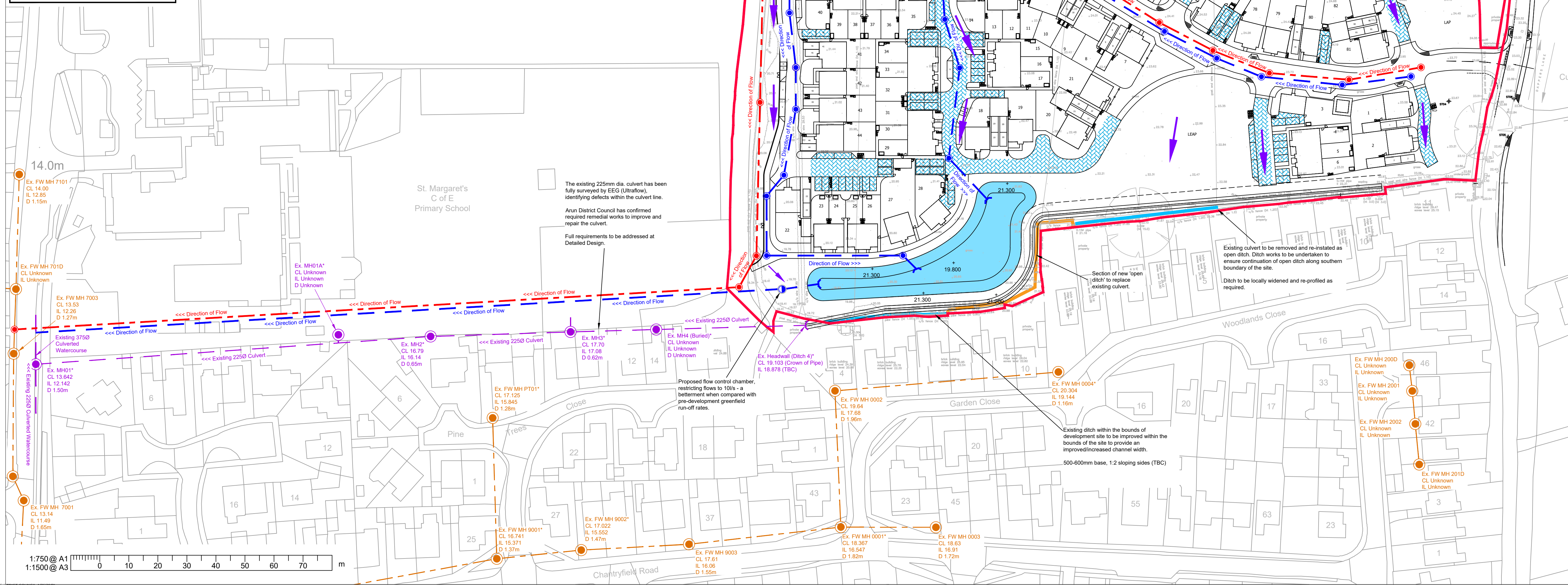
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-FOUL WATER STRATEGY-

- Foul water disposal should adhere to the following hierarchy;
 - 1. Public Sewer
 - 2. Private Treatment Plant
 - 3. Septic Tank and Drainage Field
 - 4. Cesspool
- It is proposed that foul flows generated by the proposed development will discharge to the public foul water sewer located in Arundel Road, to the west of the site.
- A S106 application will be required in order to establish a connection, with approval from Southern Water, required.
- Third party agreement will be required from St. Margaret's Church of England Primary School, as the proposed route of connection will cross third-party land.
- Alternatively, a S98 Sewer Requisition will be required - and application for which would need to be submitted to Southern Water.
- Post-development peak foul flows have been determined to be in the region of 3.89l/s (based on Sewers for Adoption, 4000l/day).



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-	20/11/2019	Original issue	SP8	MJ
Rev.	Date	Amendments	Drawn	App



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Client

Persimmon Homes

Project

Land at Dappers Lane,
Angmering, West Sussex BN16 4EW

Drawing Title

Proposed Drainage Strategy
Alternative Solution

Scale 1:750	Drawn By SPB	Checked By MJA	Approved By MJA
Date November 2019	Drawing No. D1260-PL301		Rev. C

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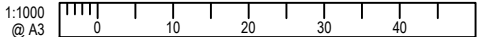
Project
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Drawing Title
Catchment Area Plan

Scale	1:1000	Drawn By	SPB	Checked By	MJA	Approved By	MJA
Date	July '20	Drawing No.	DI260-PL400	Rev.	A		

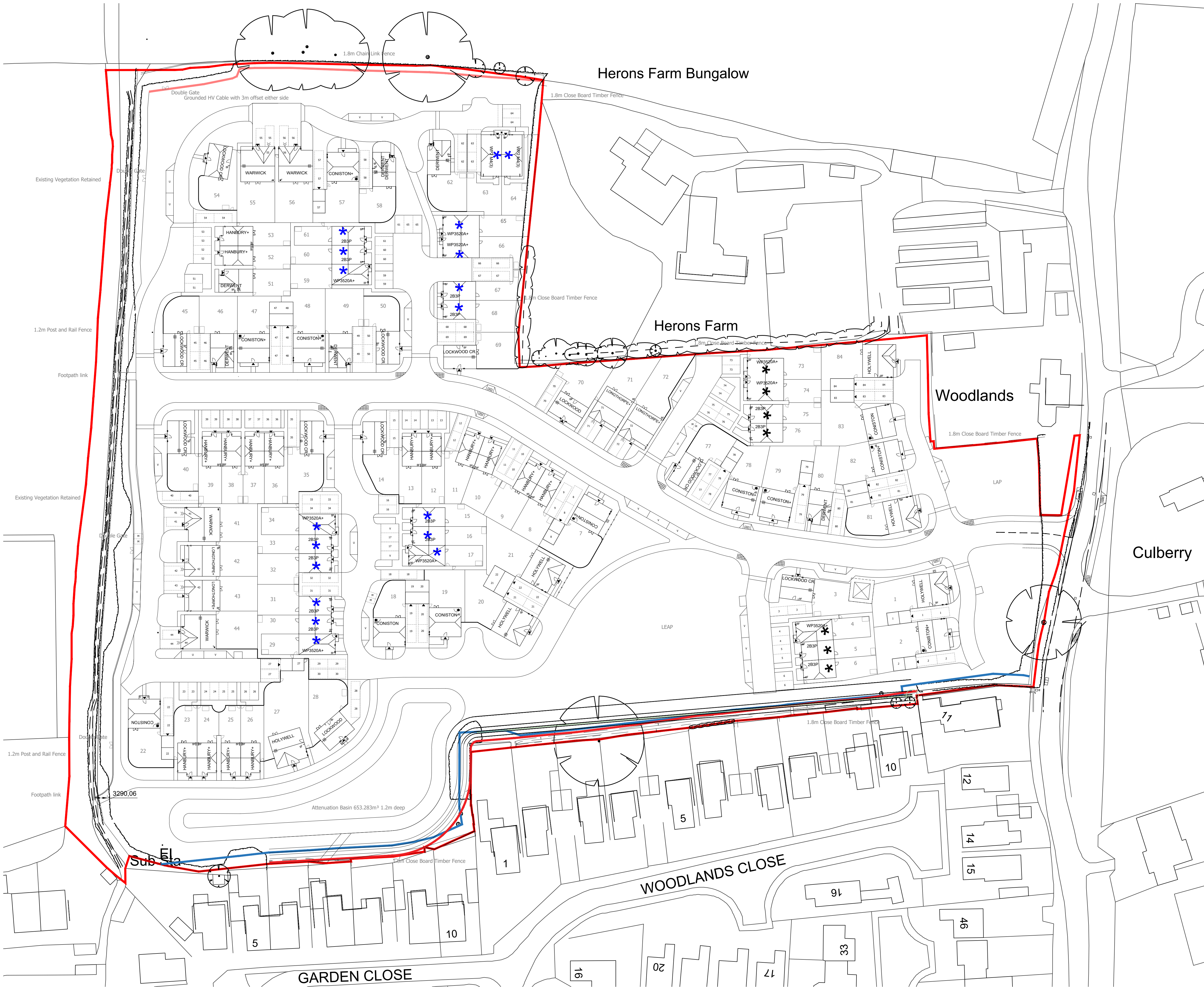
-CATCHMENT AREAS-

- Node 1 = 459.888m²
- Node 2 = 1,552.95m²
- Node 3 = 648.056m²
- Node 4 = 202.735m²
- Node 5 = 623.617m²
- Node 6 = 1,942.169m²
- Node 7 = 1,049.098m²
- Node 8 = 757.101m²
- Node 9 = 229.164m²
- Node 10 = 788.390m²
- Node 11 = 263.789m²
- Node 12 = 898.619m²
- Node 13 = 408.189m²
- Node 14 = 221.606m²
- Node 15 = 46.790m²
- Node 16 = 340.922m²
- Node 17 = 83.906m²
- Node 18 = 380.180m²
- Node 19 = 37.095m²
- Node 20 = 868.959m²
- Node 21 = 701.437m²
- Node 22 = 78.700m²
- Node 23 = 34.138m²
- Node 24 = 58.206m²
- Node 26 = 763.857m²
- Node 28 = 75.740m²
- Node 29 = 616.883m²
- Node 30 = 221.532m²
- Node 31 = 146.124m²
- Node 32 = 1,131.139m²
- Node 33 = 218.857m²
- Node 34 = 34.185m²
- Node 35 = 323.831m²
- Node 36 = 459.888m²
- Node 38 = 459.888m²



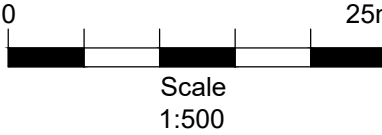
APPENDICIES

Appendix A - Architectural Proposals



- Red Line Boundary
- HA Rental Property
- HA Shared Ownership Property

Dapper's Lane, Angmering									
Market	Compliance	Units sqft (Gross)	Total units	Total sqft	Beds	Storey	Type	Habitable Rooms	
ALL NSB PRIVATE									
HANBURY+		768	16	12288	2	2	2B3P	5	
DERWENT		969	6	5914	2	2	2B3P	5	
LOCKWOOD		969	11	10989	2	2	2B3P	5	
LONGTHORPE+		1171	4	4684	3	2	3B4P	6	
CONISTON		1222	4	4888	3	2	3B4P	7	
CONISTON+	M4(2)	1234	8	9872	3	2	3B4P	7	
WARWICK		1333	4	5332	4	2	4B6P	7	
HOLYWELL		1414	6	8484	4	2	4B5P	8	
Total:			59	62351					
HA									
7 SO									
2B3P		803	4	3212	2	2	2B3P	4	
WP3520A+		1001	3	3003	3	2	3B5P	5	
18 R									
2B3P		803	10	8030	2	2	2B3P	4	
WP3520A+		1001	6	6006	3	2	3B5P	5	
WP2 M4(3)	M4(3)	1120	2	2240	2	2	2B3P	4	
Total:			25	22491					
Overall Site Total:			84	84842					
Parking									
Visitor/Unallocated		17v Bun							
Allocated (inc fix3 garages)		190							
Motorcycle		6							
EV Charging points (26 Garages + 23)		49							



PERSIMMON

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Persimmon Homes Thames Valley

Persimmon House, Knoll Road, Camberley, Surrey GU15 3TQ

Tel: 01276 808080

Site:

Dapper's Lane Angmering Littlehampton

Date:

Nov 2019

Scale:

1:500 @A1

Org No:

A77-PL-01

Drawing Title:

Planning Layout - 84 Units

Drawing Status:

SUBMITTED

Drawn by:

VW

Checked by:

ME

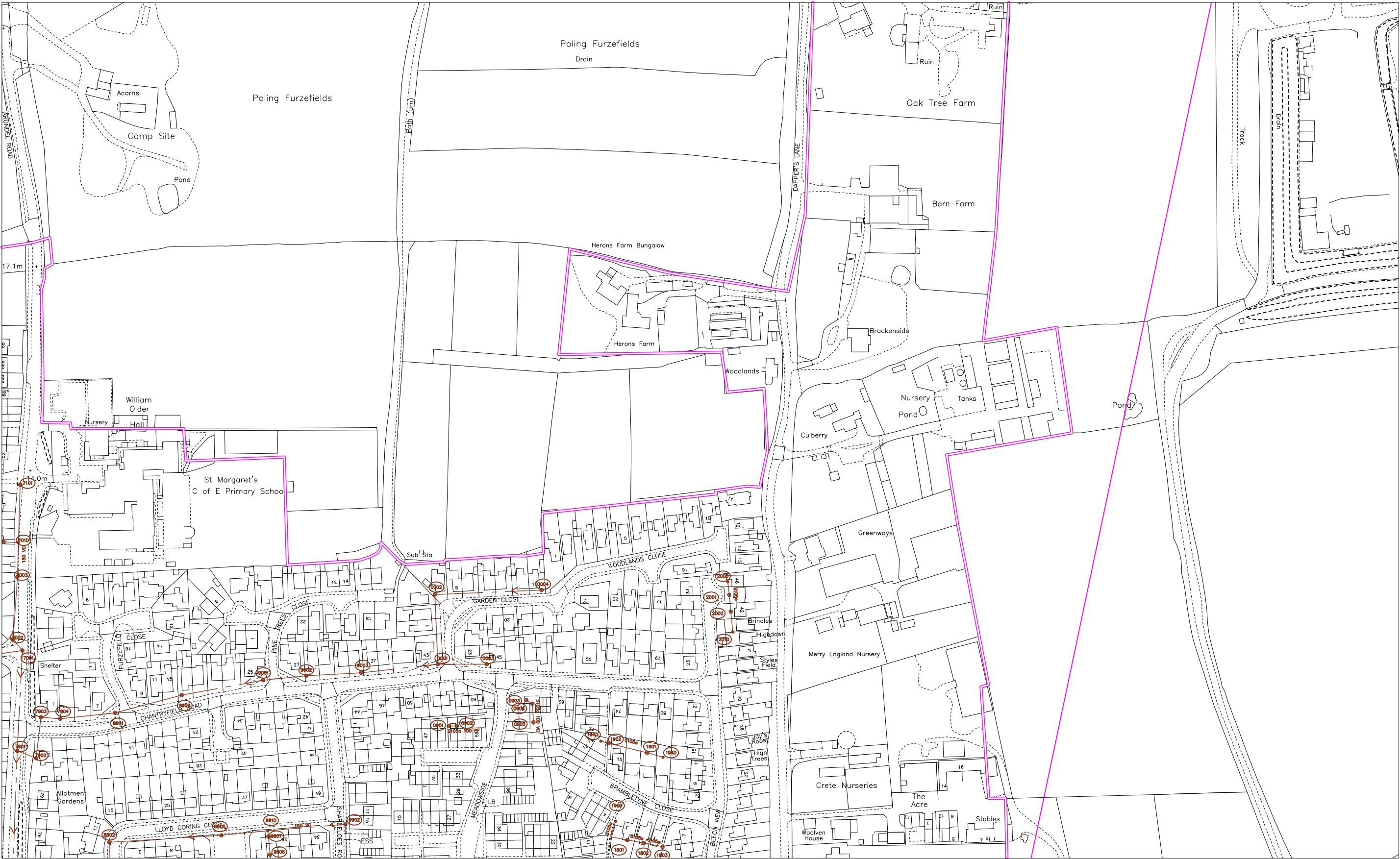
Rev:

B

Appendix B - Southern Water Public Sewer Records

SEWER RECORDS PAGE 1 OF 2

105459



104881

006732	O.S. REF. TQ0705SW	Drawn by: yadavs	The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. WARNING: BAC pipes are constructed of Bonded Asbestos Cement WARNING: Unknown (UNK) materials may Include Bonded Asbestos Cement	 N		007680
	Scale: 1:2500					
	UNCIL A/76/20/PL	Title: 254524_Dappers Lane, Angmering	Date: 31/07/2017	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.		

SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape
0001X	18.41	16.59	150	VC	CIRC
0002X	19.64	17.68	150	VC	CIRC
0003X	18.63	16.91	150	VC	CIRC
0004X	20.18	18.92	150	VC	CIRC
0902X			100	PF	CIRC
0904X			100	VC	CIRC
0905X			100	VC	CIRC
1801X			UNK	UNK	CIRC
1802X			UNK	UNK	CIRC
1901X			UNK	UNK	CIRC
1902X			UNK	UNK	CIRC
190DX			UNK	UNK	CIRC
194DX			UNK	UNK	CIRC
2001X			UNK	UNK	CIRC
2002X			UNK	UNK	CIRC
200DX			UNK	UNK	CIRC
7001X	13.14	11.49	150	VC	CIRC
7002X	13.15	11.9	150	VC	CIRC
7003X	13.53	12.26	150	VC	CIRC
701DX			150	VC	CIRC
7101X	14	12.85	150	VC	CIRC
7901X	12.71	11.11	150	VC	CIRC
7902X	14.23	11.67	150	VC	CIRC
7903X	14.22	12.42	150	VC	CIRC
7904X	14.35	12.95	150	VC	CIRC
8802X	14.1	12	150	VC	CIRC
8805X	14.58	12.53	150	VC	CIRC
8901X	15.05	13.93	150	VC	CIRC
8902X	15.82	14.66	150	VC	CIRC
9001X	16.78	15.4	150	VC	CIRC
9002X	17.09	15.63	150	VC	CIRC
9003X	17.61	16.06	150	VC	CIRC
9806X			UNK	UNK	CIRC
9807X			UNK	UNK	CIRC
981DX			150	VC	CIRC
9902X	16.06	14.14	150	VC	CIRC

ARUN DISTRICT COUNCIL A/76/20/PL



Southern
Water

Appendix C - LEAP Environmental Geotechnical Investigation (Existing)

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APPENDIX B – Figures

APPENDIX C – Historic Maps and Environmental Database Searches

APPENDIX D – Qualitative Risk Assessment Model

APPENDIX E – Site Photographs

APPENDIX F – Trial Hole and Borehole Logs

APPENDIX G – Geotechnical Laboratory Test Results

APPENDIX H – Chemical Laboratory Test Results

APPENDIX I – Water Monitoring Results

APPENDIX J - Soil Screening Table



EXECUTIVE SUMMARY

The site comprises an area of south westward sloping open grass land which is currently divided into seven fields used for grazing horses. The site covers an area of approximately 3.70Ha, situated on the to the west of Dapper's Lane, Angmering, West Sussex. It is proposed to redevelop the site with 88 No. 2 storey residential properties with private gardens and areas of publicly accessible open space.

The site has been mapped as open fields since the earliest available historical maps (1870s). The only on-site development since this period has been the installation of a well on the west of the site and a substation on the southern site boundary. The desk study has identified minor potential sources of contamination associated with the site's use. These include petroleum hydrocarbons from agricultural vehicle fuel spillages, PCBs from a nearby electrical substation and pesticides and heavy metals from potential arable farming activities on the site. The site is not affected by radon gas.

The site is mapped as being underlain by Head deposits (except for the north and north east of the site) over the London Clay Formation. Ground conditions comprise topsoil and subsoil to around 0.40m over firm to stiff slightly silty slightly sandy clay to between 3.35 and 5.00m over stiff slightly silty gravelly clay. Extremely weak mudstone was encountered below 3.35m in one trial hole. Relic shear surfaces were noted within several excavations at depths between 1.20m and 2.60mbgl. A groundwater seepage was encountered within TPI0 at 2.20mbgl.

Five of the six scheduled groundwater monitoring visits have been undertaken between the 1st of March and the 29th of April 2019. Monitoring identified water levels within 1.00m of the ground surface. It was however noted that the water levels were recorded after a period of prolonged heavy rainfall. Based on this observation it is considered possible that surface water seepage into the wells has occurred. Therefore, further monitoring is recommended to full assess the groundwater regime.

The site is not mapped within a river water flood risk zone by the Environment Agency, its western margin is however classified as being at low risk from surface water flooding.

An allowable bearing capacity of 100kPa is recommended for the stiff clays below about 1.00m. The London Clay and head deposits are both are classified as high VCP, and deepening will be required in proximity to trees. In such cases, piled foundations may be the preferred option. Suspended floor slabs are recommended due to the high VCP of the clays. Suspended floor slabs are also recommended with piled foundations.

The site is sloping at 2-3 degrees, and shear surfaces, possibly indicative of historical ground movements, have been encountered in some of the trial pits. Whilst global stability issues are considered unlikely on site in its current condition, there is the potential to destabilise the slope, particularly if significant cut and fill operations and/or retaining structures are proposed. Further assessment of global stability is recommended once the detailed design is available.

Soil sulphates in the clays fall within BRE design class DS-1 and the site conditions fall within the ACEC class AC-1s. However, due to the selenite crystals noted within several of the excavations further testing is recommended to ensure high sulphate concentrations do not occur on site, and a conservative classification of DS-2 may be more appropriate at this stage. A preliminary design CBR value of 2.0% is recommended for the clay soils. The soils are not considered frost susceptible based on the results of plasticity testing.

The soils on site are not suitable for soakaway drainage and provision should be in place to pipe surface water off site.

A geo-environmental risk assessment has been carried out. Contamination testing of the soils indicated none of the contaminants tested were above the generic assessment criteria for a residential development with private gardens. In addition, testing for the presence of organochlorine and organophosphorus pesticides and triazine herbicides recorded no pesticides or herbicides above the limit of detections. On that basis no remedial measures with respect to contaminated land are indicated at this stage.

As with any redevelopment site, there is always the risk of hitherto undetected contamination, and further investigations should be carried out prior to redevelopment.

Much of the soils on site will be expected to be classified as non-hazardous waste although additional WAC tasting may allow the classification of the soil as inert for landfill waste acceptance purposes.

D PHASE II - INTRUSIVE INVESTIGATION

9 Investigation Rationale

A total of 13 trial holes were excavated across the site. These included 9 No. machine excavated trial pits to a depth of 3.00m and 4 No. windowless sampler boreholes to a depth of 5.00m.

The trial holes were located to give general coverage, taking into consideration the proposed development and the potential geoenvironmental and geotechnical risks/hazards highlighted by the CSM in accordance with BS10175.

The trial hole spacing was consistent with the recommended density of 25 to 50m for an exploratory investigation after BS10175 Section 7.7.

The investigation rationale for the trial holes / test locations is summarised below:

Table 5 Rationale for Investigation Locations

Trial Hole/Test Location	Rationale	Proposed Depth (mbGL)	Notes
TP2-TP9	To give a general coverage of the site and assess the ground conditions as well as allow for both geotechnical and geoenvironmental sampling.	3.00	Perth Penetrometer tests undertaken in each trial pit at 1.00mbgl.
WS1, WS2, WS3 and WS5	To give a general coverage of the site and assess the ground conditions and allow the installation of groundwater monitoring wells.	5.00	Water monitoring wells installed in all WS boreholes.
HA1 – HA2	To allow an assessment of the soakage potential of the soils on site.	1.00	Soakage tests undertaken in both excavations.

DCPI-DCP7	To assess the subgrade quality along the alignment of the proposed roads.	0.90	
-----------	---	------	--

The site investigation locations are shown on Figure 3, Appendix B.

10 Site Work

10.1 Date and Weather Conditions

The intrusive investigations were undertaken in two phases, the first on the 26th of February and the second on the 27th of March 2019. At the time of both the investigations, the weather was clear and bright.

Both December and February received broadly average rainfall for the time of year, however, January was a much drier month with 52% of the average rainfall recorded across the UK.

10.2 Site Work Methods

10.2.1 Borehole Drilling

Boreholes were drilled using a windowless sampler rig. Borehole logs are available in Appendix F.

10.2.2 Trial Pitting

Trial pits were dug by a backhoe excavator. The trial pits had a target depth of 3.00mbgl and were typically 0.60m wide by 2.00m long. Spoil was replaced in reverse order. Trial pits were left mounded to allow for future settlement. Trial pit are logs are available in Appendix F.

10.2.3 Soil Logging and Sampling

Soil samples were recovered from the boreholes and trial pits for field screening, logging and sampling.

Boreholes were logged in general accordance with the requirements of BS 5930:2015⁷ and BS EN ISO 14688⁸. Borehole logs are presented in Appendix F.

⁷ BS5930:2015 Code of Practice for Ground Investigation

⁸ BS EN ISO 14688 Parts 1-2 Geotechnical Investigation and Testing. Identification and classification of soil

Visual and olfactory evidence of contamination was noted if encountered. These observations were used to aid scheduling of samples for chemical laboratory analyses, and are included on the borehole logs in Appendix F.

Samples were collected by hand (using dedicated nitrile gloves for each sampling location). Samples were placed into laboratory supplied sampling containers, specific to the type of analyses required.

All sample containers were sealed and labelled with a unique location identity, depth and date of sampling.

10.2.4 Monitoring Well Installation

4 No. monitoring wells were installed during this investigation within the windowless sample boreholes. The monitoring wells were constructed of 63mm diameter HDPE pipe. The response zone was typically targeted to intercept the groundwater surface and was surrounded by washed filter gravel. The plain zone was surrounded with bentonite to provide a seal. The monitoring wells were finished with bungs with gas taps and flush mounted steel covers. Monitoring well installations are shown on the borehole logs and summarised in the following table.

Table 6: Borehole installation details

Borehole	Type G-gas W-water V-vapour	Plain Well Screen (mbgl) and ID (mm)	Slotted Well Screen (mbgl)	Bentonite Seal (mbgl)
WS1	W	0.00-1.00	1.00-5.00	0.20-1.00
WS2	W	0.00-1.00	1.00-5.00	0.20-1.00
WS3	W	0.00-1.00	1.00-5.00	0.20-1.00
WS5	W	0.00-1.00	1.00-5.00	0.20-1.00

10.3 Field Tests

10.3.1 Standard Penetration Tests

Standard penetration tests were undertaken in the boreholes at 1.00m centres in accordance with BS EN ISO 22476-3;2005. Uncorrected blow counts, 'N values', are recorded on the borehole logs in Appendix F.

10.3.2 Perth Penetrometer Tests

Perth penetration tests were undertaken in the trial pits at 1.00m depth. Uncorrected blow counts, 'N values', are recorded on the trial pit logs in Appendix F.

10.3.3 Hand Penetrometer Test

Hand Penetrometer tests were undertaken on cohesive soil arisings from both trial pits and windowless sampler boreholes. The results are recorded on the trial pits logs in Appendix F.

10.3.4 In-situ California Bearing Ratio Test – Dynamic Cone Penetrometer

7 No. in-situ CBR tests have been undertaken across the site using the Dynamic Cone Penetrometer (DCP), recording blow counts over 900mm of penetration from test level. The test method and interpretation of the results have been undertaken in accordance with DMRB HD 29/08⁹ using a modified DCP. The results are attached in Appendix F.

10.3.5 BRE365 Soakage Tests

2 No. modified soakage tests have been carried out in Hand auger excavations in accordance with BRE Digest 365¹⁰.

10.4 Groundwater Monitoring

Groundwater level monitoring was undertaken and comprised six fortnightly monitoring visits from the 4th of March with the intended completion date of the 13th of May 2019.

10.5 Laboratory Analysis

10.5.1 Chemical Soil Analysis

Selected samples of soil have been subjected to laboratory testing. Sampling techniques and storage have been undertaken as per BS 10175:2011+A1:2013 Code of Practice for Investigation of Potentially Contaminated Sites. The laboratory testing has been carried out by The Environmental Laboratory Ltd at its laboratories in East Sussex. Where available, the tests procedures are UKAS and MCERTS accredited.

The following analyses were completed on selected samples:-

- LEAP standard Soil suite (metals, speciated PAHs, asbestos)
- Pesticide Screens

The full laboratory test results are presented in Appendix H.

10.5.2 Geotechnical Laboratory Testing

Selected samples of the soils have been classified by laboratory analysis for geotechnical design purposes. The laboratory testing has been carried out by Geolabs Ltd at its laboratories in Watford, in accordance with BS1377¹¹ and BS EN ISO17892¹². The sampling technique, type,

⁹ HD22/08 Data for Pavement Assessment. Design Manual for Roads and Bridges; Volume 7 Pavement Design and Maintenance; Section 3 Pavement Maintenance Assessment Part 2

¹⁰ Building Research Establishment DG365 Digest Soakaway Design (2016)

¹¹ BS1377 Parts 1-9:1990 Methods of test for Soils for Civil Engineering Purposes

¹² BS EN ISO 17892 Parts 1-12 Geotechnical Investigation and Testing. Laboratory testing of soil

storage and transport and the number of laboratory tests have been undertaken where possible in accordance with BS EN 1997-2:2007 and BS EN ISO 22475¹³.

The following laboratory tests have been undertaken:-

Table 7 Geotechnical Laboratory Testing

Test	Number of tests	
	London Clay	Head
Moisture Content	9	2
Atterberg Limit Test	9	2
BRE SDI Suite B	2	2

II Ground Conditions

The ground conditions are described in detail in the logs attached in Appendix F. In summary the soil conditions were as follows:

Table 8: Summary of soils encountered

Depth From (m)	Depth To (m)	Soil Type	Description
Ground Level	0.10 / 0.50	TOPSOIL	Dark brown slightly gravelly silty clayey TOPSOIL with frequent rootlets. Gravel is fine to coarse, sub angular to angular flint. Gravel of fine to coarse, sub rounded chalk was also observed in TPs 3, 4, 5 and 6.
0.10 / 0.15	0.23 / 0.45	SUBSOIL	Dark brown slightly gravelly silty clayey SUBSOIL. Gravel is fine to coarse sub angular to sub rounded flint.
0.23 – 0.50	1.00 – 1.40	CLAY	Firm to stiff orangish brown slightly silty slightly gravelly occasional slightly sandy CLAY Gravel is fine to coarse, sub-rounded to angular flint. (HEAD)
1.00 – 1.40	3.35 – 5.00*	CLAY	Stiff grey mottled orange slightly silty occasionally slightly sandy and slightly

¹³ BS EN ISO 22475 Parts 1-3 Geotechnical Investigation and Testing. Sampling methods and groundwater measurements

			gravelly CLAY. Gravel is fine to coarse sub angular to angular extremely weak mudstone. Sub horizontal slip surfaces were noted. (LONDON CLAY)
3.35	5.00*	MUDSTONE**	Extremely weak relic laminated dark brown mottled grey MUDSTONE with occasional partings of stiff clay. (LONDON CLAY)

*full depth of excavation

**Only encountered in WSI

The ground conditions were found to be relatively consistent across the site. Comprising topsoil and subsoil underlain by clays which become progressively stiffer with depth and contained gravel of weathered mudstone below ~2.5m. Extremely weak laminated mudstone was encountered within WSI only.

Relic sub-horizontal shear surfaces which may be indicative of historical slope movement were noted within the London Clay in six of the trial pits excavated. The surfaces were noted at depths between 1.20m and 2.60mbgl.

11.1.1 Groundwater

Groundwater was encountered as a slight seepage in TP 10 only, however evidence for groundwater was also encountered as recorded below:-

Table 9: Groundwater Strikes

Trial Hole	Date of water strike	Depth to Groundwater strike (mbgl)	Comments
WS1	-	-	Sampler was recovered wet from below 4.00mbgl
WS2	-	-	Sampler was recovered wet from below 4.00mbgl
WS3	-	-	Sampler was recovered wet from below 4.00mbgl
WS5	-	-	Sampler was recovered wet from below 4.00mbgl
TP10	-	-	Slight groundwater seepage observed at 2.20mbgl

Groundwater monitoring results are summarised as follows:-

Table 10: Groundwater Monitoring Results

Monitoring well	Depth to groundwater (mbgl)					
	01/03/19	18/03/19	01/04/19	15/04/19	29/04/19	13/05/19
WS1	5.33	0.39	0.65	0.79	1.02	1.73
WS2	5.02	0.35	0.73	0.78	0.9	1.77
WS3	4.98	0.56	0.82	0.92	1.04	1.61
WS5	Dry	0.14	0.60	0.90	1.02	2.14

Groundwater monitoring recorded water levels between 0.14 and 1.04mbgl over the majority of the monitoring period. Water levels during the first monitoring visit however were significantly lower. The implication of this are discussed further in section 15 of the geotechnical appraisal.

16 Soakage Potential

16.1 Test Results

2 No. small scale soakage tests were undertaken on site in general accordance with BRE365¹⁵. The tests were undertaken in 1.00m deep hand auger boreholes one on the north and the second on the south of the site. The pits were filled to 0.10mbgl. Given the time restrictions, it was only possible to fill and test each pit once. The results are attached in Appendix F and are summarised below:

Table 13: Summary of soakage tests

Test Location	Soakage Rate (m/s)	Comments
HA1	6.94E-08	Results are not compliant with BRE365 as level did not fall by the required 75%.
HA2	1.12E-07	Results are not compliant with BRE365 as level did not fall by the required 75%.

16.2 Recommendations

Based on the above results, the site is not suitable for conventional soakaways, and allowance should be made for surface water to be piped off site at this stage.

17 Bearing Capacity and Foundations

17.1 Shallow Foundations

All loads should be transferred beneath any topsoil, made ground, loose, soft, low strength, desiccated or disturbed soils and transferred onto the stiff clays at depth. For low rise housing, based on local experience and BS8103¹⁶ Table 8, an allowable bearing capacity of 100kPa is recommended for shallow foundations, on the stiff clays below about 1m. However, foundations will require deepening in the clay soils near trees to NHBC HIGH VCP precautions.

¹⁵ Building Research Establishment DG365: 2016. Digest Soakaway Design



- X
 Window sampler
- +
 HA soakage tests
- X
 DCP
- site boundary
- +
 Trial Pits



Client:

Persimmon Homes
Thames Valley

Title:

Site Layout and
Exploratory Hole
Plan

Project ID:

LP01877

Project:

Land west of Dappers
Lane, Angmering

Date:

26/04/19

Figure No.

03



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Borehole Log

Borehole No.

HA1

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
HA

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:10

Client: Persimmon Homes Thames Valley

Dates: 27/03/2019 - 27/03/2019

Logged By
MN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Grass over dark brown clayey TOPSOIL with frequent rootlets.	
					0.23			Dark brown sandy clayey SUBSOIL. Very rare fine flint gravel	
					1.00			Stiff to firm orangish red brown slightly silty CLAY. Occasional grey streaking with very rare fine angular flint gravel	
								End of borehole at 1.00 m	1
									2

Remarks

Dry and Stable. 22cm diameter



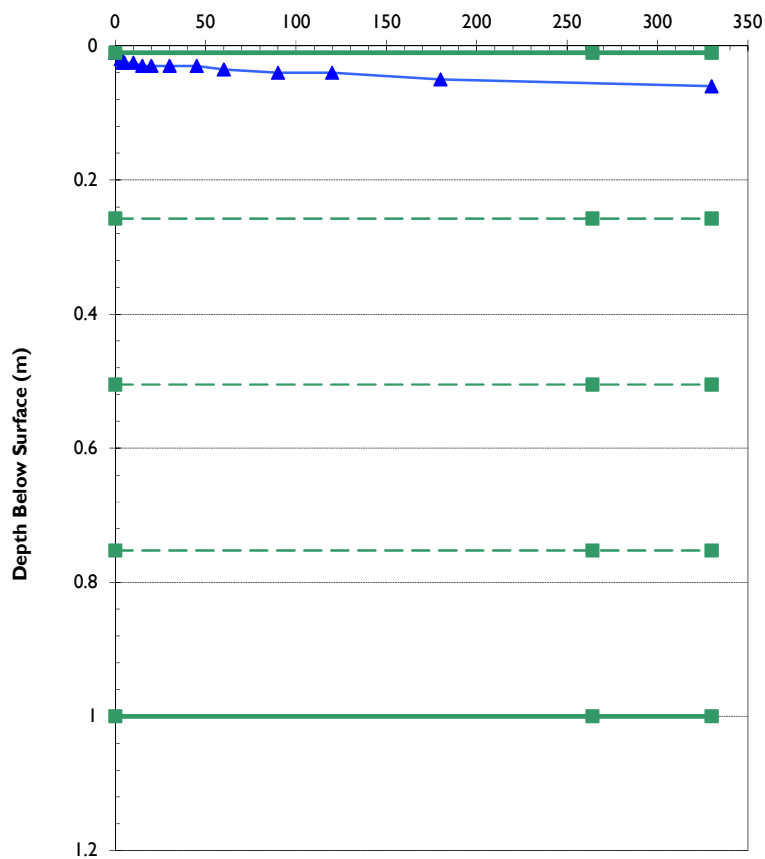
 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA Tel: 01306 646510 www.leapenvironmental.com					Borehole Log			Borehole No. HA2 Sheet 1 of 1	
Project Name: Dapper's Lane, Angmering,					Project No. LP1877		Co-ords: -		Hole Type HA
Location: Dapper's Lane Angmering, West Sussex					Level:		Scale 1:10		
Client: Persimmon Homes Thames Valley					Dates: 27/03/2019 - 27/03/2019		Logged By MN		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Grass over dark brown clayey TOPSOIL with frequent rootlets.	
					0.30			Brown sandy slightly clayey gravelly SUBSOIL. Gravel is fine to coarse, rounded to sub rounded flint.	
					1.00			Orange red brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular flint.	
							End of borehole at 1.00 m		1
									2

Remarks
 Dry and Stable. 30cm diameter



BRE Digest 365 - Soakage Test

Filling to Max Water Depth (min)



Test Hole No: HA1
Test No: Test No 1



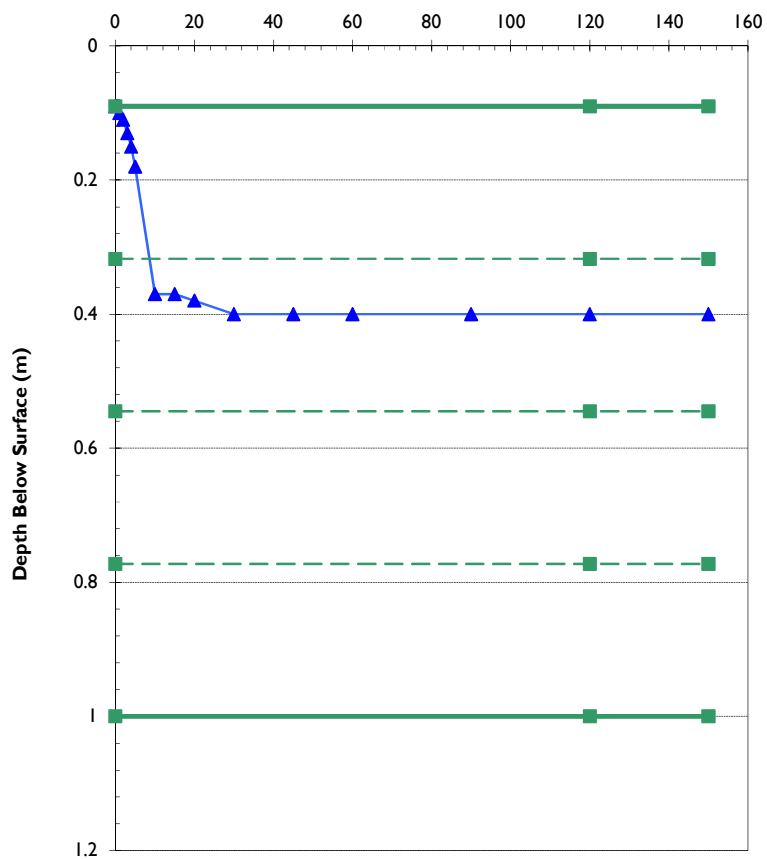
Diameter of Borehole (m)	0.22
Depth to End of Borehole Casing (m)	
Depth to Borehole Base (m)	1
Depth to Top of Permeable Soils (m)	
Depth to Groundwater Surface (m)	
Depth to Top of Granular Fill (m)	
Voids Assumed within Borehole (%)	
Depth of Water at Start of Test (m)	0.01
Max Water Dropdown during Test (m)	0.05
Total Soakage Test Time (min)	330
Mean Internal Discharge Area (m ²)	0.692014
Discharge Rate (litre/min)	0.00288
Soakage Rate (litre/m ² /min)	0.004161
BRE Soil Infiltration Rate (m/sec)	6.94E-08

Comments: Water level did not fall to 75% max water depth, calculations were based on actual fall of water level
Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client:
Site:
Tested By:
Test Date: 01/04/19

BRE Digest 365 - Soakage Test

Filling to Max Water Depth (min)



Test Hole No: HA2
Test No: Test No 1



Diameter of Borehole (m)	0.03
Depth to End of Borehole Casing (m)	
Depth to Borehole Base (m)	1
Depth to Top of Permeable Soils (m)	
Depth to Groundwater Surface (m)	
Depth to Top of Granular Fill (m)	
Voids Assumed within Borehole (%)	
Depth of Water at Start of Test (m)	0.09
Max Water Dropdown during Test (m)	0.31
Total Soakage Test Time (min)	150
Mean Internal Discharge Area (m2)	0.061143
Discharge Rate (litre/min)	0.000412
Soakage Rate (litre/m2/min)	0.006746
BRE Soil Infiltration Rate (m/sec)	1.12E-07

Comments: Water level fell to 75% -- 50% max water depth, calculations were based on actual fall of water level
Result not compliant with BRE365 requirement since water did not fall to 25% max water depth.

Client:
Site:
Tested By:
Test Date: 01/04/19



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Trial Pit Log

Trialpit No

TP2

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
3.00

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.05	ES	N=6	0.35			Grass over brown slightly gravelly silty clayey TOPSOIL. Gravel is medium to coarse, sub angular flint	1
	0.20	ES					Firm to stiff light yellowish brown silty CLAY with occasional pockets of sandy clay.	
	0.70	D					Hand Pen at 0.7m = 135kPa	
							Evidence of sub horizontal slip surfaces at 1.2m Hand Pen at 1.3m = 130kPa	
							Pockets of orange sandy clay at 1.6m	
	2.00	D		2.20			Stiff finely laminated grey mottled orangish brown slightly silty gravelly CLAY. Gravel is extremely weak fine to medium mudstone. Hand Pen at 2.2m = 210kPa pockets of slightly sandy clay at 2.5m Hand Pen at 2.6m = 260kPa	2
	3.00	D		3.00			End of pit at 3.00 m	3
								4
								5

Remarks: Trial pit remained dry and stable

Stability: Stable





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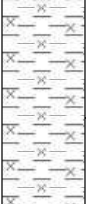
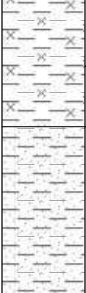
Trial Pit Log

Trialpit No

TP3

Sheet 1 of 1

Project Name:	Dapper's Lane, Angmering,	Project No.	LP1877	Co-ords: -	Level:	Date	27/03/2019
Location:	Dapper's Lane Angmering, West Sussex			Dimensions (m):	2	Scale	1:25
Client:	Persimmon Homes Thames Valley			Depth	3.00	Logged	ADC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES	N=8	0.20			Grass over brown slightly gravelly silty clayey TOPSOIL. Gravel is medium to coarse, angular to sub angular flint and fine to coarse sub rounded chalk.	
	0.30	ES					Firm light brown mottled grey silty CLAY.	
	1.00	D		1.30			Hand Pen at 0.6m = 150kPa	1
							pockets of slightly sandy clay below 1.1m	
	2.10	D					Firm to stiff grey mottled orange slightly sandy CLAY.	2
							Hand Pen at 1.9m = 150kPa	
							fine selenite crystals noted at 2.2m	
							clay shows relic laminations below 2.6m	
	3.00	D		3.00			Stiff grey mottled orange slightly sandy CLAY.	3
							slip surfaces noted at 2.7m	
							Hand Pen at 2.8m = 165kPa	
							End of pit at 3.00 m	4
								5

Remarks:	Trial pit remained dry and stable	
Stability:	Stable	



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Trial Pit Log

Trialpit No

TP4

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
2.90

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.13			Grass over slightly gravelly clayey TOPSOIL. Gravel is medium to coarse, angular to sub angular flint and fine to coarse sub angular to sub rounded chalk.	
	0.20	ES		0.30			Brown slightly gravelly silty clayey SUBSOIL. Gravel is medium to coarse, angular to sub angular flint and fine to coarse sub angular to sub rounded chalk. <u>Hand Pen at 0.13m = 130kPa</u>	
			N=8				Firm light brown silty CLAY with rare medium flint gravel.	1
	1.10	D		1.30			Stiff grey mottled orange silty CLAY. <u>Sub horizontal slip surfaces noted between 1.3-1.6m.</u> <u>Hand Pen at 1.5m = 160kPa</u>	2
	2.30	D					occasional pockets of sandy clay from 2.2m	
							clay shows relict laminations below 2.5m	
	2.90	D		2.90			End of pit at 2.90 m	3
								4
								5

Remarks: Trial pit remained dry and stable

Stability: Stable





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Trial Pit Log

Trialpit No

TP6

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
2.90

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.10			Grass over brown slightly gravelly clayey TOPSOIL. Gravel is medium to coarse sub angular flint and fine to medium sub rounded chalk.	
	0.20	ES		0.30			Brown mottled orange slightly gravelly silty clayey SUBSOIL. Gravel is medium to coarse, sub angular flint and fine to medium sub rounded chalk Firm to stiff light brownish orange silty CLAY.	
							<i>Hand Pen at 0.7m = 200kPa</i>	
	1.10	D	N=5	1.00			Firm to stiff grey mottled orange slightly silty CLAY with pockets of orange sandy clay. <i>clay is laminated below 1.2m</i>	1
							<i>Hand Pen at 1.7m = 170kPa</i> <i>occasional selenite crystals below 1.8m</i>	
	2.10	D					<i>Hand Pen at 2.2m = 250kPa</i>	2
				2.70				
	3.00	D		2.90			Stiff grey mottled orange slightly silty slightly gravelly CLAY. Gravel is extremely weak fine to medium extremely weak mudstone. End of pit at 2.90 m	3
								4
								5

Remarks: Trial pit remained dry and stable

Stability: Stable





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Trial Pit Log

Trialpit No

TP7

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
3.10

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.10	ES	N=11	0.25			Grass over slightly gravelly silty clayey TOPSOIL with frequent roots. Gravel is fine to coarse, sub angular flint.	1	
	0.30	ES					Firm light orangish brown silty CLAY with rare coarse flint.		
				1.30			Hand Pen at 0.6m = 130kPa	2	
	1.40	D					Stiff grey mottled orange silty CLAY with pockets of sandy clay. Sand is fine grained.		
				2.10			Hand Pen at 1.8m = 240kPa	3	
	2.30	D					Stiff finely laminated bluish grey slightly gravelly silty CLAY. Gravel is extremely weak grey mudstone.		
				3.10			slip surfaces observed at 2.3m	4	
							Hand Pen at 2.5m = 345kPa		
							selenite crystals observed below 2.7m		
	3.00	D					Hand Pen at 3m = 305kPa	5	
							End of pit at 3.10 m		

Remarks: Trial pit remained dry and stable

Stability: Stable





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Trial Pit Log

Trialpit No

TP8

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
3.00

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES	N=11	0.30		Grass over brown slightly gravelly silty clayey TOPSOIL. Gravel is medium to coarse, angular flint.		
	0.25	ES				Firm light brown silty CLAY with rare medium coarse flint gravel.		
				Hand Pen at 0.6m = 120kPa				
	1.10	D		1.00		Firm to stiff grey mottled orange silty CLAY with occasional selenite crystals.	1	
					Hand Pen at 1.3m = 210kPa			

Remarks: Trial pit remained dry and stable

Stability: Stable





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Trial Pit Log

Trialpit No

TP9

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
3.00

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES	N=12	0.15			Grass over brown slightly gravelly silty clayey TOPSOIL. Gravel is medium to coarse, sub angular flint.	
	0.30	ES		0.30			Orangish brown slightly gravelly silty clayey SUBSOIL.	
							Firm light brown slightly gravelly slightly silty CLAY.	
							Land drain at the south end of the pit between 0.4 and 0.55m comprising clayey gravel. Gravel is coarse angular flint brick. 0.4-0.55m	
							Hand Pen at 0.7m = 150kPa	
							mottled grey below 1.2m	
							Sub horizontal slip surface at 1.5m	
							Sub horizontal slip planes noted at 1.6m	
							Hand Pen at 1.7m = 260kPa	
							Hand Pen at 2.4m = 245kPa	
							relict laminations below 2.8m	
							End of pit at 3.00 m	
	1.50	D						
	2.50	D						
	3.00	D		3.00				

Remarks: Trial pit remained dry and stable

Stability: Stable





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Trial Pit Log

Trialpit No

TP10

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions (m):

2

Depth
3.00

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

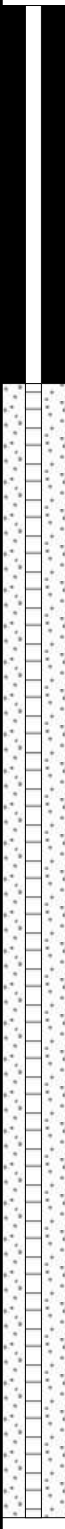
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES	N=12	0.15			Grass over brown slightly gravelly silty clayey TOPSOIL. Gravel is medium to coarse, sub angular flint.	1
	0.30	ES					Firm to stiff light yellowish brown slightly silty CLAY.	
	1.00	D					Hand Pen at 0.9m = 100kPa	
	2.00	D					colour changes to grey mottled orange below 1.5m. Slightly gravelly. Gravel is angular fine selenite crystals Hand Pen at 1.7m = 160kPa	
	2.70	D	3.00	3.00			Stiff bluish grey slightly gravelly slightly silty CLAY. Hand Pen at 2.1m = 190kPa seepage at 2.2m Hand Pen at 2.4m = 210kPa	2
	3.00	D					Firm to stiff bluish grey slightly silty slightly gravelly CLAY. Gravel is extremely weak finely laminated grey mudstone. Hand Pen at 2.8m = 195kPa	
							End of pit at 3.00 m	3
								4
								5

Remarks: Very slight seepage observed at 2.2m depth

Stability: Stable

AGS

 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA Tel: 01306 646510 www.leapenvironmental.com		Borehole Log			Borehole No. WS1 Sheet 1 of 2	
Project Name: Dapper's Lane, Angmering,		Project No. LP1877		Co-ords: -		Hole Type WS
Location: Dapper's Lane Angmering, West Sussex		Level:		Scale 1:20		
Client: Persimmon Homes Thames Valley		Dates: 26/02/2019 - 26/02/2019		Logged By ADC		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.18	ES		0.20		Grass over dark brown silty clayey TOPSOIL.		
					0.45		Dark brown silty slightly gravelly clayey SUBSOIL. Gravel is fine sub-rounded to rounded, chalk and coarse, sub-angular to sub-rounded flint.		
							Firm orange brown slightly silty CLAY with rare coarse, sub-angular to sub-rounded flint.		
		0.90	D				Hand Pen at 0.8m =170kPa		
							Frequent roots to 0.1m		
		1.20		N=9 (1,1/1,2,2,4)			Becomes stiff below 1.2m	1	
		1.50	D						
		2.00		N=11 (1,2/2,2,3,4)			Becomes grey below 1.9m	2	
							Hand Pen at 2.1m =270kPa		
		2.50	D						
	3.00		N=11 (1,2/2,2,3,4)			Hand Pen at 2.9m =350kPa	3		
						Hand Pen at 3.3m =380kPa			
	3.50	D			3.35		Extremely weak dark brown mottled grey relicly laminated MUDSTONE with occasional partings of stiff clay.		
						Hand Pen at 3.8m =390kPa			
	4.00		N=13 (2,2/3,3,3,4)					4	

Continued on next sheet

Remarks Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.	
--	---



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Borehole Log

Borehole No.

WS1

Sheet 2 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

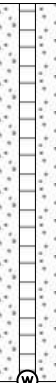
Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		4.70 - 5.00	D						
		5.00		N=13 (1,3/2,3,4,4)	5.00			Hand Pen at 4.5m exceeds 500kPa End of borehole at 5.00 m	5
									6
									7
									8

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.





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Borehole Log

Borehole No.

WS2

Sheet 1 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.40				
		0.60	ES						
		0.87	D		1.00				
		1.20		N=12 (1,2/3,3,3,3)					1
		1.60	D		1.60				
		2.00		N=10 (1,1/2,2,3,3)					2
		2.50	D						
		3.00		N=12 (1,2/2,3,3,4)					3
		3.50	D						
		4.00		N=13 (1,2/2,3,4,4)					4

Continued on next sheet

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.





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Borehole Log

Borehole No.

WS2

Sheet 2 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

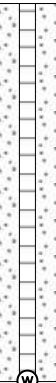
Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					4.50			Hand Pen at 4.2m =410kPa	
		4.80	D					Stiff grey slightly silty gravelly CLAY. Gravel is fine to coarse sub-angular to angular mudstone.	
		5.00		N=15 (2,2/3,3,4,5)	5.00			Hand Pen at 4.8m =410kPa	
								End of borehole at 5.00 m	5
									6
									7
									8

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.





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Borehole Log

Borehole No.

WS3

Sheet 1 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	ES		0.20			Grass over brown silty clay TOPSOIL. <i>Frequent rootlets to 0.1m</i>	
		0.30	ES		0.40			Pale brown pale orange slightly gravelly silty clayey SUBSOIL. Gravel is fine angular flint.	
								Firm orange brown slightly silty very gravelly CLAY. Gravel is fine to coarse sub-rounded to angular flint. <i>Hand Pen at 0.6m =290kPa</i>	
		1.00	D		1.10			Stiff orange mottled grey slightly silty slightly sandy CLAY. Sand is fine to medium grained. <i>Hand Pen at 1.2m =320kPa</i>	1
		1.20		N=13 (1,1/3,3,3,4)				<i>Hand Pen at 1.5m =280kPa</i>	
		1.70	D					<i>Hand Pen at 1.9m =290kPa</i>	
		2.00		N=24 (2,2/4,6,7,7)	2.25			<i>Hand Pen at 2.1m =380kPa</i>	2
								Stiff brown orange very gravelly CLAY. Gravel is fine to coarse angular flint.	
		2.60	D						
		3.00		N=14 (1,2/2,3,4,5)	3.00			Stiff grey mottled orange brown slightly silty slightly sandy CLAY. Sand is fine grained. <i>Hand Pen at 3.3m =400kPa</i>	3
		3.50	D					<i>Hand Pen at 3.8m =340kPa</i>	
		4.00		N=12 (1,2/3,2,3,4)				Continued on next sheet	4

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.





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Borehole Log

Borehole No.

WS3

Sheet 2 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

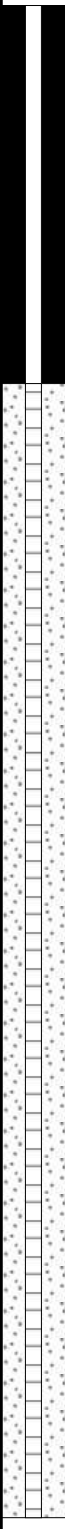
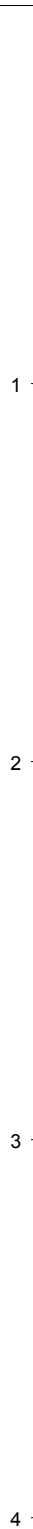
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
W		5.00		N=14 (2,2/3,3,3,5)	5.00			Hand Pen at 4.05m = 380kPa	5
								Rare mudstone gravel below 4.6m	
								Hand Pen at 4.9m = 410kPa	
								End of borehole at 5.00 m	
									6
									7
									8

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.



 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA Tel: 01306 646510 www.leapenvironmental.com		Borehole Log			Borehole No. WS5 Sheet 1 of 2	
Project Name: Dapper's Lane, Angmering,		Project No. LP1877		Co-ords: -		Hole Type WS
Location: Dapper's Lane Angmering, West Sussex		Level:		Scale 1:20		
Client: Persimmon Homes Thames Valley		Dates: 26/02/2019 - 26/02/2019		Logged By ADC		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.50		Grass over dark brown mottled pale orange slightly silty very clayey TOPSOIL with occasional fine to coarse, sub-angular to angular, flint.		
		0.60	D						Firm pale orange brown mottled grey slightly silty CLAY with rare fine angular flint gravel.
		0.80	ES						Hand Pen at 0.7m =170kPa Hand Pen at 1m =140kPa
		1.10	D	N=7 (3,2/1,2,1,3)	1.40		Hand Pen at 1m =140kPa Becomes stiff below 1.2m Coarse angular flint gravel between 1.25 and 1.35m		1
		1.20							
		1.40 - 1.60	B						Firm to stiff brown orange slightly silty slightly sandy CLAY. Sand if fine grained. Occasional medium to coarse, angular flint gravel. Hand Pen at 1.4m =170kPa Hand Pen at 1.75m =240kPa
		2.00		N=14 (2,2/4,4,3,3)					
		2.50	D		Relict lamination visible below 2.5m Hand Pen at 2.85m =230kPa				
		3.00		N=13 (1,3/2,3,4,4)	3.00				Stiff dark orange brown mottled grey slightly silty CLAY. Partings of dark orange coarse sandy clay. Hand Pen at 3.2m =250kPa Colour becomes grey below 3.3m
		3.50	D				Hand Pen at 3.8m =270kPa		
	4.00		N=13 (3,3/3,3,3,4)		Continued on next sheet		4		

Remarks
 Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.



Borehole Log

Borehole No.

WS5

Sheet 2 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type	WS
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
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80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

Location: Dapper's Lane Angmering, West Sussex

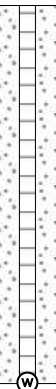
Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		4.10	D				<u>Sampler was recovered wet below 4m</u>	5 6 7 8	
		4.50	D				<u>Very stiff below 4m along with rare fine gravel of extremely weak mudstone.</u>		
		5.00	N=17 (2,3/4,4,4,5)				5.00		<u>Parting of clayey sand between 4 and 4.15m</u> <u>Slightly sandy below 4.2m</u>
End of borehole at 5.00 m									

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.



Appendix D - LEAP Environmental Geotechnical Investigation (Additional)

Robert Clark
Persimmon Homes Thames Valley
Persimmon House
Knoll Road
Camberley
GU15 3TQ

24th January 2020

Our ref MW/20/LP1877

Dear Robert,

Re: Groundwater Winter Monitoring, Land off Dappers Lane, Angmering.

1. Introduction

Leap Environmental Ltd (hereafter referred to as **LEAP**) has been appointed by Persimmon Homes Thames Valley (the Client) to undertake further ground investigation and groundwater level monitoring during the winter months at the above-named site. This is as per instruction by Robert Clark of Persimmon Homes Thames Valley dated 21st November 2019.

The agreed scope of works comprised:

- Installation of two new groundwater monitoring wells to 3.0 m bgl at locations specified by Arun District Council;
- Inspection of existing monitoring well surface seals to confirm integrity and repair, if necessary;
- Winter groundwater monitoring comprising one monitoring visit per month November to December 2019 and twice monthly from January to March 2020; and
- Production of a factual letter report.

2. Fieldwork

The intrusive works were completed on 22nd November 2019 by contractors who have been scrutinised and are on **LEAP's** approved contractor list. The windowless sampling was carried out by Oaklands Site Investigation Ltd and supervised by **LEAP**.

WS101 was located in a central location in the western half of the site and WS102 was located in the location of a proposed new retention pond. An exploratory hole plan and borehole logs are provided as Appendix B and C, respectively.

On completion of the two new windowless sampler positions the surface seals at WS1, WS2 and WS3 were inspected. Remedial works were required on all positions, which comprised: the removal of the

cover and cement seal; over digging to 0.50 m and replacement of materials with new bentonite pellets, which were saturated with clean water to create a good seal around the standpipe; and re-cementing in the headworks/surface cover.

It was not possible to locate WS5, due to high grass limiting the visibility of the flush cover.

3. Winter Groundwater Monitoring

Groundwater level monitoring comprised three additional monitoring visits on 29th November 2019, 17th December 2019 and 6th January 2020. On completion of the January 2020 monitoring visit a provisional set of results were issued to the Client's representative (Stuart Burnett of Bright Plan Civils), who following liaison with Arun District Council instructed LEAP that no further works were required.

A summary of all groundwater level monitoring visits is provided as Appendix D.

We trust that the information provided within this factual report is to your satisfaction. Should you have any queries please do not hesitate to contact the undersigned.

Yours sincerely



Martin Weil

For Leap Environmental Ltd

Appendix A – Limitations

Appendix B - Figures

Appendix C – Borehole Logs

Appendix D – Groundwater Levels

APPENDIX A – Limitations

Limitations

This report is confidential to the Client, and Leap Environmental Ltd accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known, unless formally agreed by Leap Environmental Ltd beforehand. Any such party relies upon the report at their own risk. Unless explicitly agreed otherwise in writing, this report has been prepared under LEAP's standard terms and conditions, as included in the quotation for this works.

This report has been prepared by Leap Environmental Ltd on the basis of information received from a variety of sources which Leap Environmental Ltd believes to be accurate. Nevertheless, Leap Environmental Ltd cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

Leap Environmental Ltd has used all reasonable skill, care and diligence in the design and execution of this report, taking into account the manpower and resources devoted to it in agreement with the Client. Although every reasonable effort has been made to obtain all relevant information, all potential contamination, environmental constraints or liabilities associated with the site may not necessarily have been revealed. LEAP cannot be held responsible for any disclosures or changes in regulation that are provided post production of this report, and will not automatically update the report.

The conclusions reached in this report are necessarily restricted to those which can be determined from the information consulted, and may be subject to amendment in the light of additional information becoming available. These conclusions may not be appropriate for alternative schemes.

The extent of the exploratory holes, laboratory testing and monitoring undertaken may have been restricted due to a number of factors including accessibility, the presence of buried or overhead services, current development and site usage, timescales or clients specification. The exploratory holes only assess a small proportion of the site area with respect to the site as a whole, and as such may only provide an overall assessment of ground conditions on site. The presence of hotspots of undisclosed contamination or exceptional and unforeseen ground conditions cannot be discounted.

Eurocode 7 gives guidance on the type of sampling, sample quality, number and spacing of intrusive investigations, and number of laboratory tests required. It is intended that the Geotechnical Information section of this report will fulfil the general requirements of the Ground Investigation Report as set out in section 6 of Eurocode⁷¹, although this is subject to the restrictions imposed on the investigation as listed above. For geotechnical design, Eurocode 7 requires the Geotechnical Design Report to address both the geotechnical and structural aspects of the geotechnical design for both the limit and serviceability states. The Geotechnical Appraisal section of this report will not meet the requirements of a Geotechnical Design Report (GDR), and should therefore be used for preliminary guidance only.

¹ BS EN 1997 Eurocode 7- Geotechnical Design - Part 1: General Rules (2004) and Part 2: Ground Investigation and Testing (2007)

The presence of asbestos may be noted during the site walkover survey, intrusive investigations and/or from the results of contamination testing. However, this report does not constitute an asbestos survey. On this basis, the presence of asbestos on site cannot be discounted and a full asbestos survey should be undertaken.



APPENDIX B – Figures

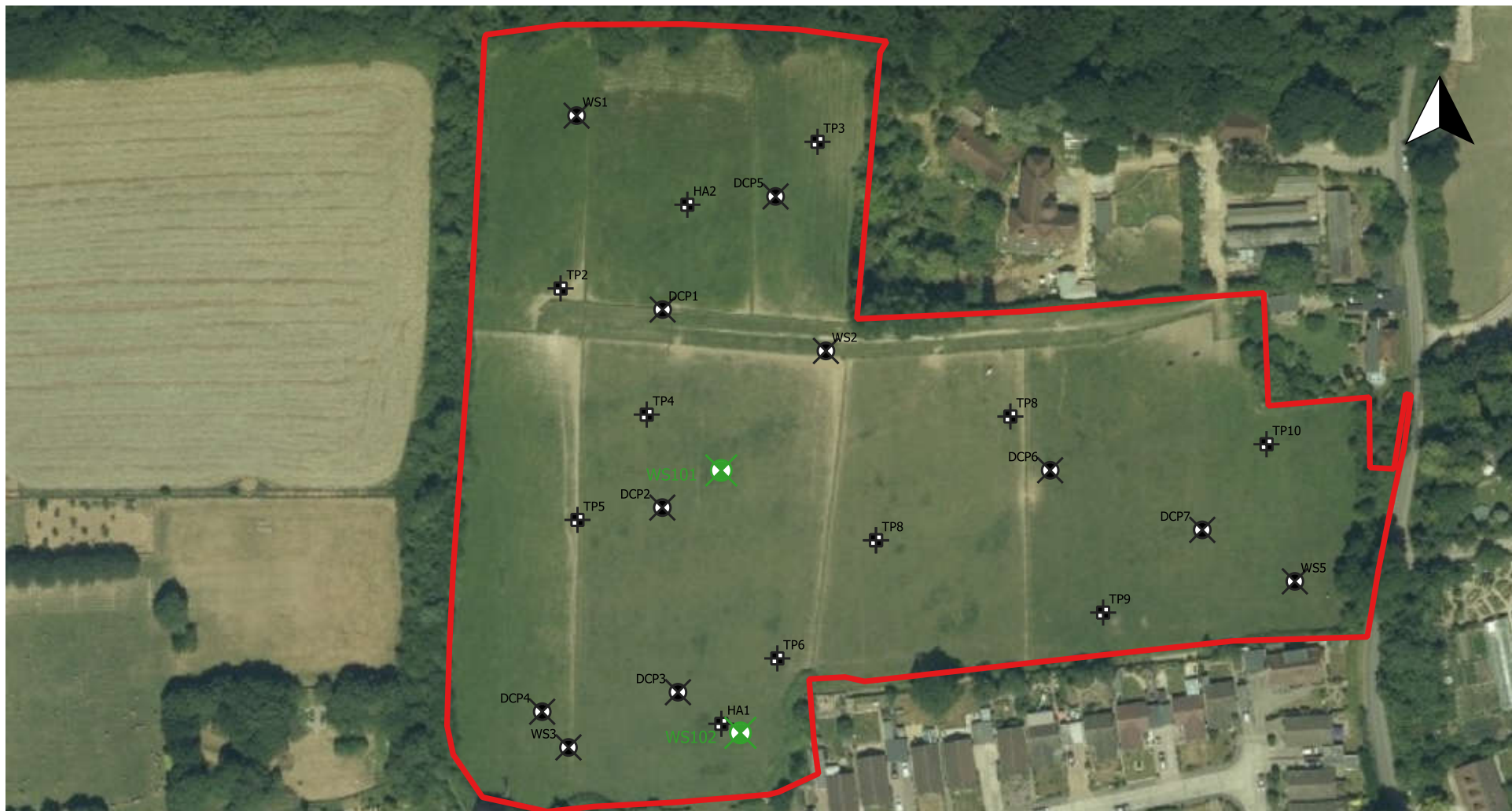
Figures



Angmering



	Client:	Persimmon Homes Thames Valley	Date:	02/04/19	Project ID:	LPI877
	Project:	Dapper's Lane Angmering	Title:	Site location	Fig. No.	I



- ✕ New monitoring wells (install to ~3.0 m bgl)
- ✕ Window sampler (Feb 2019)
- ✕ DCP (Feb 2019)
- ✕ Trial Pit (Feb 2019)



Client:	Persimmon Homes Thames Valley	Title:	Site Layout and Exploratory Hole Plan	Project ID:	LP01877
Project:	Land west of Dappers Lane, Angmering	Date:	24/01/20	Figure No.	002

APPENDIX C – Borehole Logs

Borehole Logs



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Borehole Log

Borehole No.

HA1

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
HA

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:10

Client: Persimmon Homes Thames Valley

Dates: 27/03/2019 - 27/03/2019

Logged By
MN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Grass over dark brown clayey TOPSOIL with frequent rootlets.	
					0.23			Dark brown sandy clayey SUBSOIL. Very rare fine flint gravel	
								Stiff to firm orangish red brown slightly silty CLAY. Occasional grey streaking with very rare fine angular flint gravel	
					1.00			End of borehole at 1.00 m	1
									2

Remarks

Dry and Stable. 22cm diameter



 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA Tel: 01306 646510 www.leapenvironmental.com					Borehole Log			Borehole No. HA2 Sheet 1 of 1	
Project Name: Dapper's Lane, Angmering,					Project No. LP1877		Co-ords: -		Hole Type HA
Location: Dapper's Lane Angmering, West Sussex					Level:		Scale 1:10		Logged By MN
Client: Persimmon Homes Thames Valley					Dates: 27/03/2019 - 27/03/2019				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Grass over dark brown clayey TOPSOIL with frequent rootlets.	
					0.30			Brown sandy slightly clayey gravelly SUBSOIL. Gravel is fine to coarse, rounded to sub rounded flint.	
					1.00			Orange red brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub angular flint.	
							End of borehole at 1.00 m		1
									2
Remarks Dry and Stable. 30cm diameter									



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Trial Pit Log

Trialpit No

TP10

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
3.00

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES	N=12	0.15			Grass over brown slightly gravelly silty clayey TOPSOIL. Gravel is medium to coarse, sub angular flint.	1
	0.30	ES					Firm to stiff light yellowish brown slightly silty CLAY.	
	1.00	D					Hand Pen at 0.9m = 100kPa	
	2.00	D					colour changes to grey mottled orange below 1.5m. Slightly gravelly. Gravel is angular fine selenite crystals Hand Pen at 1.7m = 160kPa	
	2.00	D		2.00			Stiff bluish grey slightly gravelly slightly silty CLAY. Hand Pen at 2.1m = 190kPa seepage at 2.2m Hand Pen at 2.4m = 210kPa	2
	3.00	D					Firm to stiff bluish grey slightly silty slightly gravelly CLAY. Gravel is extremely weak finely laminated grey mudstone. Hand Pen at 2.8m = 195kPa	
							End of pit at 3.00 m	
								3
								4
								5

Remarks: Very slight seepage observed at 2.2m depth

Stability: Stable





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Trial Pit Log

Trialpit No

TP2

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
3.00

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.05	ES	N=6	0.35			Grass over brown slightly gravelly silty clayey TOPSOIL. Gravel is medium to coarse, sub angular flint	1
	0.20	ES					Firm to stiff light yellowish brown silty CLAY with occasional pockets of sandy clay.	
	0.70	D					Hand Pen at 0.7m = 135kPa	
							Evidence of sub horizontal slip surfaces at 1.2m Hand Pen at 1.3m = 130kPa	
							Pockets of orange sandy clay at 1.6m	
	2.00	D		2.20			Stiff finely laminated grey mottled orangish brown slightly silty gravelly CLAY. Gravel is extremely weak fine to medium mudstone. Hand Pen at 2.2m = 210kPa pockets of slightly sandy clay at 2.5m Hand Pen at 2.6m = 260kPa	2
	3.00	D		3.00			End of pit at 3.00 m	3
								4
								5

Remarks: Trial pit remained dry and stable

Stability: Stable





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Trial Pit Log

Trialpit No

TP3

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
3.00

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES	N=8	0.20			Grass over brown slightly gravelly silty clayey TOPSOIL. Gravel is medium to coarse, angular to sub angular flint and fine to coarse sub rounded chalk.	
	0.30	ES					Firm light brown mottled grey silty CLAY.	
	1.00	D				<u>Hand Pen at 0.6m = 150kPa</u>	1	
						<u>pockets of slightly sandy clay below 1.1m</u>		
								
								
	2.10	D		1.30			Firm to stiff grey mottled orange slightly sandy CLAY.	2
							<u>Hand Pen at 1.9m = 150kPa</u>	
						<u>fine selenite crystals noted at 2.2m</u>		
								
						<u>clay shows relic laminations below 2.6m</u>		
								
	3.00	D	2.70			Stiff grey mottled orange slightly sandy CLAY.	3	
						<u>slip surfaces noted at 2.7m</u>		
						<u>Hand Pen at 2.8m = 165kPa</u>		
			3.00				End of pit at 3.00 m	4
								5

Remarks: Trial pit remained dry and stable

Stability: Stable





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Trial Pit Log

Trialpit No

TP4

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
2.90

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.13			Grass over slightly gravelly clayey TOPSOIL. Gravel is medium to coarse, angular to sub angular flint and fine to coarse sub angular to sub rounded chalk.	
	0.20	ES		0.30			Brown slightly gravelly silty clayey SUBSOIL. Gravel is medium to coarse, angular to sub angular flint and fine to coarse sub angular to sub rounded chalk. <i>Hand Pen at 0.13m = 130kPa</i>	
			N=8				Firm light brown silty CLAY with rare medium flint gravel.	1
	1.10	D		1.30			Stiff grey mottled orange silty CLAY. <i>Sub horizontal slip surfaces noted between 1.3-1.6m.</i> <i>Hand Pen at 1.5m = 160kPa</i>	2
	2.30	D					occasional pockets of sandy clay from 2.2m	
							clay shows relict laminations below 2.5m	
	2.90	D		2.90			End of pit at 2.90 m	3
								4
								5

Remarks: Trial pit remained dry and stable

Stability: Stable



Trial Pit Log

Trialpit No

TP5

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Scale
1:25

Client: Persimmon Homes Thames Valley

Depth
3.00

06

Logged
ADC

[illegible]

Remarks:	Trial pit remained dry and stable
----------	-----------------------------------

Stability: Stable





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Trial Pit Log

Trialpit No

TP6

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
2.90

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.10			Grass over brown slightly gravelly clayey TOPSOIL. Gravel is medium to coarse sub angular flint and fine to medium sub rounded chalk.	
	0.20	ES		0.30			Brown mottled orange slightly gravelly silty clayey SUBSOIL. Gravel is medium to coarse, sub angular flint and fine to medium sub rounded chalk Firm to stiff light brownish orange silty CLAY.	
							<i>Hand Pen at 0.7m = 200kPa</i>	
	1.10	D	N=5	1.00			Firm to stiff grey mottled orange slightly silty CLAY with pockets of orange sandy clay. <i>clay is laminated below 1.2m</i>	1
							<i>Hand Pen at 1.7m = 170kPa</i> <i>occasional selenite crystals below 1.8m</i>	
	2.10	D					<i>Hand Pen at 2.2m = 250kPa</i>	2
				2.70				
	3.00	D		2.90			Stiff grey mottled orange slightly silty slightly gravelly CLAY. Gravel is extremely weak fine to medium extremely weak mudstone. End of pit at 2.90 m	3
								4
								5

Remarks: Trial pit remained dry and stable

Stability: Stable





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Trial Pit Log

Trialpit No

TP7

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
3.10

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES	N=11	0.25			Grass over slightly gravelly silty clayey TOPSOIL with frequent roots. Gravel is fine to coarse, sub angular flint.	1
	0.30	ES					Firm light orangish brown silty CLAY with rare coarse flint.	
	1.40	D				Hand Pen at 0.6m = 130kPa	2	
						Stiff grey mottled orange silty CLAY with pockets of sandy clay. Sand is fine grained.		
	2.30	D				Hand Pen at 1.8m = 240kPa	3	
						Stiff finely laminated bluish grey slightly gravelly silty CLAY. Gravel is extremely weak grey mudstone.		
	3.00	D				slip surfaces observed at 2.3m	4	
						Hand Pen at 2.5m = 345kPa		
						selenite crystals observed below 2.7m	5	
						Hand Pen at 3m = 305kPa		
			End of pit at 3.10 m					

Remarks: Trial pit remained dry and stable

Stability: Stable





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Trial Pit Log

Trialpit No

TP8

Sheet 1 of 1

Project Name:	Dapper's Lane, Angmering,	Project No.	LP1877	Co-ords: -	Level:	Date	27/03/2019
Location:	Dapper's Lane Angmering, West Sussex			Dimensions (m):	2	Scale	1:25
Client:	Persimmon Homes Thames Valley			Depth	3.00	Logged	ADC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES					Grass over brown slightly gravelly silty clayey TOPSOIL. Gravel is medium to coarse, angular flint.	
	0.25	ES		0.30			Firm light brown silty CLAY with rare medium coarse flint gravel.	
							Hand Pen at 0.6m = 120kPa	
	1.10	D	N=11	1.00			Firm to stiff grey mottled orange silty CLAY with occasional selenite crystals.	1
							Hand Pen at 1.3m = 210kPa	
							Below 1.9m, occasional pockets of slightly sandy silty clay	2
	2.10	D					Hand Pen at 2.2m = 250kPa	
				2.80			Stiff finely laminated grey mottled orange gravelly silty CLAY. Gravel is extremely weak mudstone.	
	3.00	D		3.00			Hand Pen at 2.8m = 300kPa	3
							End of pit at 3.00 m	
								4
								5

Remarks:	Trial pit remained dry and stable										
Stability:	Stable										



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Trial Pit Log

Trialpit No

TP9

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -
Level:

Date
27/03/2019

Location: Dapper's Lane Angmering, West Sussex

Dimensions
(m):

2

Depth
3.00

0.6

Scale
1:25

Logged
ADC

Client: Persimmon Homes Thames Valley

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES	N=12	0.15			Grass over brown slightly gravelly silty clayey TOPSOIL. Gravel is medium to coarse, sub angular flint.	1
	0.30	ES		0.30			Orangish brown slightly gravelly silty clayey SUBSOIL.	
							Firm light brown slightly gravelly slightly silty CLAY.	
							Land drain at the south end of the pit between 0.4 and 0.55m comprising clayey gravel. Gravel is coarse angular flint brick. 0.4-0.55m	
							Hand Pen at 0.7m = 150kPa	
							mottled grey below 1.2m	
							Sub horizontal slip surface at 1.5m	
							Sub horizontal slip planes noted at 1.6m	
							Hand Pen at 1.7m = 260kPa	
							Hand Pen at 2.4m = 245kPa	
							relict laminations below 2.8m	
							End of pit at 3.00 m	
	1.50	D	N=12				Sub horizontal slip surface at 1.5m	2
							Sub horizontal slip planes noted at 1.6m	
							Hand Pen at 1.7m = 260kPa	
							Hand Pen at 2.4m = 245kPa	
							relict laminations below 2.8m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
	2.50	D	N=12				Sub horizontal slip surface at 1.5m	3
							Sub horizontal slip planes noted at 1.6m	
							Hand Pen at 1.7m = 260kPa	
							Hand Pen at 2.4m = 245kPa	
							relict laminations below 2.8m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
	3.00	D	N=12	3.00			Sub horizontal slip surface at 1.5m	4
							Sub horizontal slip planes noted at 1.6m	
							Hand Pen at 1.7m = 260kPa	
							Hand Pen at 2.4m = 245kPa	
							relict laminations below 2.8m	
							End of pit at 3.00 m	
							End of pit at 3.00 m	
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							End of pit at 3.00 m	



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Borehole Log

Borehole No.

WS1

Sheet 1 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.18	ES		0.20			Grass over dark brown silty clayey TOPSOIL.	
					0.45			Dark brown silty slightly gravelly clayey SUBSOIL. Gravel is fine sub-rounded to rounded, chalk and coarse, sub-angular to sub-rounded flint.	
								Firm orange brown slightly silty CLAY with rare coarse, sub-angular to sub-rounded flint.	
		0.90	D					Hand Pen at 0.8m =170kPa Frequent roots to 0.1m	1
		1.20		N=9 (1,1/1,2,2,4)				Becomes stiff below 1.2m	
		1.50	D						
		2.00		N=11 (1,2/2,2,3,4)				Becomes grey below 1.9m Hand Pen at 2.1m =270kPa	2
		2.50	D						
		3.00		N=11 (1,2/2,2,3,4)				Hand Pen at 2.9m =350kPa	3
		3.50	D		3.35			Extremely weak dark brown mottled grey relicly laminated MUDSTONE with occasional partings of stiff clay. Hand Pen at 3.3m =380kPa	
		4.00		N=13 (2,2/3,3,3,4)				Hand Pen at 3.8m =390kPa	4

Continued on next sheet

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.





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Borehole Log

Borehole No.

WS1

Sheet 2 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

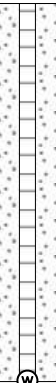
Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		4.70 - 5.00	D						
		5.00		N=13 (1,3/2,3,4,4)	5.00			Hand Pen at 4.5m exceeds 500kPa	
								End of borehole at 5.00 m	5
									6
									7
									8

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.





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Borehole Log

Borehole No.

WS2

Sheet 1 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.40				
		0.60	ES						
		0.87	D		1.00				
		1.20		N=12 (1,2/3,3,3,3)					1
		1.60	D		1.60				
		2.00		N=10 (1,1/2,2,3,3)					2
		2.50	D						
		3.00		N=12 (1,2/2,3,3,4)					3
		3.50	D						
		4.00		N=13 (1,2/2,3,4,4)					4

Continued on next sheet

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.





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Borehole Log

Borehole No.

WS2

Sheet 2 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

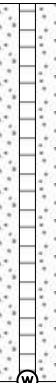
Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					4.50			Hand Pen at 4.2m =410kPa	
		4.80	D					Stiff grey slightly silty gravelly CLAY. Gravel is fine to coarse sub-angular to angular mudstone.	
		5.00		N=15 (2,2/3,3,4,5)	5.00			Hand Pen at 4.8m =410kPa	
								End of borehole at 5.00 m	5
									6
									7
									8

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.





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Borehole Log

Borehole No.

WS3

Sheet 1 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	ES		0.20			Grass over brown silty clay TOPSOIL. <i>Frequent rootlets to 0.1m</i>	
		0.30	ES		0.40			Pale brown pale orange slightly gravelly silty clayey SUBSOIL. Gravel is fine angular flint.	
								Firm orange brown slightly silty very gravelly CLAY. Gravel is fine to coarse sub-rounded to angular flint. <i>Hand Pen at 0.6m =290kPa</i>	
		1.00	D		1.10				1
		1.20		N=13 (1,1/3,3,3,4)				Stiff orange mottled grey slightly silty slightly sandy CLAY. Sand is fine to medium grained. <i>Hand Pen at 1.2m =320kPa</i>	
								<i>Hand Pen at 1.5m =280kPa</i>	
		1.70	D						
		2.00		N=24 (2,2/4,6,7,7)	2.25			<i>Hand Pen at 1.9m =290kPa</i> <i>Hand Pen at 2.1m =380kPa</i>	2
								Stiff brown orange very gravelly CLAY. Gravel is fine to coarse angular flint.	
		2.60	D						
		3.00		N=14 (1,2/2,3,4,5)	3.00			Stiff grey mottled orange brown slightly silty slightly sandy CLAY. Sand is fine grained. <i>Hand Pen at 3.3m =400kPa</i>	3
		3.50	D					<i>Hand Pen at 3.8m =340kPa</i>	
		4.00		N=12 (1,2/3,2,3,4)				Continued on next sheet	4

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.





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Borehole Log

Borehole No.

WS3

Sheet 2 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WS

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

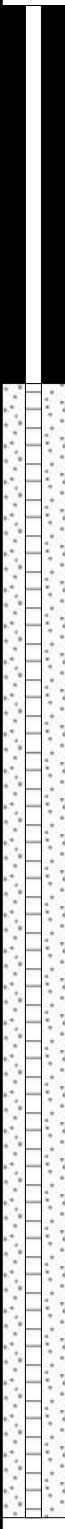
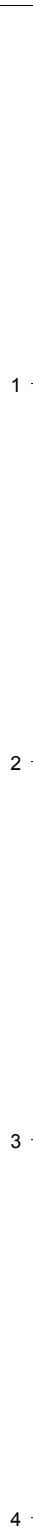
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
W		5.00		N=14 (2,2/3,3,3,5)	5.00			Hand Pen at 4.05m = 380kPa	5
								Rare mudstone gravel below 4.6m	
								Hand Pen at 4.9m = 410kPa	
								End of borehole at 5.00 m	
									6
									7
									8

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.



 Leap Environmental Ltd The Atrium, Curtis Road Dorking, Surrey RH4 1XA Tel: 01306 646510 www.leapenvironmental.com		Borehole Log			Borehole No. WS5 Sheet 1 of 2	
Project Name: Dapper's Lane, Angmering,		Project No. LP1877		Co-ords: -		Hole Type WS
Location: Dapper's Lane Angmering, West Sussex		Level:		Scale 1:20		
Client: Persimmon Homes Thames Valley		Dates: 26/02/2019 - 26/02/2019		Logged By ADC		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.50		Grass over dark brown mottled pale orange slightly silty very clayey TOPSOIL with occasional fine to coarse, sub-angular to angular, flint.		
		0.60	D						Firm pale orange brown mottled grey slightly silty CLAY with rare fine angular flint gravel.
		0.80	ES						Hand Pen at 0.7m =170kPa
		1.10	D		1.40				Hand Pen at 1m =140kPa
		1.20		N=7 (3,2/1,2,1,3)			Becomes stiff below 1.2m		
		1.40 - 1.60	B				Coarse angular flint gravel between 1.25 and 1.35m		
		2.00		N=14 (2,2/4,4,3,3)		Firm to stiff brown orange slightly silty slightly sandy CLAY. Sand if fine grained. Occasional medium to coarse, angular flint gravel.			
		2.50	D			Hand Pen at 1.4m =170kPa			
		3.00		N=13 (1,3/2,3,4,4)		Hand Pen at 1.75m =240kPa			
		3.50	D		3.00		Relict lamination visible below 2.5m		
	4.00		N=13 (3,3/3,3,3,4)	Hand Pen at 2.85m =230kPa					
				Stiff dark orange brown mottled grey slightly silty CLAY.					
						Partings of dark orange coarse sandy clay.			
						Hand Pen at 3.2m =250kPa			
						Colour becomes grey below 3.3m			
						Hand Pen at 3.8m =270kPa			
						Continued on next sheet			

Remarks
 Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.



Borehole Log

Borehole No.

WS5

Sheet 2 of 2

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type	WS
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
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36	36
37	37
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68	68
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77	77
78	78
79	79
80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

Location: Dapper's Lane Angmering, West Sussex

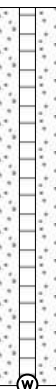
Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 26/02/2019 - 26/02/2019

Logged By
ADC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		4.10	D					<u>Sampler was recovered wet below 4m</u>	5
		4.50	D					<u>Very stiff below 4m along with rare fine gravel of extremely weak mudstone.</u>	
								<u>Parting of clayey sand between 4 and 4.15m</u>	
5.00		N=17 (2,3/4,4,4,5)	5.00			<u>Slightly sandy below 4.2m</u>	End of borehole at 5.00 m	5	
									6
									7
									8

Remarks

Stable. Sampler was recovered wet below 4m. Water monitoring well installed. The install comprised slotted pipe from 5mbgl to 1mbgl and plane pipe from 1mbgl to ground level. The borehole was backfilled with gravel from 5mbgl to 1mbgl and bentonite from 1mbgl to the ground surface. The installation was capped with a metal cover which was flush to ground level.





Leap Environmental Ltd
The Atrium, Curtis Road
Dorking, Surrey RH4 1XA
Tel: 01306 646510
www.leapenvironmental.com

Borehole Log

Borehole No.

WS101

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WLS

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 22/11/2019 - 22/11/2019

Logged By
MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.15			Grass over grey brown clayey TOPSOIL.	
					0.50			Soft becoming firm yellowish brown slightly gravelly silty CLAY.	
		1.00		N=6 (0,2/1,2,1,2)	1.50			Firm brown yellowish orange slightly gravelly CLAY. Gravel is fine chalk and occasional fine to coarse sub-angular flint. <u>Hand Pen at 0.5m =140kPa</u>	1
		2.00		N=10 (1,2/2,2,2,4)				Firm becoming stiff grey mottled brown CLAY with occasional relict rootlets. <u>Hand Pen at 1.5m =190kPa</u>	2
		3.00		N=9 (1,2/2,2,2,3)	3.00			<u>Hand Pen at 2m =260kPa</u> <u>Hand Pen at 2.5m =210kPa</u>	3
								End of borehole at 3.00 m	4

Remarks

Borehole remained dry and stable.





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Borehole Log

Borehole No.

WS102

Sheet 1 of 1

Project Name: Dapper's Lane, Angmering,

Project No.
LP1877

Co-ords: -

Hole Type
WLS

Location: Dapper's Lane Angmering, West Sussex

Level:

Scale
1:20

Client: Persimmon Homes Thames Valley

Dates: 22/11/2019 - 22/11/2019

Logged By
MW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.40			Grass over grey brown clayey TOPSOIL.	
								Firm becoming stiff orange mottled brown gravelly CLAY. Gravel is sub-angular to rounded flint. <i>Hand Pen at 0.5m =100kPa</i>	
		1.00		N=11 (2,2/2,3,3,3)				<i>More gravelly between 0.8m - 1.6m</i> <i>Hand Pen at 1m =150kPa</i>	1
								<i>Too gravelly for Hand Pen.</i>	
		2.00		N=8 (1,2/2,2,2,2)	2.00			<i>Slightly sandy between 1.6m - 2.0m. Sand is Medium to coarse.</i>	
								Stiff grey mottled orange brown slightly gravelly silty CLAY. Gravel is sub-angular to rounded flint. <i>Hand Pen at 2m =210kPa</i>	2
								<i>Hand Pen at 2.5m =150kPa</i>	
		3.00		N=37 (5,2/6,8,12,11)				<i>Hand Pen at 3m =230kPa</i> <i>Becomes more gravelly below 3.0m</i>	3
					3.45			End of borehole at 3.45 m	
									4

Remarks

Borehole remained stable. Slight seepage noted at 1.0mbgl



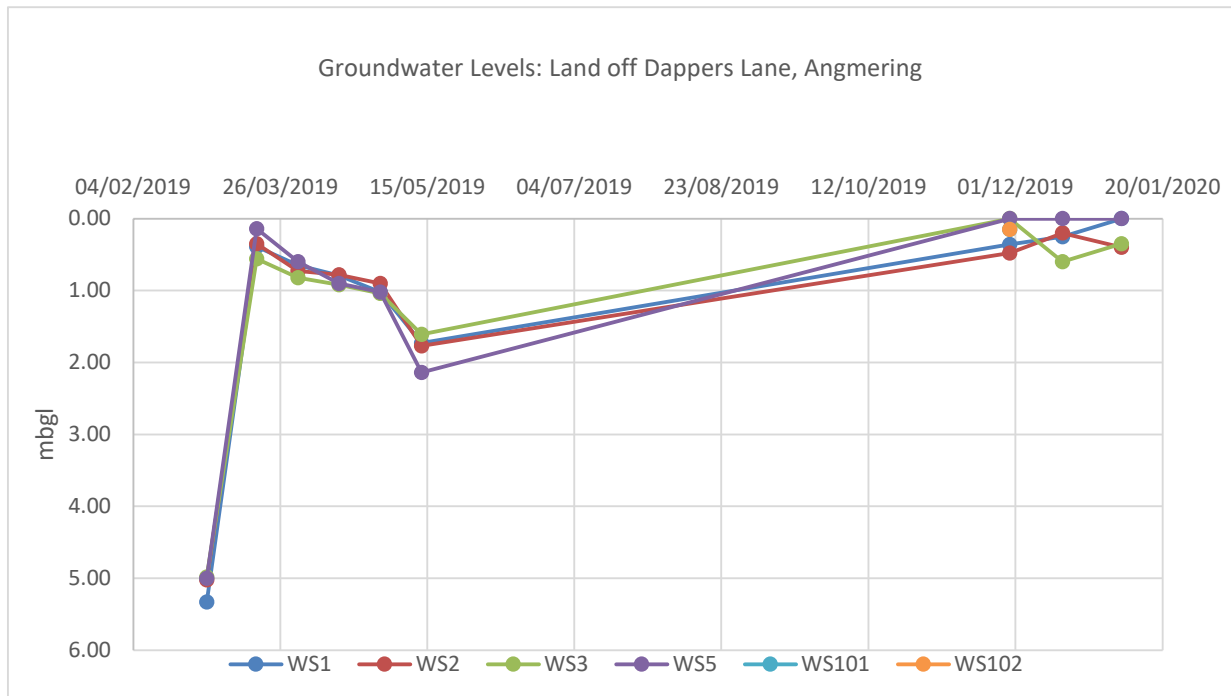
APPENDIX D – Groundwater Levels

Groundwater Levels

		01/03/19	18/03/19	01/04/19	15/04/19	29/04/19	13/05/19	29/11/19	17/12/19	06/01/20
Well Depth	Well No.	mbgl	mbgl	mbgl	mbgl	mbgl	mbgl	mbgl	mbgl	mbgl
5	WS1	5.33	0.39	0.65	0.79	1.02	1.73	0.36	0.25	0.00
5	WS2	5.02	0.35	0.73	0.78	0.9	1.77	0.48	0.20	0.40
5	WS3	4.98	0.56	0.82	0.92	1.04	1.61	2.24^	0.60	0.35
5	WS5	5	0.14	0.6	0.9	1.02	2.14	n/a	n/a	n/a
3	WS101	-	-	-	-	-	-	0.15	0.2	0.15
3	WS102	-	-	-	-	-	-	0.15	0.2	0.15

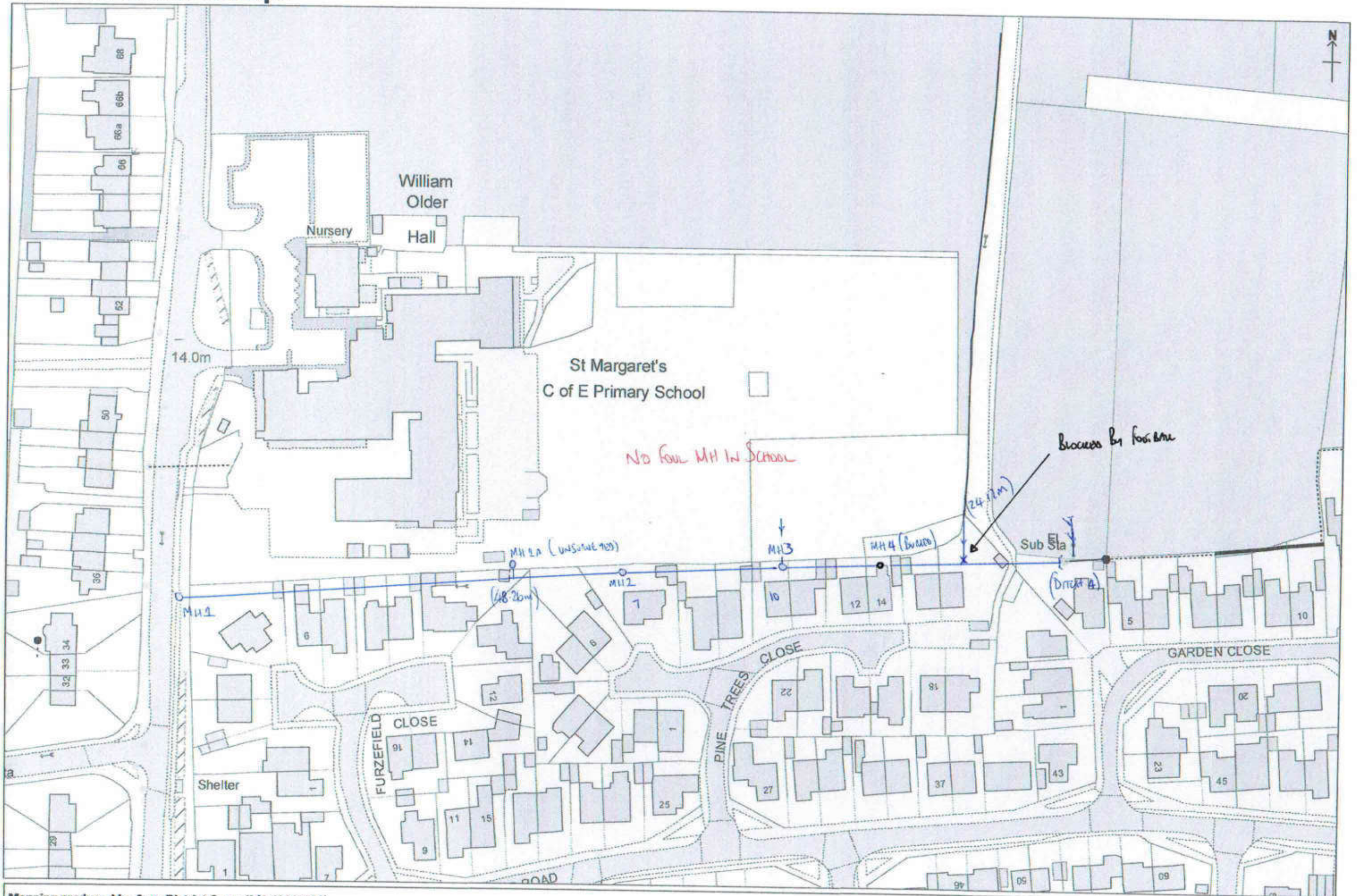
n/a = not accessible / located due to high grass

^ = Position baled dry on 22/11/19



Appendix E - EEG (Ultraflow) Drainage Investigation

Arun District Council Maps



Mapping produced by Arun District Council (1:1000@A3)

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Production Date: 02 September 2019

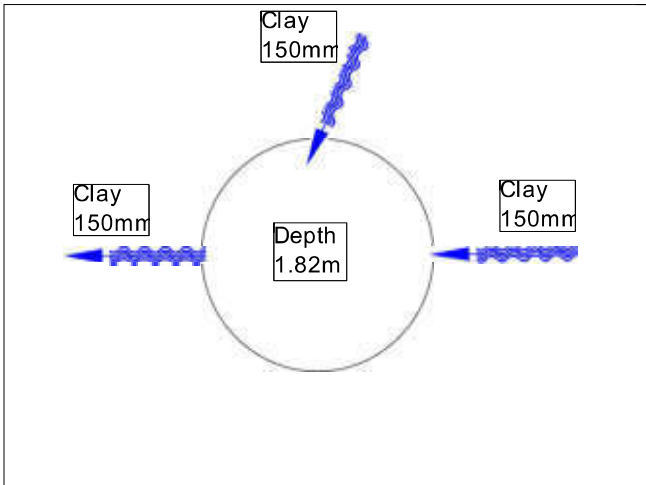
www.arun.gov.uk



Manhole Details

Item Type	Manhole	System Type	Foul	Owner	Public	Date of Survey	24/09/2019
Downstream Watercourse		Origin of Data		Other Source			
Easting (m)	507029.912	Northing (m)	105012.021	Identifier		Asset Reference	
Ladder	No	Step Irons	2	Side Entry	No	Manhole Construction	Precast Concrete
						Number of Landings	0
Cover Level (m AOD)	18.367	Cover Shape	Rectangle	Other Shape			Cover Duty
							Heavy
Cover Width (m)	0.53	Cover Length (m)	0.68	Manufacturer			Grating
							No
Shaft Width (m)	0.45	Shaft Length (m)	0.61	Chamber Width (m)	1.05	Chamber Length (m)	0
Flap Valve	No	Orifice	No	Sluice Gate	No	Weir	No
						Screens	No
						Penstock	No
						Flume	No
						Headwall	

Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											



Manhole Details

Item Type	Manhole	System Type	Foul	Owner	Public	Date of Survey	524/09/201
Downstream Watercourse		Origin of Data		Other Source			
Easting (m)	507027.902	Northing (m)	105058.948	Identifier		Asset Reference	
Manhole	0002						
Ladder	☐	Step Irons	☐	Side Entry	☐	Manhole Construction	
Number of Landings	0						
Cover Level (m AOD)	19.571	Cover Shape	Rectangle	Other Shape			Cover Duty
Cover Width (m)	0	Cover Length (m)	0	Manufacturer	Lid damaged		Grating
	No						
Shaft Width (m)	0	Shaft Length (m)	0	Chamber Width (m)	0	Chamber Length (m)	0
Flap Valve	☐	Orifice	☐	Sluice Gate	☐	Weir	☐
Screens	☐	Penstock	☐	Flume	☐	Headwall	☒

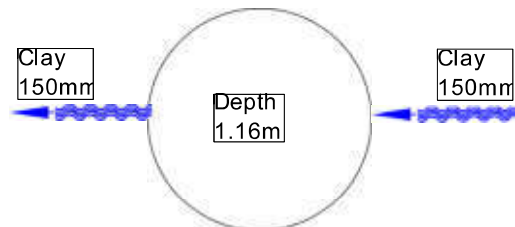
Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											

Lid damaged so
unable to lift



Manhole Details															
Item Type	Manhole		System Type	Foul		Owner	Public		Date of Survey	24/09/2019					
Downstream Watercourse				Origin of Data	Internal Survey		Other Source								
Easting (m)	507104.834		Northing (m)	105065.439		Identifier		Asset Reference							
Ladder	No	Step Irons	1	Side Entry	No	Manhole Construction	Precast Concrete		Number of Landings	0					
Cover Level (m AOD)	20.304		Cover Shape	Rectangle		Other Shape			Cover Duty	Medium					
Cover Width (m)	0.54		Cover Length (m)	0.68		Manufacturer			Grating	No					
Shaft Width (m)	0.47		Shaft Length (m)	0.6		Chamber Width (m)	1.05		Chamber Length (m)	0					
Flap Valve	No	Orifice	No	Sluice Gate	No	Weir	No	Screens	No	Penstock	No	Flume	No	Headwall	

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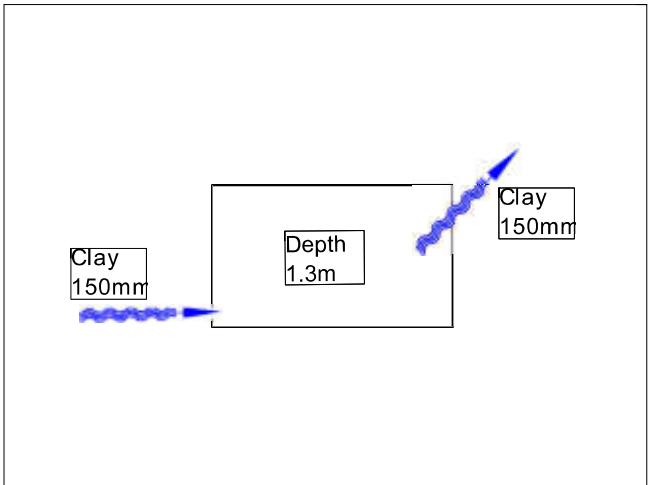
Manhole Details

Item Type	Manhole	System Type	Foul	Owner	Public	Date of Survey	26/09/2019
Downstream Watercourse		Origin of Data	Internal Survey	Other Source			
Easting (m)	0	Northing (m)	0	Identifier		Asset Reference	
Ladder	No	Step Irons		Side Entry	No	Manhole Construction	
						Number of Landings	0
Cover Level (m AOD)	0	Cover Shape		Other Shape		Cover Duty	Heavy
Cover Width (m)	0	Cover Length (m)	0	Manufacturer		Grating	No
Shaft Width (m)	0	Shaft Length (m)	0	Chamber Width (m)	0	Chamber Length (m)	0
Flap Valve	No	Orifice	No	Sluice Gate	No	Weir	No
						Screens	No
						Penstock	No
						Flume	No
						Headwall	

Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											

Manhole Details											
Item Type	Manhole		System Type	Foul		Owner	Public		Date of Survey	24/09/2019	
Downstream Watercourse				Origin of Data	Internal Survey		Other Source				
Easting (m)	506744.696		Northing (m)	105029.49		Identifier			Asset Reference		
Ladder	No		Step Irons	No		Side Entry	No		Manhole Construction	Precast Concrete	
Cover Level (m AOD)	13.17		Cover Shape				Other Shape			Number of Landings	0
Cover Width (m)	0.58		Cover Length (m)	0.6		Manufacturer				Grating	No
Shaft Width (m)	0.55		Shaft Length (m)	0.6			Chamber Width (m)	0.76		Chamber Length (m)	1.34
Flap Valve	No		Orifice	No		Sluice Gate	No		Weir	No	
Screens	No		Penstock	No		Flume	No		Headwall		

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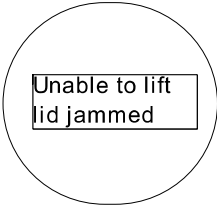


Manhole Details

Item Type	Manhole	System Type	Surface Water	Owner	Public	Date of Survey	24/09/2019
Downstream Watercourse		Origin of Data		Other Source			
Easting (m)	506745.143	Northing (m)	105068.964	Identifier		Asset Reference	
				Manhole	7003		
Ladder	☐	Step Irons	☐	Side Entry	☐	Manhole Construction	
						Number of Landings	0
Cover Level (m AOD)	13.486	Cover Shape	Circular	Other Shape			Cover Duty
							Heavy
Cover Width (m)	0.56	Cover Length (m)	0	Manufacturer			Grating
							No
Shaft Width (m)	0	Shaft Length (m)	0	Chamber Width (m)	0	Chamber Length (m)	0
Flap Valve	☐	Orifice	☐	Sluice Gate	☐	Weir	☐
						Screens	☐
						Penstock	☐
						Flume	☐
						Headwall	☒

Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											

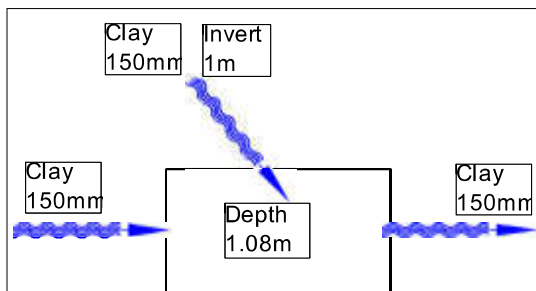
7003



Manhole Details

Item Type	Manhole	System Type	Foul	Owner	Public	Date of Survey	24/09/2019
Downstream Watercourse		Origin of Data	Internal Survey	Other Source			
Easting (m)	0	Northing (m)	0	Identifier		Asset Reference	
Ladder	No	Step Irons	No	Side Entry	No	Manhole Construction	Precast Concrete
						Number of Landings	0
Cover Level (m AOD)	0	Cover Shape	Circular	Other Shape			Cover Duty
							Heavy
Cover Width (m)	0.56	Cover Length (m)	0	Manufacturer			Grating
							No
Shaft Width (m)	0	Shaft Length (m)	0	Chamber Width (m)	0.87	Chamber Length (m)	1.08
Flap Valve	No	Orifice	No	Sluice Gate	No	Weir	No
						Screens	No
						Penstock	No
						Flume	No
						Headwall	

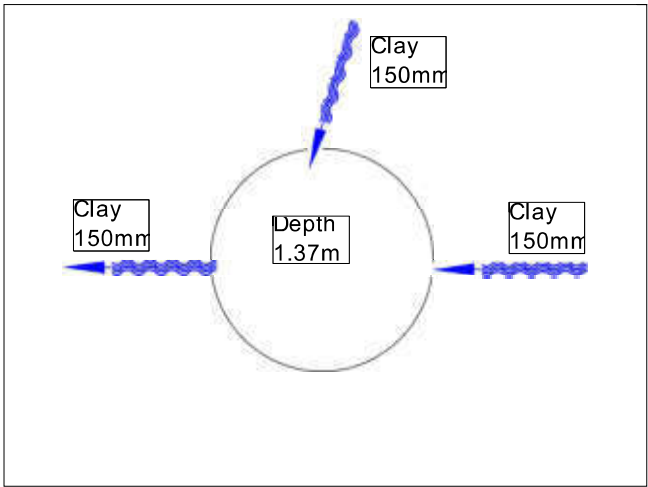
Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											



Manhole Details

Item Type	Manhole	System Type	Foul	Owner	Public	Date of Survey	24/09/2019
Downstream Watercourse		Origin of Data	Internal Survey	Other Source			
Easting (m)	506914.042	Northing (m)	105002.254	Identifier		Asset Reference	
Manhole	9001						
Ladder	No	Step Irons	2	Side Entry		Manhole Construction	
Number of Landings	0						
Cover Level (m AOD)	16.741	Cover Shape	Rectangle	Other Shape			Cover Duty
Heavy							
Cover Width (m)	0.53	Cover Length (m)	0.68	Manufacturer			Grating
No							
Shaft Width (m)	0.54	Shaft Length (m)	0	Chamber Width (m)	1.05	Chamber Length (m)	0
Flap Valve	No	Orifice	No	Sluice Gate	No	Weir	No
Screens	No	Penstock	No	Flume	No	Headwall	☒

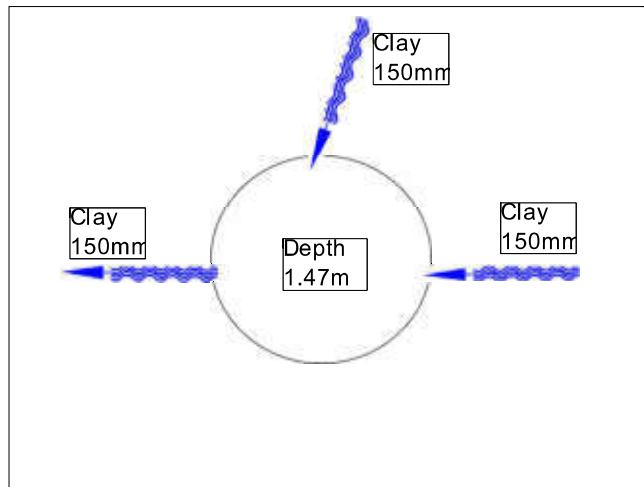
Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											



Manhole Details

Item Type	Manhole	System Type	Foul	Owner	Public	Date of Survey	24/09/2019
Downstream Watercourse		Origin of Data	Internal Survey	Other Source			
Easting (m)	506940.172	Northing (m)	105003.064	Identifier		Asset Reference	
Ladder	No	Step Irons	1	Side Entry	No	Manhole Construction	Precast Concrete
						Number of Landings	0
Cover Level (m AOD)	17.022	Cover Shape	Rectangle	Other Shape			Cover Duty
							Medium
Cover Width (m)	0.53	Cover Length (m)	0.68	Manufacturer			Grating
							No
Shaft Width (m)	0.45	Shaft Length (m)	0.58	Chamber Width (m)	1.05	Chamber Length (m)	0
Flap Valve	No	Orifice	No	Sluice Gate	No	Weir	No
						Screens	No
						Penstock	No
						Flume	No
						Headwall	

Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											



Manhole Details

Item Type	Manhole	System Type	Foul	Owner	Public	Date of Survey	24/09/2019
Downstream Watercourse		Origin of Data		Other Source			
Easting (m)	506979.157	Northing (m)	105007.517	Identifier		Asset Reference	
Manhole	9003						
Ladder	☐	Step Irons	☐	Side Entry	☐	Manhole Construction	
Number of Landings	0						
Cover Level (m AOD)	17.563	Cover Shape	Rectangle	Other Shape			Cover Duty
Cover Width (m)	0.53	Cover Length (m)	0.68	Manufacturer	Manhole lid damaged		Grating
	No						
Shaft Width (m)	0	Shaft Length (m)	0	Chamber Width (m)	0	Chamber Length (m)	0
Flap Valve	☐	Orifice	☐	Sluice Gate	☐	Weir	☐
Screens	☐	Penstock	☐	Flume	☐	Headwall	☒

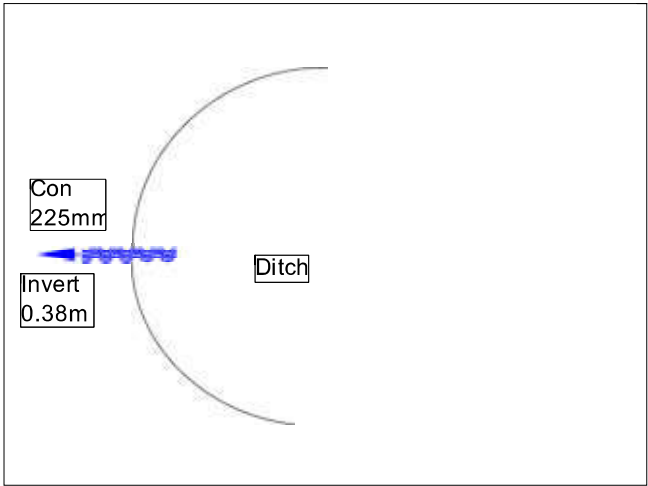
Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											

Lid damaged
unable to lift



Outfall Details															
Item Type	Outfall	System Type		Owner	Public	Date of Survey	24/09/2019								
Downstream Watercourse		Origin of Data	External Survey	Other Source											
Easting (m)	507017.801	Northing (m)	105081.513	Identifier		Asset Reference		Manhole	Ditch (4)						
Ladder		Step Irons		Side Entry		Manhole Construction		Number of Landings							
Cover Level (m AOD)	19.103	Cover Shape		Other Shape		Cover Duty									
Cover Width (m)		Cover Length (m)		Manufacturer		Grating									
Shaft Width (m)		Shaft Length (m)		Chamber Width (m)		Chamber Length (m)									
Flap Valve		Orifice		Sluice Gate		Weir		Screens		Penstock		Flume		Headwall	

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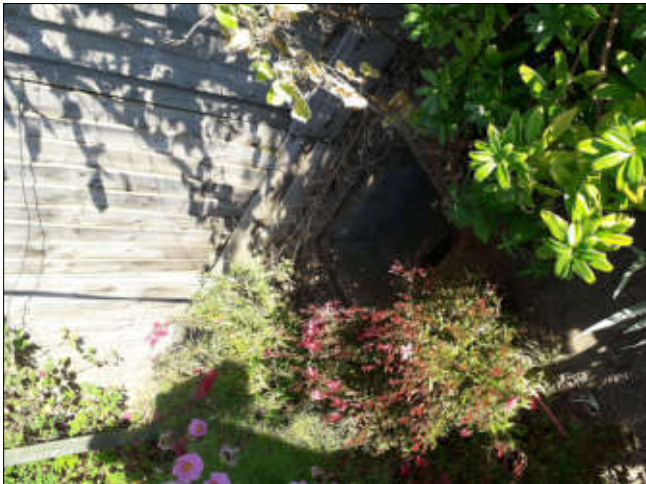
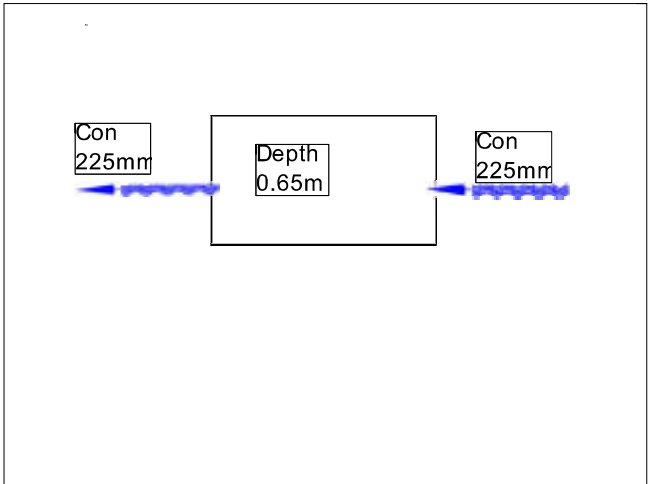


Details															
Item Type		System Type		Owner		Date of Survey	24/09/2019								
Downstream Watercourse			Origin of Data			Other Source									
Easting (m)	0	Northing (m)	0	Identifier		Asset Reference			Manhole	Ditch(4)					
Ladder		Step Irons		Side Entry		Manhole Construction			Number of Landings	0					
Cover Level (m AOD)	0	Cover Shape			Other Shape			Cover Duty							
Cover Width (m)	0	Cover Length (m)	0	Manufacturer				Grating							
Shaft Width (m)	0	Shaft Length (m)	0		Chamber Width (m)	0	Chamber Length (m)	0							
Flap Valve		Orifice		Sluice Gate		Weir		Screens		Penstock		Flume		Headwall	

[illegible]

Manhole Details																							
Item Type	Manhole		System Type	Surface Water		Owner	Public		Date of Survey	24/09/2019													
Downstream Watercourse				Origin of Data	Internal Survey		Other Source																
Easting (m)	506888.605		Northing (m)	105077.678		Identifier			Asset Reference		Manhole	MH 2											
Ladder	No		Step Irons	No		Side Entry	No		Manhole Construction	Precast Concrete		Number of Landings	0										
Cover Level (m AOD)	16.79		Cover Shape	Rectangle		Other Shape				Cover Duty	Low												
Cover Width (m)	0.64		Cover Length (m)	0.49		Manufacturer				Grating	No												
Shaft Width (m)	0		Shaft Length (m)	0		Chamber Width (m)	0.62		Chamber Length (m)	0.46													
Flap Valve	No		Orifice	No		Sluice Gate	No		Weir	No		Screens	No		Penstock	No		Flume	No		Headwall		

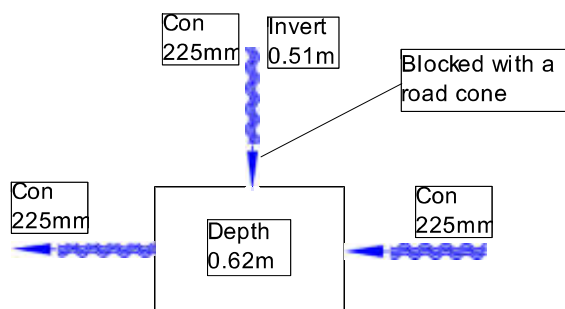
[illegible]



Manhole Details

Item Type	Manhole	System Type	Surface Water	Owner	Public	Date of Survey	24/09/2019
Downstream Watercourse		Origin of Data	Internal Survey	Other Source			
Easting (m)	506936.794	Northing (m)	105079.24	Identifier		Asset Reference	
Ladder	No	Step Irons	No	Side Entry	No	Manhole Construction	Precast Concrete
						Number of Landings	0
Cover Level (m AOD)	17.7	Cover Shape	Rectangle	Other Shape			Cover Duty
							Medium
Cover Width (m)	0.67	Cover Length (m)	0.51	Manufacturer			Grating
							No
Shaft Width (m)	0	Shaft Length (m)	0	Chamber Width (m)	0.6	Chamber Length (m)	0.4
Flap Valve	No	Orifice	No	Sluice Gate	No	Weir	No
						Screens	No
						Penstock	No
						Flume	No
						Headwall	

Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											



Manhole Details

Item Type	Manhole	System Type	Surface Water	Owner	Public	Date of Survey	24/09/2019
Downstream Watercourse		Origin of Data		Other Source			
Easting (m)	0	Northing (m)	0	Identifier		Asset Reference	
Manhole	MH 4						
Ladder		Step Irons		Side Entry		Manhole Construction	
Number of Landings	0						
Cover Level (m AOD)	0	Cover Shape			Other Shape		
Cover Duty							
Cover Width (m)	0	Cover Length (m)	0	Manufacturer			
Grating							
Shaft Width (m)	0	Shaft Length (m)	0	Chamber Width (m)	0	Chamber Length (m)	0
Flap Valve		Orifice		Sluice Gate		Weir	
Screens		Penstock		Flume		Headwall	☒

Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											

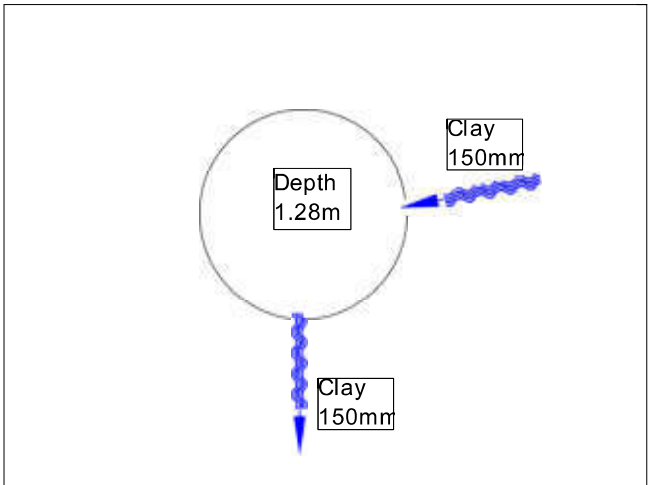
MH 4

Unable to gain
access to garden

Manhole Details

Item Type	Manhole	System Type	Foul	Owner	Public	Date of Survey	24/09/2019	
Downstream Watercourse		Origin of Data	Internal Survey	Other Source				
Easting (m)	506909.976	Northing (m)	105049.627	Identifier		Asset Reference		
Ladder	No	Step Irons	1	Side Entry	No	Manhole Construction	Brick	
						Number of Landings	0	
Cover Level (m AOD)	17.125	Cover Shape	Rectangle	Other Shape			Cover Duty	Medium
Cover Width (m)	0.53	Cover Length (m)	0.68	Manufacturer			Grating	No
Shaft Width (m)	0.55	Shaft Length (m)	0	Chamber Width (m)	1.05	Chamber Length (m)	0	
Flap Valve	No	Orifice	No	Sluice Gate	No	Weir	No	
				Screens	No	Penstock	No	
				Flume	No	Headwall		

Video Ref.	Photo Ref.	Dist (m)	Cont. defect	Letters				Numbers					Remarks
				Code	Joint	Material	Band	Dimension		%	Clock		
								1	2		At/ From	To	
		0.0											



Appendix F - Arun District Council Correspondence

From: Paul Cann
Sent: 05 November 2019 15:43
To: Stuart Burnett
Subject: RE: D1260 Dappers Lane, Angmering

Hi Stuart

In terms of the culvert, we need to ensure that it is fit for purpose now and for the foreseeable future, before allowing any formal discharge from the new development to it. We are more than happy to work with Persimmons in terms of getting the identified issues resolved.

Whilst, we work on behalf of WSCC (the lead local flood authority) in terms of undertaking enforcement in respect to land drainage, you are no doubt aware, that we are significantly understaffed at present and therefore formal enforcement against landowners could be a long process and therefore not in alignment with the developments timescales. Also, not all of the identified issues are enforceable.

I have summarised below the main issues identified by the CCTV survey that need resolving;

MH1 to MH2 (225mm dia)

4.5m JDM/OJM
14.7m JDM/OJM
23.2m JDM/OJM
41.4m Brick through side & multiple fractures (Could possibly be repaired internally/remotely ie. cutting/patch lining?) (Survey abandoned)

MH2 to MH1 (225mm dia)

30.4m Top of pipe has been previously cut out, but then fixed back in position – ok
47.35m JDM
55.6m Multiple fractures & hole (Suggest patch lining repair)
57.5m JDM/OJM
58.2m Small hole & fractures in invert (Suggest patch lining repair)
72.5m JDM
74.2m JDM
82.0m Hole in top of pipe but appears plugged - ok
91.0m JDM (Survey abandoned)

MH1 to MH2 will require full CCTV after remedial works to check remainder of pipeline not surveyed. Any issues found to be discussed.

MH2 to MH3 (225mm dia)

25.4m Hole in top of pipe but appears plugged - ok

MH3 to MH4 (225mm dia)

1.9m JDM & soil deposits
4.3m Hole in top of pipe and fractures (Suggest patch lining repair)
13.26m JDM & debris deposits

27.6m Encrustation at joint (Suggest remote cutting due to no access to immediately adjacent manhole)

MH4 to MH5? (225mm dia)

20.1m Length of guttering pipeline (Survey abandoned)

Ditch to MH4 (225mm dia)

6.05m On verge of collapse (under building?)

10.7m Metallic spike from fence post/fractures

24.0m Intruding poor connection and football obstruction (Survey abandoned)

MH4 to Ditch will require full CCTV after remedial works to check remainder of pipeline not surveyed. Any issues found to be discussed.

In terms of way forward, may I suggest that you obtain prices for undertaking the necessary repair works (some repairs can be done internally rather than open excavation). All the above works need to be considered unless there is an 'ok'. Once you have this information, we can discuss the matter further.

If the culvert were diverted into the school land (ensuring any existing connections are reconnected to the new pipe and the existing pipe filled with concrete to abandon it), then legally the school would become responsible for it as landowner. The other landowners would also have to agree to it.

An alternative would be to lay a private surface water pipe on that same school route and connect into manhole 1, therefore bypassing the issues. This pipe would need to be maintained by Persimmons management company unless you offer it for adoption to Southern Water or requisition it from Southern Water.

I await to hear from you once you have considered the above.

Regards

Paul Cann

Senior Engineer (Drainage & Coastal)

[Paul Cann](#) | Senior Engineer (Drainage & Coastal), Engineering Services, [Arun District Council](#) |

Location: First Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF

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Paul.Cann@arun.gov.uk

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Visit Arun's web site at <http://www.arun.gov.uk/> and www.chichester.gov.uk

P Save the environment - think before you print.

Arun District Council Enquiry

Hi Mark

Comments below;

1. I am sure Kevin will comment in respect to the flood zones.
2. There are known existing watercourses (open and culverted) on the southern and western boundaries of the site. These are believed to drain to Station Road to the west. There are historical known problems with this system, especially where it is culverted through Furzefield Close.
3. There is a fragmented land drainage system in Dappers Lane. Overland/overspill flows that use the lane as a conduit have contributed to the historical flooding in Angmering Village. Angmering Parish Council have undertaken works in Dappers Lane (operation watershed?) but more work is needed to bring the drainage system back into full working order. The main source of the flooding in Angmering Village is the Black ditch (main river).
4. The EA are currently looking at flood alleviation schemes for Angmering Village and have commissioned a study. WSCC/ADC have been involved to some degree in this respect and a further meeting is planned soon.
5. The most current SFRA is on the ADC website.
6. Guidance notes enclosed in respect to SUDS on new development.
7. Our land drainage records are enclosed. The information will need to be verified. A site survey will be required to ascertain the presence of any other culverts, etc, that we may not be aware of.

Regards

Paul Cann
Senior Engineer (Drainage & Coastal)

Paul Cann | Senior Engineer (Drainage & Coastal), Engineering Services, [Arun District Council](#) | Location: First Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF
Internal: 37819 | External: +44 (0) 1903 737819 | Fax: +44 (0) 1903 716019 | E-mail: Paul.Cann@arun.gov.uk
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Visit Arun's web site at <http://www.arun.gov.uk/> and www.chichester.gov.uk
 Save the environment - think before you print.

From: Mark Akmenkalns [<mailto:m.akmenkalns@rgpdesign.co.uk>]

Sent: 24 July 2017 12:26

To: Kevin Macknay; Paul Cann

Subject: D1260 - Dapper's Lane, Angmering, BN16 4EW - FRA & DS Enquiry 17-07-24

Dear Kevin/Paul,

We are preparing a drainage strategy for the above site and would be grateful if you could provide us with any relevant information you have as per our drainage checklist below:

Flood Zones

- Please confirm the Flood Zones for this area.
- Please confirm surface water, reservoir flooding, sewer flooding. Please provide plans and depth data from your GIS UFMSW for 30yr, 100yr & 1000yr as applicable (OS Datum).
- Please confirm mapping and records for any surface water assets owned or maintained.

Arun District Council Enquiry

- Please confirm if there are any future drainage improvements proposed for this area.
- Please confirm details of existing or planned flood alleviation and defences in this area.
- Please confirm if you are aware of any historic flooding within the confines of the site.
- Please confirm if you are aware of any historic flooding in close vicinity and/or on the public highway.

Groundwater

- Please confirm details of any groundwater flooding issues in the area, including flood levels, flood extents and any available anecdotal information.

Assets

- Please confirm mapping and records for any surface water assets owned or maintained.
- Please confirm if there are any historic culverted watercourses within or in close vicinity to the site. Please provide map records where available.
- Please can you provide any map records denoting the highway drainage network. Is this a piped system or soakaways?

Policy/Future

- Please confirm the most recent Strategic Flood Risk Assessment (SFRA).
- Please confirm if there are any future drainage improvements proposed for this area.
- Please confirm if any drainage studies and/or SWMP have/are being assess for this area.

We look forward to hearing from you in due course.

Regards,

Mark Akmenkalns

Director

T. 01243 210418

M. 07557 774314

E. m.akmenkalns@rgpdesign.co.uk

W. www.rgp.co.uk

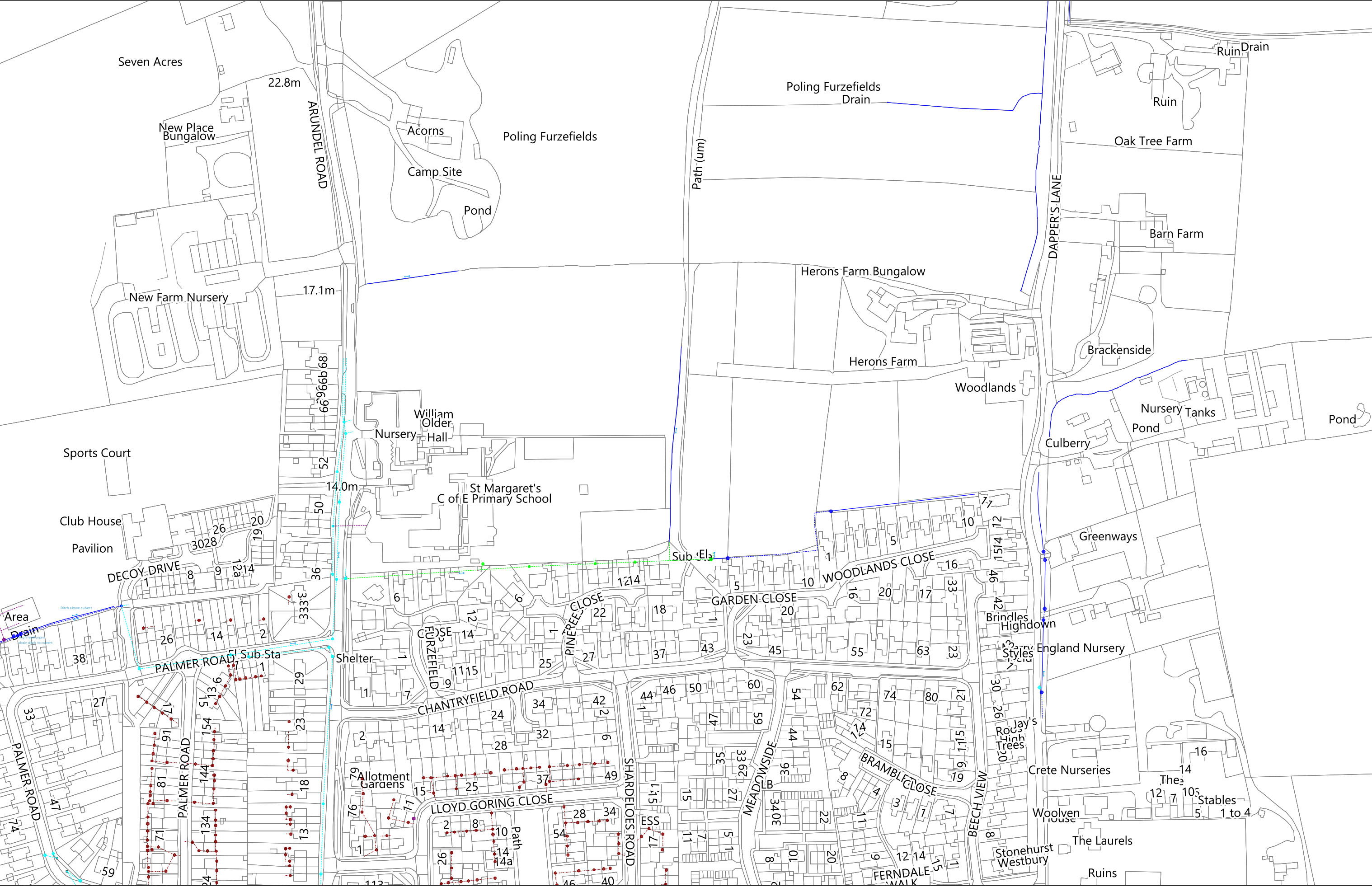


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Arun District Council Maps



Appendix G - Environment Agency Correspondence

Mr M Akmenkalns
rgp design

Your ref: D1260

Our ref: SSD54738

28 July 2017

Dear Mark,

Thank you for your request of 24 July 2017 to use Environment Agency Product 4 data, for the site at Dapper's lane Angmering, BN16 4EW

The Environment Agency's records indicate that the above site is located in Flood Zone 1 (land assessed as having less than 0.1% (1 in 1,000) chance of flooding in any given year from rivers or the sea). Therefore the likelihood of flooding in this area is estimated as 'very low'.

The above site is approximately 500m away from Flood Zone 2/3.

We are therefore unable to provide data from our detailed fluvial or tidal models which is relevant to your site.

Please be aware that in February 2016 the Environment Agency updated its guidance on climate change allowances. The standard allowance of adding 20% to peak flows – as per previous guidance in the National Planning Policy Framework, may not be applicable for the purposes of informing development proposals. It is possible that our current modelling has under estimated flood risk when taking climate change into consideration. This does not however have an effect on Flood Zone 2 or 3. For further information please visit:

<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

Further details about the Environment Agency information supplied can be found on the GOV.UK website:

<https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather>

If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of Environment Agency Information for Flood Risk Assessments

<https://www.gov.uk/planning-applications-assessing-flood-risk>

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

Please get in touch if you have any further queries or contact us within two months if you would like us to review the information we have sent. Please send any future correspondence to our team email account at ssdenquiries@environment-agency.gov.uk

For information on what you can expect from us and our full service commitment to you, please click on this link;

<https://www.gov.uk/government/publications/environment-agency-customer-service-commitment--2/environment-agency-customer-service-commitment>

Kind regards,

Customers & Engagement | Environmental Planning and Engagement | Solent and South Downs Area | **Environment Agency** | Guildbourne House, Chatsworth Road, Worthing, BN11 1LD

SSDEnquiries@environment-agency.gov.uk

National Contact Call Centre: 03708 506506



Appendix H - West Sussex County Council Correspondence (Lead Local Flood Authority)

West Sussex County Council Enquiry

Mark,

Further to your recent enquiry. Please see reply below:

Flood Zones

- Please confirm the Flood Zones for this area.
Based on current EA mapping the proposed site is within Flood Zone 1.
- Please confirm surface water, reservoir flooding, sewer flooding. Please provide plans and depth data from your GIS UFMSW for 30yr, 100yr & 1000yr as applicable (OS Datum).
Please see attached mapping. The proposed development site is not shown to be at risk from surface water flooding. However, it should be noted that we are aware that Dapper's Lane is an area at risk from surface water flooding and does act as a natural flow route for surface water from the field to the north east of the proposed development.
- Please confirm mapping and records for any surface water assets owned or maintained.
Please see attached mapping.
- Please confirm if there are any future drainage improvements proposed for this area.
No future drainage improvements proposed for this area. We are aware that the local flood action group have carried out improvements to the local surface water drainage system along Drappers Lane in the past few years.
- Please confirm details of existing or planned flood alleviation and defences in this area.
None that we are aware of for the proposed development site. However, we are aware that the EA are currently looking at the local flood risk posed by the Black Ditch to the village of Angmering.
- Please confirm if you are aware of any historic flooding within the confines of the site.
None that we are aware of.
- Please confirm if you are aware of any historic flooding in close vicinity and/or on the public highway.
We are aware that Drappers Lane has flooded a number of times in the past 10 years. This uncontrolled flow of surface water has flowed south into Water Lane and ended up in Angmering village square.

Groundwater

- Please confirm details of any groundwater flooding issues in the area, including flood levels, flood extents and any available anecdotal information.
Based on current JBA ground water risk maps the site is shown to be at negligible risk of ground water flooding.

Assets

- Please confirm mapping and records for any surface water assets owned or maintained.
Please see attached mapping.
- Please confirm if there are any historic culverted watercourses within or in close vicinity to the site. Please provide map records where available.
None that we are aware of. The site boundaries may have once been ditches / watercourses, this should be investigated further.

West Sussex County Council Enquiry

- Please can you provide any map records denoting the highway drainage network. Is this a piped system or soakaways?

See attached mapping. Drappers Lane has a combination of ditches and positive drainage system running south along the eastern verge.

Policy/Future

- Please confirm the most recent Strategic Flood Risk Assessment (SFRA).
WSCC – SFRA dated January 2010.
- Please confirm if there are any future drainage improvements proposed for this area.
None planned.
- Please confirm if any drainage studies and/or SWMP have/are being assess for this area.
The Black Ditch is part of a current EA study looking at historic flood in Angmering.

Kevin Macknay

Flood Risk Management – Team Leader
Economy, Infrastructure and Environment
Highways and Transport
West Sussex County Council



Location: Western Area Office, Drayton Lane, Nr. Chichester, West Sussex. PO20 2AJ.

Contact: **Internal:** 26429 | **External:** +44 (0)330 222 6429 | **Mobile:** +44 (0)7540 641819

E-mail: kevin.macknay@westsussex.gov.uk

[Report a problem with a road or pavement](#) or [raise a highways related enquiry](#)

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From: Mark Akmenkalns [<mailto:m.akmenkalns@rgpdesign.co.uk>]

Sent: 24 July 2017 12:26

To: Kevin Macknay; Paul Cann

Subject: D1260 - Dapper's Lane, Angmering, BN16 4EW - FRA & DS Enquiry 17-07-24

Dear Kevin/Paul,

We are preparing a drainage strategy for the above site and would be grateful if you could provide us with any relevant information you have as per our drainage checklist below:

Flood Zones

- Please confirm the Flood Zones for this area.
- Please confirm surface water, reservoir flooding, sewer flooding. Please provide plans and depth data from your GIS UFMSW for 30yr, 100yr & 1000yr as applicable (OS Datum).
- Please confirm mapping and records for any surface water assets owned or maintained.
- Please confirm if there are any future drainage improvements proposed for this area.
- Please confirm details of existing or planned flood alleviation and defences in this area.
- Please confirm if you are aware of any historic flooding within the confines of the site.
- Please confirm if you are aware of any historic flooding in close vicinity and/or on the public highway.

Groundwater

West Sussex County Council Enquiry

- Please confirm details of any groundwater flooding issues in the area, including flood levels, flood extents and any available anecdotal information.

Assets

- Please confirm mapping and records for any surface water assets owned or maintained.
- Please confirm if there are any historic culverted watercourses within or in close vicinity to the site. Please provide map records where available.
- Please can you provide any map records denoting the highway drainage network. Is this a piped system or soakaways?

Policy/Future

- Please confirm the most recent Strategic Flood Risk Assessment (SFRA).
- Please confirm if there are any future drainage improvements proposed for this area.
- Please confirm if any drainage studies and/or SWMP have/are being assess for this area.

We look forward to hearing from you in due course.

Regards,

Mark Akmenkalns

Director

T. 01243 210418

M. 07557 774314

E. m.akmenkalns@rgpdesign.co.uk

W. www.rgp.co.uk



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Appendix I - Microdrainage Calculations

RGP Design Limited		Page 1
2 West Barn Norton Lane Chichester PO20 3AF	Land at Dappers Lane Angmering Greenfield Run-Off	
Date 20/11/2019 File	Designed by SPB Checked by MJA	
Innovyze Source Control 2018.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	3.700	Urban	0.000
SAAR (mm)	747	Region Number	Region 7

Results l/s

QBAR Rural	13.6
QBAR Urban	13.6
Q100 years	43.3
Q1 year	11.5
Q30 years	30.8
Q100 years	43.3

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RGP Design Limited		Page 1
2 West Barn Norton Lane Chichester PO20 3AF	Land at Dappers Lane Angmering Greenfield Volume	
Date 20/11/2019 File	Designed by SPB Checked by MJA	
Innovyze Source Control 2018.1		

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.500
Ratio R	0.350
Areal Reduction Factor	1.00
Area (ha)	3.700
SAAR (mm)	743
CWI	110.548
Urban	0.000
SPR	37.000

Results

Percentage Runoff (%)	37.60
Greenfield Runoff Volume (m³)	896.636

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Appendix J - Causeway Flow Hydraulic Calculations



Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	8	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	19.700	Minimum Backdrop Height (m)	0.200
Ratio-R	0.350	Preferred Cover Depth (m)	0.900
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
35	0.032	5.00	21.600	450	507021.498	105135.498	0.600
34	0.003	5.00	22.100	450	507017.340	105182.030	0.600
33	0.022	5.00	23.000	450	507011.892	105223.146	1.050
32	0.113	5.00	22.834	1200	507012.208	105212.885	1.000
31	0.015	5.00	22.500	1200	507012.208	105189.126	0.934
30	0.022	5.00	22.450	1200	507014.413	105170.320	1.098
29	0.062	5.00	22.350	1200	507014.413	105155.930	1.160
28	0.008	5.00	22.000	1200	507010.285	105133.240	1.070
27			21.750	1200	507004.325	105126.064	0.925
26	0.076	5.00	21.500	1200	507004.325	105105.538	1.200
24	0.006	5.00	22.000	450	507063.179	105136.295	1.000
23	0.003	5.00	22.800	450	507074.835	105179.393	1.050
22	0.008	5.00	23.000	450	507042.066	105204.036	1.050
21	0.070	5.00	23.250	1200	507044.411	105208.011	1.346
20	0.087	5.00	23.550	450	507085.843	105222.635	1.050
19	0.004	5.00	24.950	450	507118.205	105206.679	1.050
18	0.038	5.00	24.350	450	507148.168	105194.097	1.050
17	0.008	5.00	24.250	450	507160.468	105181.210	1.050
16	0.034	5.00	23.600	450	507174.586	105157.594	1.050
15	0.005	5.00	24.000	450	507195.841	105172.966	1.050
14	0.022	5.00	23.700	450	507230.413	105161.466	1.050
13	0.041	5.00	24.000	450	507223.633	105180.530	1.050
12	0.090	5.00	23.750	1200	507226.259	105167.217	1.246
11	0.026	5.00	23.750	1200	507202.626	105164.313	1.387
10	0.079	5.00	23.650	1200	507174.770	105167.217	1.527
9	0.023	5.00	24.000	1200	507159.368	105173.494	1.945
8	0.076	5.00	24.300	1200	507141.384	105182.749	2.328
7	0.105	5.00	24.750	1350	507102.428	105206.604	3.040
6	0.194	5.00	23.500	1350	507086.186	105210.484	1.842
5	0.062	5.00	23.500	1350	507064.404	105207.495	2.095
4	0.020	5.00	23.500	1350	507065.699	105186.887	2.146
3	0.065	5.00	22.750	1350	507070.829	105170.166	1.439
2	0.155	5.00	22.000	1350	507067.107	105139.084	1.431
1	0.046		21.300	1350	507082.115	105122.997	1.350
36	0.046		21.300	1200	507024.757	105096.251	1.342
37			21.300	1200	507032.632	105087.965	1.600
38	0.046	5.00	21.300	1200	507039.359	105096.152	1.500



Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
12.007	26	36	22.444	0.600	20.300	19.958	0.342	65.6	300	6.64	50.0
12.006	27	26	20.526	0.600	20.825	20.593	0.232	88.5	300	6.44	50.0
12.005	28	27	9.328	0.600	20.930	20.825	0.105	88.8	300	6.24	50.0
14.000	35	28	11.438	0.600	21.000	20.930	0.070	163.4	150	5.24	50.0
12.004	29	28	23.062	0.600	21.190	21.030	0.160	144.1	300	6.15	50.0
12.003	30	29	14.390	0.600	21.352	21.252	0.100	143.9	300	5.85	50.0
13.000	34	30	12.070	0.600	21.500	21.352	0.148	81.6	150	5.18	50.0
12.002	31	30	18.935	0.600	21.566	21.452	0.114	166.1	300	5.67	50.0
12.001	32	31	23.759	0.600	21.834	21.666	0.168	141.4	300	5.41	50.0
12.000	33	32	10.266	0.600	21.950	21.850	0.100	102.7	300	5.11	50.0
1.011	2	1	22.001	0.600	20.569	19.950	0.619	35.5	450	8.78	50.0
11.000	24	2	4.817	0.600	21.000	20.919	0.081	59.5	100	5.08	50.0
1.010	3	2	31.304	0.600	21.311	20.569	0.742	42.2	450	8.67	50.0
10.000	23	3	10.059	0.600	21.750	21.611	0.139	72.4	150	5.14	50.0
1.009	4	3	17.490	0.600	21.354	21.311	0.043	406.7	450	8.51	50.0
1.008	5	4	20.649	0.600	21.405	21.354	0.051	404.9	450	8.22	50.0
9.001	21	5	20.000	0.600	21.904	21.705	0.199	100.5	150	5.41	50.0
1.007	6	5	21.986	0.600	21.658	21.480	0.178	123.5	375	7.87	50.0
8.000	20	6	12.156	0.600	22.500	22.379	0.121	100.5	150	5.20	50.0
1.006	7	6	16.699	0.600	21.710	21.658	0.052	321.1	375	7.65	50.0
7.000	19	7	15.777	0.600	23.900	23.700	0.200	78.9	150	5.23	50.0
1.005	8	7	45.680	0.600	21.972	21.785	0.187	244.3	300	7.37	50.0
6.000	18	8	13.221	0.600	23.300	23.168	0.132	100.2	150	5.22	50.0
1.004	9	8	20.226	0.600	22.055	21.972	0.083	243.7	300	6.61	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
12.007	1.943	137.4	51.7	0.900	1.042	0.353	0.0	127	1.811
12.006	1.672	118.2	40.5	0.625	0.607	0.277	0.0	121	1.521
12.005	1.669	117.9	40.5	0.770	0.625	0.277	0.0	121	1.518
14.000	0.783	13.8	4.7	0.450	0.920	0.032	0.0	60	0.708
12.004	1.307	92.4	34.7	0.860	0.670	0.237	0.0	127	1.218
12.003	1.308	92.5	25.6	0.798	0.798	0.175	0.0	108	1.123
13.000	1.114	19.7	0.4	0.450	0.948	0.003	0.0	16	0.452
12.002	1.217	86.0	22.0	0.634	0.698	0.150	0.0	103	1.021
12.001	1.320	93.3	19.8	0.700	0.534	0.135	0.0	93	1.054
12.000	1.551	109.7	3.2	0.750	0.684	0.022	0.0	35	0.696
1.011	3.418	543.7	178.7	0.981	0.900	1.221	0.0	177	3.078
11.000	1.000	7.9	0.9	0.900	0.981	0.006	0.0	22	0.652
1.010	3.137	498.8	155.1	0.989	0.981	1.060	0.0	172	2.784
10.000	1.183	20.9	0.4	0.900	0.989	0.003	0.0	15	0.468
1.009	1.002	159.3	145.2	1.696	0.989	0.992	0.0	340	1.129
1.008	1.004	159.7	142.3	1.645	1.696	0.972	0.0	333	1.128
9.001	1.002	17.7	11.4	1.196	1.645	0.078	0.0	88	1.063
1.007	1.629	179.9	121.8	1.467	1.645	0.832	0.0	227	1.745
8.000	1.002	17.7	12.7	0.900	0.971	0.087	0.0	94	1.088
1.006	1.005	111.0	80.6	2.665	1.467	0.551	0.0	238	1.093
7.000	1.133	20.0	0.6	0.900	0.900	0.004	0.0	18	0.504
1.005	1.001	70.8	64.7	2.028	2.665	0.442	0.0	226	1.130
6.000	1.004	17.7	5.6	0.900	0.982	0.038	0.0	58	0.890
1.004	1.003	70.9	48.0	1.645	2.028	0.328	0.0	181	1.075



Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.003	10	9	16.636	0.600	22.123	22.055	0.068	244.7	300	6.27	50.0
5.000	17	9	7.794	0.600	23.200	22.950	0.250	31.2	150	5.07	50.0
4.000	16	10	9.625	0.600	22.550	22.273	0.277	34.7	150	5.09	50.0
1.002	11	10	28.012	0.600	22.363	22.198	0.165	169.8	225	6.00	50.0
3.000	15	11	10.996	0.600	22.950	22.700	0.250	44.0	150	5.12	50.0
1.001	12	11	23.811	0.600	22.504	22.363	0.141	168.9	225	5.53	50.0
2.000	14	12	7.094	0.600	22.650	22.579	0.071	99.9	150	5.12	50.0
1.000	13	12	13.570	0.600	22.950	22.579	0.371	36.6	150	5.14	50.0
9.000	22	21	4.615	0.600	21.950	21.904	0.046	100.3	150	5.08	50.0
15.000	38	37	10.596	0.600	19.800	19.700	0.100	106.0	150	5.18	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.003	1.000	70.7	43.5	1.227	1.645	0.297	0.0	170	1.050
5.000	1.809	32.0	1.2	0.900	0.900	0.008	0.0	20	0.859
4.000	1.713	30.3	5.0	0.900	1.227	0.034	0.0	41	1.273
1.002	1.000	39.8	26.9	1.162	1.227	0.184	0.0	136	1.072
3.000	1.521	26.9	0.7	0.900	0.900	0.005	0.0	17	0.665
1.001	1.003	39.9	22.4	1.021	1.162	0.153	0.0	121	1.032
2.000	1.005	17.8	3.2	0.900	1.021	0.022	0.0	43	0.763
1.000	1.669	29.5	6.0	0.900	1.021	0.041	0.0	46	1.316
9.000	1.003	17.7	1.2	0.900	1.196	0.008	0.0	26	0.567
15.000	0.976	17.2	6.7	1.350	1.450	0.046	0.0	65	0.918

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
12.007	22.444	65.6	300	Circular	21.500	20.300	0.900	21.300	19.958	1.042
12.006	20.526	88.5	300	Circular	21.750	20.825	0.625	21.500	20.593	0.607
12.005	9.328	88.8	300	Circular	22.000	20.930	0.770	21.750	20.825	0.625
14.000	11.438	163.4	150	Circular	21.600	21.000	0.450	22.000	20.930	0.920
12.004	23.062	144.1	300	Circular	22.350	21.190	0.860	22.000	21.030	0.670
12.003	14.390	143.9	300	Circular	22.450	21.352	0.798	22.350	21.252	0.798
13.000	12.070	81.6	150	Circular	22.100	21.500	0.450	22.450	21.352	0.948
12.002	18.935	166.1	300	Circular	22.500	21.566	0.634	22.450	21.452	0.698
12.001	23.759	141.4	300	Circular	22.834	21.834	0.700	22.500	21.666	0.534
12.000	10.266	102.7	300	Circular	23.000	21.950	0.750	22.834	21.850	0.684

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
12.007	26	1200	Manhole	Adoptable	36	1200	Manhole	Adoptable
12.006	27	1200	Manhole	Adoptable	26	1200	Manhole	Adoptable
12.005	28	1200	Manhole	Adoptable	27	1200	Manhole	Adoptable
14.000	35	450	Manhole	Adoptable	28	1200	Manhole	Adoptable
12.004	29	1200	Manhole	Adoptable	28	1200	Manhole	Adoptable
12.003	30	1200	Manhole	Adoptable	29	1200	Manhole	Adoptable
13.000	34	450	Manhole	Adoptable	30	1200	Manhole	Adoptable
12.002	31	1200	Manhole	Adoptable	30	1200	Manhole	Adoptable
12.001	32	1200	Manhole	Adoptable	31	1200	Manhole	Adoptable
12.000	33	450	Manhole	Adoptable	32	1200	Manhole	Adoptable

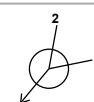


Pipeline Schedule

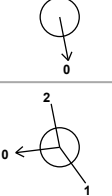
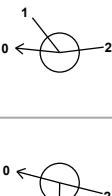
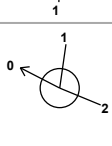
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.011	22.001	35.5	450	Circular	22.000	20.569	0.981	21.300	19.950	0.900
11.000	4.817	59.5	100	Circular	22.000	21.000	0.900	22.000	20.919	0.981
1.010	31.304	42.2	450	Circular	22.750	21.311	0.989	22.000	20.569	0.981
10.000	10.059	72.4	150	Circular	22.800	21.750	0.900	22.750	21.611	0.989
1.009	17.490	406.7	450	Circular	23.500	21.354	1.696	22.750	21.311	0.989
1.008	20.649	404.9	450	Circular	23.500	21.405	1.645	23.500	21.354	1.696
9.001	20.000	100.5	150	Circular	23.250	21.904	1.196	23.500	21.705	1.645
1.007	21.986	123.5	375	Circular	23.500	21.658	1.467	23.500	21.480	1.645
8.000	12.156	100.5	150	Circular	23.550	22.500	0.900	23.500	22.379	0.971
1.006	16.699	321.1	375	Circular	24.750	21.710	2.665	23.500	21.658	1.467
7.000	15.777	78.9	150	Circular	24.950	23.900	0.900	24.750	23.700	0.900
1.005	45.680	244.3	300	Circular	24.300	21.972	2.028	24.750	21.785	2.665
6.000	13.221	100.2	150	Circular	24.350	23.300	0.900	24.300	23.168	0.982
1.004	20.226	243.7	300	Circular	24.000	22.055	1.645	24.300	21.972	2.028
1.003	16.636	244.7	300	Circular	23.650	22.123	1.227	24.000	22.055	1.645
5.000	7.794	31.2	150	Circular	24.250	23.200	0.900	24.000	22.950	0.900
4.000	9.625	34.7	150	Circular	23.600	22.550	0.900	23.650	22.273	1.227
1.002	28.012	169.8	225	Circular	23.750	22.363	1.162	23.650	22.198	1.227
3.000	10.996	44.0	150	Circular	24.000	22.950	0.900	23.750	22.700	0.900
1.001	23.811	168.9	225	Circular	23.750	22.504	1.021	23.750	22.363	1.162
2.000	7.094	99.9	150	Circular	23.700	22.650	0.900	23.750	22.579	1.021
1.000	13.570	36.6	150	Circular	24.000	22.950	0.900	23.750	22.579	1.021
9.000	4.615	100.3	150	Circular	23.000	21.950	0.900	23.250	21.904	1.196
15.000	10.596	106.0	150	Circular	21.300	19.800	1.350	21.300	19.700	1.450

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.011	2	1350	Manhole	Adoptable	1	1350	Manhole	Adoptable
11.000	24	450	Manhole	Adoptable	2	1350	Manhole	Adoptable
1.010	3	1350	Manhole	Adoptable	2	1350	Manhole	Adoptable
10.000	23	450	Manhole	Adoptable	3	1350	Manhole	Adoptable
1.009	4	1350	Manhole	Adoptable	3	1350	Manhole	Adoptable
1.008	5	1350	Manhole	Adoptable	4	1350	Manhole	Adoptable
9.001	21	1200	Manhole	Adoptable	5	1350	Manhole	Adoptable
1.007	6	1350	Manhole	Adoptable	5	1350	Manhole	Adoptable
8.000	20	450	Manhole	Adoptable	6	1350	Manhole	Adoptable
1.006	7	1350	Manhole	Adoptable	6	1350	Manhole	Adoptable
7.000	19	450	Manhole	Adoptable	7	1350	Manhole	Adoptable
1.005	8	1200	Manhole	Adoptable	7	1350	Manhole	Adoptable
6.000	18	450	Manhole	Adoptable	8	1200	Manhole	Adoptable
1.004	9	1200	Manhole	Adoptable	8	1200	Manhole	Adoptable
1.003	10	1200	Manhole	Adoptable	9	1200	Manhole	Adoptable
5.000	17	450	Manhole	Adoptable	9	1200	Manhole	Adoptable
4.000	16	450	Manhole	Adoptable	10	1200	Manhole	Adoptable
1.002	11	1200	Manhole	Adoptable	10	1200	Manhole	Adoptable
3.000	15	450	Manhole	Adoptable	11	1200	Manhole	Adoptable
1.001	12	1200	Manhole	Adoptable	11	1200	Manhole	Adoptable
2.000	14	450	Manhole	Adoptable	12	1200	Manhole	Adoptable
1.000	13	450	Manhole	Adoptable	12	1200	Manhole	Adoptable
9.000	22	450	Manhole	Adoptable	21	1200	Manhole	Adoptable
15.000	38	1200	Manhole	Adoptable	37	1200	Manhole	Adoptable

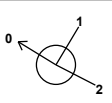
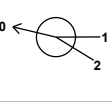
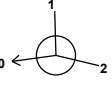
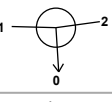
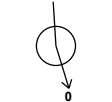
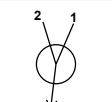
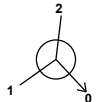
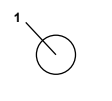
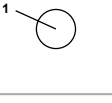
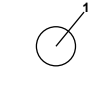
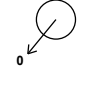
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
35	507021.498	105135.498	21.600	0.600	450	 0	14.000	21.000	150
34	507017.340	105182.030	22.100	0.600	450	 0	13.000	21.500	150
33	507011.892	105223.146	23.000	1.050	450	 0	12.000	21.950	300
32	507012.208	105212.885	22.834	1.000	1200	1  1	12.000	21.850	300
31	507012.208	105189.126	22.500	0.934	1200	1  1	12.001	21.834	300
30	507014.413	105170.320	22.450	1.098	1200	1 2  1	13.000	21.352	150
29	507014.413	105155.930	22.350	1.160	1200	2 1  2	12.002	21.452	300
28	507010.285	105133.240	22.000	1.070	1200	1  1	12.003	21.352	300
27	507004.325	105126.064	21.750	0.925	1200	1  1	12.003	21.252	300
26	507004.325	105105.538	21.500	1.200	1200	2 1  1	14.000	20.930	150
25	507004.325	105105.538	21.500	1.200	1200	2 1  2	12.004	21.030	300
24	507063.179	105136.295	22.000	1.000	450	0  0	12.005	20.930	300
23	507074.835	105179.393	22.800	1.050	450	1  1	12.005	20.825	300
22	507042.066	105204.036	23.000	1.050	450	0  0	12.006	20.825	300
21	507042.066	105204.036	23.000	1.050	450	1  1	12.006	20.593	300
20	507063.179	105136.295	22.000	1.000	450	0  0	12.007	20.300	300
19	507074.835	105179.393	22.800	1.050	450	0  0	11.000	21.000	100
18	507074.835	105179.393	22.800	1.050	450	0  0	10.000	21.750	150
17	507042.066	105204.036	23.000	1.050	450	0  0	9.000	21.950	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
21	507044.411	105208.011	23.250	1.346	1200		1	9.000	21.904	150
20	507085.843	105222.635	23.550	1.050	450		0	9.001	21.904	150
19	507118.205	105206.679	24.950	1.050	450		0	8.000	22.500	150
18	507148.168	105194.097	24.350	1.050	450		0	7.000	23.900	150
17	507160.468	105181.210	24.250	1.050	450		0	6.000	23.300	150
16	507174.586	105157.594	23.600	1.050	450		0	5.000	23.200	150
15	507195.841	105172.966	24.000	1.050	450		0	4.000	22.550	150
14	507230.413	105161.466	23.700	1.050	450		0	3.000	22.950	150
13	507223.633	105180.530	24.000	1.050	450		0	2.000	22.650	150
12	507226.259	105167.217	23.750	1.246	1200		1	2.000	22.579	150
11	507202.626	105164.313	23.750	1.387	1200		2	1.000	22.579	150
10	507174.770	105167.217	23.650	1.527	1200		0	1.001	22.504	225
9	507159.368	105173.494	24.000	1.945	1200		1	3.000	22.700	150
							2	1.001	22.363	225
							0	1.002	22.363	225
							1	4.000	22.273	150
							2	1.002	22.198	225
							0	1.003	22.123	300
							1	5.000	22.950	150
							2	1.003	22.055	300
							0	1.004	22.055	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
8	507141.384	105182.749	24.300	2.328	1200		1 6.000 2 1.004	23.168 21.972	150 300
7	507102.428	105206.604	24.750	3.040	1350		0 1.005 1 7.000 2 1.005	21.972 23.700 21.785	300 150 300
6	507086.186	105210.484	23.500	1.842	1350		0 1.006 1 8.000 2 1.006	21.710 22.379 21.658	375 150 375
5	507064.404	105207.495	23.500	2.095	1350		0 1.007 1 9.001 2 1.007	21.658 21.705 21.480	375 150 375
4	507065.699	105186.887	23.500	2.146	1350		0 1.008 1 1.008	21.405 21.354	450 450
3	507070.829	105170.166	22.750	1.439	1350		0 1.009 1 10.000 2 1.009	21.354 21.611 21.311	450 150 450
2	507067.107	105139.084	22.000	1.431	1350		0 1.010 1 11.000 2 1.010	21.311 20.919 20.569	450 100 450
1	507082.115	105122.997	21.300	1.350	1350		0 1.011 1 1.011	20.569 19.950	450 450
36	507024.757	105096.251	21.300	1.342	1200		0 1.007 1 12.007	19.958 19.958	300 300
37	507032.632	105087.965	21.300	1.600	1200		0 15.000 1 15.000	19.700 19.700	150 150
38	507039.359	105096.152	21.300	1.500	1200		0 15.000 1 15.000	19.800 19.800	150 150

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Detailed
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	19.700	Drain Down Time (mins)	240
Ratio-R	0.350	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x



Storm Durations
15 | 30 | 60 | 120 | 180 | 240 | 360

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	40	0	0
2	40	0	0
30	40	0	0
100	40	0	0

Node 13 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	22.950	Diameter (m)	0.026		

Node 14 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	22.650	Diameter (m)	0.026		

Node 15 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	22.950	Diameter (m)	0.026		

Node 16 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	22.550	Diameter (m)	0.026		

Node 17 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	23.200	Diameter (m)	0.026		

Node 18 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	23.300	Diameter (m)	0.026		

Node 19 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	23.900	Diameter (m)	0.026		

Node 20 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	22.500	Diameter (m)	0.026		



Node 22 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	21.950	Diameter (m)	0.026		

Node 23 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	21.750	Diameter (m)	0.026		

Node 24 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	21.000	Diameter (m)	0.026		

Node 33 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	21.950	Diameter (m)	0.026		

Node 34 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	21.500	Diameter (m)	0.026		

Node 35 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.450	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	21.000	Diameter (m)	0.026		

Node 36 Online Orifice Control

Flap Valve	x	Invert Level (m)	19.958	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.300		

Node 1 Online Orifice Control

Flap Valve	x	Invert Level (m)	19.950	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.450		

Node 37 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	19.700	Product Number	CTL-SHE-0137-1000-1600-1000
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	10.0	Min Node Diameter (mm)	1200



Node 13 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	22.950	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	192	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	36.400		

Node 14 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	22.650	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	52	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	22.199		

Node 15 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	22.950	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	9.358		

Node 16 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	22.550	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	40	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	59.501		

Node 17 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	23.200	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	16.781		

Node 18 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	23.300	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	112	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	52.091		

Node 19 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	23.900	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	7.419		

Node 20 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	22.500	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	146.530		



Node 22 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	21.950	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	15.740		

Node 23 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	21.750	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	106.515		

Node 24 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	21.000	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	115.725		

Node 33 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	21.950	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	43.756		

Node 34 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	21.500	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	6.837		

Node 35 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	21.000	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	200	Depth (m)	0.450
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	0.32	Length (m)	61.728		

Node 38 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	80.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	19.800	Main Channel Slope (1:X)	200.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.025

Inlets

1 | 36

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	653.9	0.0	0.800	889.6	0.0	1.500	1125.4	0.0
0.400	767.2	0.0	1.200	1020.9	0.0			



Results for 1 year +40% CC Critical Storm Duration. Lowest mass balance: 99.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	35	94	21.148	0.148	2.1	3.6933	0.0000	OK
30 minute winter	34	24	21.532	0.032	0.4	0.1744	0.0000	OK
60 minute winter	33	51	22.065	0.115	2.2	2.1842	0.0000	OK
15 minute winter	32	10	21.934	0.100	21.3	0.3386	0.0000	OK
15 minute winter	31	11	21.678	0.112	23.4	0.1630	0.0000	OK
15 minute winter	30	11	21.472	0.120	27.5	0.1839	0.0000	OK
15 minute winter	29	11	21.333	0.143	38.5	0.3138	0.0000	OK
15 minute winter	28	11	21.066	0.136	40.2	0.1743	0.0000	OK
15 minute winter	27	11	20.953	0.128	40.2	0.1444	0.0000	OK
15 minute winter	26	11	20.428	0.128	53.1	0.3066	0.0000	OK
30 minute winter	24	25	21.054	0.054	0.9	0.3767	0.0000	OK
30 minute winter	23	23	21.784	0.034	0.4	0.1652	0.0000	OK
30 minute winter	22	26	22.012	0.062	1.2	0.6295	0.0000	OK
15 minute winter	21	11	22.001	0.097	13.0	0.2107	0.0000	OK
240 minute winter	20	188	22.853	0.353	3.6	12.8917	0.0000	SURCHARGED
30 minute winter	19	24	23.938	0.038	0.6	0.2449	0.0000	OK
120 minute winter	18	96	23.466	0.166	2.5	4.5752	0.0000	SURCHARGED
60 minute winter	17	44	23.260	0.060	0.8	0.5947	0.0000	OK
120 minute winter	16	94	22.705	0.155	2.2	3.9567	0.0000	SURCHARGED
60 minute winter	15	43	22.994	0.044	0.5	0.3215	0.0000	OK
120 minute winter	14	90	22.765	0.115	1.4	2.1955	0.0000	OK
180 minute winter	13	136	23.124	0.174	2.0	5.0009	0.0000	SURCHARGED
15 minute winter	12	10	22.611	0.107	17.4	0.2744	0.0000	OK
15 minute winter	11	11	22.486	0.123	22.0	0.1858	0.0000	OK
15 minute winter	10	11	22.292	0.169	36.0	0.3669	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute winter	35	14.000	28	0.5	0.366	0.037	0.0601	
30 minute winter	34	13.000	30	0.2	0.146	0.010	0.0832	
60 minute winter	33	12.000	32	0.4	0.381	0.004	0.0540	
15 minute winter	32	12.001	31	20.7	1.049	0.222	0.4704	
15 minute winter	31	12.002	30	23.6	1.018	0.274	0.4385	
15 minute winter	30	12.003	29	27.7	1.106	0.299	0.3601	
15 minute winter	29	12.004	28	38.6	1.219	0.418	0.7302	
15 minute winter	28	12.005	27	40.2	1.348	0.341	0.2781	
15 minute winter	27	12.006	26	39.8	1.465	0.337	0.5593	
15 minute winter	26	12.007	36	52.9	0.917	0.385	1.1114	
30 minute winter	24	11.000	2	0.3	0.468	0.036	0.0029	
30 minute winter	23	10.000	3	0.2	0.375	0.010	0.0055	
30 minute winter	22	9.000	21	0.4	0.362	0.023	0.0325	
15 minute winter	21	9.001	5	12.5	1.063	0.703	0.2344	
240 minute winter	20	8.000	6	0.8	0.507	0.046	0.0195	
30 minute winter	19	7.000	7	0.2	0.375	0.011	0.0094	
120 minute winter	18	6.000	8	0.5	0.451	0.031	0.0159	
60 minute winter	17	5.000	9	0.3	0.567	0.010	0.0042	
120 minute winter	16	4.000	10	0.5	0.648	0.017	0.0079	
60 minute winter	15	3.000	11	0.2	0.474	0.009	0.0058	
120 minute winter	14	2.000	12	0.4	0.422	0.025	0.0074	
180 minute winter	13	1.000	12	0.6	0.649	0.019	0.0118	
15 minute winter	12	1.001	11	17.0	0.849	0.427	0.4805	
15 minute winter	11	1.002	10	21.8	1.009	0.549	0.6063	
15 minute winter	10	1.003	9	36.1	0.853	0.511	0.7072	



Results for 1 year +40% CC Critical Storm Duration. Lowest mass balance: 99.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	9	11	22.235	0.180	40.4	0.2456	0.0000	OK
15 minute winter	8	11	22.172	0.200	53.9	0.3568	0.0000	OK
15 minute winter	7	11	21.952	0.242	70.6	0.5143	0.0000	OK
15 minute winter	6	11	21.888	0.230	104.7	0.8137	0.0000	OK
15 minute winter	5	11	21.719	0.314	127.4	0.6343	0.0000	OK
15 minute winter	4	11	21.622	0.268	130.2	0.4335	0.0000	OK
15 minute winter	3	11	21.484	0.173	141.1	0.4032	0.0000	OK
15 minute winter	2	11	20.738	0.169	167.9	0.6063	0.0000	OK
15 minute winter	1	11	20.433	0.483	175.2	1.0214	0.0000	OK
360 minute winter	36	344	20.374	0.416	11.8	0.7562	0.0000	OK
360 minute winter	37	336	20.331	0.631	10.1	0.7137	0.0000	OK
360 minute winter	38	336	20.374	0.574	48.0	1.0008	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	9	1.004	8	40.2	0.859	0.568	0.9497	
15 minute winter	8	1.005	7	52.5	1.129	0.742	2.1272	
15 minute winter	7	1.006	6	70.2	0.989	0.632	1.2204	
15 minute winter	6	1.007	5	104.2	1.455	0.579	1.5916	
15 minute winter	5	1.008	4	126.7	1.170	0.794	2.2332	
15 minute winter	4	1.009	3	129.5	1.690	0.813	1.3498	
15 minute winter	3	1.010	2	140.6	2.570	0.282	1.7235	
15 minute winter	2	1.011	1	167.2	1.360	0.308	2.3386	
15 minute winter	1	Flow through pond	38	234.5	0.403	0.007	111.8943	
360 minute winter	36	Flow through pond	38	46.5	0.114	0.001	270.1926	
360 minute winter	37	Hydro-Brake®		10.0				307.1
360 minute winter	38	15.000	37	10.1	0.574	0.586	0.1865	

Results for 2 year +40% CC Critical Storm Duration. Lowest mass balance: 99.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	35	98	21.171	0.171	2.6	4.8688	0.0000	SURCHARGED
30 minute winter	34	24	21.538	0.038	0.6	0.2350	0.0000	OK
120 minute winter	33	92	22.084	0.134	1.8	2.9489	0.0000	OK
15 minute winter	32	10	21.949	0.115	27.5	0.3906	0.0000	OK
15 minute winter	31	11	21.696	0.130	30.3	0.1886	0.0000	OK
15 minute winter	30	11	21.492	0.140	35.6	0.2138	0.0000	OK
15 minute winter	29	11	21.357	0.167	49.9	0.3683	0.0000	OK
15 minute winter	28	11	21.090	0.160	52.1	0.2051	0.0000	OK
15 minute winter	27	11	20.974	0.149	52.1	0.1688	0.0000	OK
15 minute winter	26	12	20.509	0.209	68.9	0.5008	0.0000	OK
30 minute winter	24	25	21.064	0.064	1.1	0.5303	0.0000	OK
30 minute winter	23	24	21.790	0.040	0.6	0.2252	0.0000	OK
30 minute winter	22	27	22.023	0.073	1.5	0.8851	0.0000	OK
15 minute winter	21	11	22.023	0.119	16.8	0.2577	0.0000	OK
240 minute winter	20	192	22.902	0.402	4.4	16.5953	0.0000	SURCHARGED
30 minute winter	19	24	23.945	0.045	0.8	0.3296	0.0000	OK
120 minute winter	18	108	23.491	0.191	3.1	6.0290	0.0000	SURCHARGED
60 minute winter	17	46	23.270	0.070	1.0	0.8163	0.0000	OK
120 minute winter	16	98	22.728	0.178	2.8	5.1931	0.0000	SURCHARGED
30 minute winter	15	25	23.002	0.052	0.9	0.4453	0.0000	OK
120 minute winter	14	92	22.786	0.136	1.8	2.9594	0.0000	OK
240 minute winter	13	180	23.151	0.201	2.1	6.6127	0.0000	SURCHARGED
15 minute winter	12	10	22.629	0.125	22.4	0.3208	0.0000	OK
15 minute winter	11	11	22.509	0.146	28.4	0.2201	0.0000	OK
15 minute winter	10	11	22.330	0.207	46.5	0.4480	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute winter	35	14.000	28	0.5	0.375	0.040	0.0685	
30 minute winter	34	13.000	30	0.2	0.179	0.011	0.0958	
120 minute winter	33	12.000	32	0.5	0.388	0.004	0.0457	
15 minute winter	32	12.001	31	26.7	1.123	0.287	0.5692	
15 minute winter	31	12.002	30	30.5	1.087	0.354	0.5308	
15 minute winter	30	12.003	29	35.9	1.180	0.388	0.4374	
15 minute winter	29	12.004	28	50.1	1.297	0.542	0.8904	
15 minute winter	28	12.005	27	52.1	1.422	0.442	0.3416	
15 minute winter	27	12.006	26	51.7	1.559	0.437	0.6816	
15 minute winter	26	12.007	36	67.0	1.004	0.487	1.3778	
30 minute winter	24	11.000	2	0.3	0.482	0.040	0.0031	
30 minute winter	23	10.000	3	0.2	0.389	0.011	0.0060	
30 minute winter	22	9.000	21	0.5	0.377	0.027	0.0426	
15 minute winter	21	9.001	5	16.0	1.106	0.904	0.2894	
240 minute winter	20	8.000	6	0.9	0.517	0.049	0.0204	
30 minute winter	19	7.000	7	0.3	0.390	0.013	0.0102	
120 minute winter	18	6.000	8	0.6	0.461	0.033	0.0168	
60 minute winter	17	5.000	9	0.3	0.585	0.011	0.0045	
120 minute winter	16	4.000	10	0.6	0.662	0.019	0.0083	
30 minute winter	15	3.000	11	0.3	0.491	0.010	0.0063	
120 minute winter	14	2.000	12	0.5	0.434	0.027	0.0080	
240 minute winter	13	1.000	12	0.6	0.664	0.021	0.0124	
15 minute winter	12	1.001	11	21.9	0.893	0.550	0.5874	
15 minute winter	11	1.002	10	28.2	1.066	0.709	0.7403	
15 minute winter	10	1.003	9	46.4	0.878	0.656	0.8983	



Results for 2 year +40% CC Critical Storm Duration. Lowest mass balance: 99.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	9	11	22.278	0.223	51.9	0.3050	0.0000	OK
15 minute winter	8	11	22.221	0.249	68.9	0.4448	0.0000	OK
15 minute winter	7	11	22.007	0.297	91.6	0.6306	0.0000	OK
15 minute winter	6	11	21.941	0.283	135.6	1.0013	0.0000	OK
15 minute winter	5	11	21.780	0.375	165.0	0.7580	0.0000	OK
15 minute winter	4	11	21.665	0.311	168.4	0.5036	0.0000	OK
15 minute winter	3	11	21.510	0.199	182.3	0.4657	0.0000	OK
15 minute winter	2	12	20.780	0.211	216.7	0.7574	0.0000	OK
15 minute winter	1	12	20.551	0.601	222.0	1.2707	0.0000	OK
360 minute winter	36	352	20.481	0.523	14.0	0.9501	0.0000	OK
360 minute winter	37	352	20.440	0.740	10.1	0.8368	0.0000	OK
360 minute winter	38	352	20.481	0.681	55.2	1.1872	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	9	1.004	8	51.3	0.878	0.724	1.2011	
15 minute winter	8	1.005	7	67.7	1.182	0.956	2.7071	
15 minute winter	7	1.006	6	91.1	1.022	0.820	1.5273	
15 minute winter	6	1.007	5	135.0	1.475	0.750	2.0191	
15 minute winter	5	1.008	4	163.9	1.265	1.027	2.6639	
15 minute winter	4	1.009	3	167.4	1.823	1.051	1.6158	
15 minute winter	3	1.010	2	181.3	2.673	0.363	2.1779	
15 minute winter	2	1.011	1	213.4	1.601	0.393	2.5430	
15 minute winter	1	Flow through pond	38	294.8	0.457	0.009	147.6116	
360 minute winter	36	Flow through pond	38	53.5	0.097	0.002	353.4553	
360 minute winter	37	Hydro-Brake®		10.0				308.7
360 minute winter	38	15.000	37	10.1	0.575	0.587	0.1865	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	35	116	21.255	0.255	4.9	10.7012	0.0000	SURCHARGED
15 minute winter	34	15	21.567	0.067	1.6	0.5646	0.0000	OK
120 minute winter	33	100	22.152	0.202	3.4	6.6221	0.0000	OK
15 minute winter	32	10	22.002	0.168	51.9	0.5695	0.0000	OK
15 minute winter	31	11	21.758	0.192	57.1	0.2790	0.0000	OK
15 minute winter	30	12	21.587	0.235	66.6	0.3596	0.0000	OK
15 minute winter	29	12	21.541	0.351	92.7	0.7717	0.0000	SURCHARGED
15 minute winter	28	12	21.372	0.442	91.2	0.5660	0.0000	SURCHARGED
15 minute winter	27	12	21.274	0.449	87.7	0.5081	0.0000	SURCHARGED
15 minute winter	26	12	21.103	0.803	116.7	1.9266	0.0000	SURCHARGED
30 minute winter	24	28	21.102	0.102	2.4	1.3299	0.0000	SURCHARGED
30 minute winter	23	25	21.810	0.060	1.1	0.5025	0.0000	OK
30 minute winter	22	29	22.076	0.126	3.6	2.2143	0.0000	OK
15 minute winter	21	12	22.550	0.646	31.9	1.4035	0.0000	SURCHARGED
240 minute winter	20	232	23.089	0.589	8.1	35.1641	0.0000	SURCHARGED
60 minute winter	19	44	23.979	0.079	1.0	0.7427	0.0000	OK
180 minute winter	18	168	23.585	0.285	4.3	13.1678	0.0000	SURCHARGED
60 minute winter	17	49	23.308	0.108	1.9	1.8170	0.0000	OK
180 minute winter	16	152	22.815	0.265	3.9	11.4483	0.0000	SURCHARGED
15 minute winter	15	16	23.039	0.089	2.4	0.9992	0.0000	OK
120 minute winter	14	98	22.886	0.236	3.4	6.5477	0.0000	SURCHARGED
180 minute winter	13	168	23.279	0.329	4.7	14.2066	0.0000	SURCHARGED
15 minute winter	12	13	23.285	0.781	41.5	2.0116	0.0000	SURCHARGED
15 minute winter	11	12	23.212	0.849	38.9	1.2784	0.0000	SURCHARGED
15 minute winter	10	12	23.086	0.963	61.7	2.0855	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute winter	35	14.000	28	0.7	0.400	0.052	0.1233	
15 minute winter	34	13.000	30	1.9	0.264	0.099	0.1800	
120 minute winter	33	12.000	32	0.6	0.416	0.006	0.0783	
15 minute winter	32	12.001	31	50.4	1.311	0.540	0.9176	
15 minute winter	31	12.002	30	57.2	1.261	0.665	0.8585	
15 minute winter	30	12.003	29	66.1	1.281	0.715	0.9262	
15 minute winter	29	12.004	28	87.6	1.422	0.948	1.6240	
15 minute winter	28	12.005	27	87.7	1.520	0.744	0.6569	
15 minute winter	27	12.006	26	88.8	1.538	0.751	1.4454	
15 minute winter	26	12.007	36	114.5	1.626	0.833	1.5805	
30 minute winter	24	11.000	2	-4.0	0.541	-0.515	0.0377	
30 minute winter	23	10.000	3	0.3	0.425	0.015	0.0072	
30 minute winter	22	9.000	21	-2.0	0.416	-0.110	0.0812	
15 minute winter	21	9.001	5	24.8	1.410	1.402	0.3521	
240 minute winter	20	8.000	6	1.1	0.548	0.060	0.0235	
60 minute winter	19	7.000	7	0.4	0.435	0.018	0.0131	
180 minute winter	18	6.000	8	0.7	0.491	0.041	0.0195	
60 minute winter	17	5.000	9	0.4	0.633	0.014	0.0054	
180 minute winter	16	4.000	10	0.7	0.704	0.023	0.0096	
15 minute winter	15	3.000	11	-6.2	0.554	-0.229	0.1936	
120 minute winter	14	2.000	12	0.7	0.474	0.037	0.0100	
180 minute winter	13	1.000	12	0.8	0.718	0.027	0.0149	
15 minute winter	12	1.001	11	32.6	0.947	0.817	0.9470	
15 minute winter	11	1.002	10	43.7	1.099	1.099	1.1141	
15 minute winter	10	1.003	9	68.8	0.977	0.973	1.1715	



Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	9	12	23.020	0.965	72.2	1.3190	0.0000	SURCHARGED
15 minute winter	8	12	22.919	0.947	93.8	1.6899	0.0000	SURCHARGED
15 minute winter	7	11	22.535	0.825	133.8	1.7514	0.0000	SURCHARGED
15 minute winter	6	11	22.425	0.767	215.4	2.7124	0.0000	SURCHARGED
15 minute winter	5	11	22.080	0.675	261.0	1.3650	0.0000	SURCHARGED
15 minute winter	4	12	21.883	0.529	267.9	0.8560	0.0000	SURCHARGED
15 minute winter	3	12	21.678	0.367	294.5	0.8560	0.0000	OK
15 minute winter	2	12	21.410	0.841	350.7	3.0245	0.0000	SURCHARGED
15 minute winter	1	12	21.033	1.083	362.1	2.2887	0.0000	OK
360 minute winter	36	368	20.928	0.970	24.6	1.7616	0.0000	OK
360 minute winter	37	360	20.893	1.193	10.1	1.3496	0.0000	OK
360 minute winter	38	360	20.927	1.127	67.9	1.9654	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	9	1.004	8	77.6	1.102	1.095	1.4243	
15 minute winter	8	1.005	7	99.4	1.412	1.404	3.2168	
15 minute winter	7	1.006	6	133.9	1.214	1.206	1.8419	
15 minute winter	6	1.007	5	210.7	1.911	1.171	2.4250	
15 minute winter	5	1.008	4	259.3	1.637	1.624	3.2717	
15 minute winter	4	1.009	3	266.4	1.954	1.672	2.5949	
15 minute winter	3	1.010	2	289.5	2.551	0.580	4.6445	
15 minute winter	2	1.011	1	345.7	2.182	0.636	3.4859	
15 minute winter	1	Flow through pond	38	485.8	0.477	0.015	282.3026	
360 minute winter	36	Flow through pond	38	64.7	0.129	0.002	738.0292	
360 minute winter	37	Hydro-Brake®		10.0				293.5
360 minute winter	38	15.000	37	10.1	0.574	0.586	0.1865	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	35	172	21.303	0.303	4.8	15.0710	0.0000	FLOOD RISK
15 minute winter	34	16	21.607	0.107	2.6	1.0131	0.0000	OK
120 minute winter	33	114	22.190	0.240	4.4	9.2906	0.0000	OK
15 minute winter	32	12	22.106	0.272	66.7	0.9215	0.0000	OK
15 minute winter	31	12	22.054	0.488	73.8	0.7083	0.0000	SURCHARGED
15 minute winter	30	12	21.991	0.639	81.5	0.9783	0.0000	SURCHARGED
15 minute winter	29	12	21.920	0.730	104.2	1.6056	0.0000	SURCHARGED
15 minute winter	28	12	21.713	0.783	98.7	1.0029	0.0000	FLOOD RISK
15 minute winter	27	12	21.596	0.771	97.7	0.8716	0.0000	FLOOD RISK
15 minute winter	26	12	21.391	1.091	132.1	2.6162	0.0000	FLOOD RISK
360 minute winter	24	424	21.156	0.156	0.5	3.0890	0.0000	SURCHARGED
15 minute winter	23	16	21.829	0.079	2.5	0.8751	0.0000	OK
30 minute winter	22	30	22.117	0.167	4.8	3.2626	0.0000	SURCHARGED
15 minute winter	21	12	23.210	1.306	41.3	2.8344	0.0000	FLOOD RISK
360 minute winter	20	344	23.193	0.693	7.8	48.5046	0.0000	SURCHARGED
60 minute winter	19	46	24.004	0.104	1.3	1.0414	0.0000	OK
180 minute winter	18	172	23.647	0.347	5.7	18.3367	0.0000	SURCHARGED
60 minute winter	17	56	23.336	0.136	2.6	2.5601	0.0000	OK
180 minute winter	16	172	22.863	0.313	5.1	15.9246	0.0000	SURCHARGED
30 minute winter	15	27	23.095	0.145	3.1	1.8643	0.0000	OK
120 minute winter	14	112	22.956	0.306	4.4	9.0638	0.0000	SURCHARGED
180 minute winter	13	176	23.373	0.423	6.1	19.7380	0.0000	SURCHARGED
15 minute winter	12	12	23.750	1.246	53.1	3.2097	2.1243	FLOOD
15 minute winter	11	12	23.730	1.367	46.9	2.0580	0.0000	FLOOD RISK
15 minute winter	10	12	23.650	1.527	70.0	3.3075	1.2232	FLOOD

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute winter	35	14.000	28	0.8	0.209	0.055	0.1206	
15 minute winter	34	13.000	30	-6.1	-0.348	-0.312	0.2125	
120 minute winter	33	12.000	32	0.7	0.427	0.006	0.0983	
15 minute winter	32	12.001	31	64.9	1.378	0.696	1.6336	
15 minute winter	31	12.002	30	68.5	1.268	0.796	1.3334	
15 minute winter	30	12.003	29	71.5	1.267	0.773	1.0133	
15 minute winter	29	12.004	28	94.3	1.422	1.020	1.6240	
15 minute winter	28	12.005	27	97.7	1.531	0.828	0.6569	
15 minute winter	27	12.006	26	100.1	1.559	0.847	1.4454	
15 minute winter	26	12.007	36	131.5	1.868	0.958	1.5805	
360 minute winter	24	11.000	2	0.4	0.506	0.048	0.0377	
15 minute winter	23	10.000	3	-10.3	-0.673	-0.492	0.1771	
30 minute winter	22	9.000	21	-3.7	0.437	-0.206	0.0812	
15 minute winter	21	9.001	5	29.8	1.692	1.682	0.3521	
360 minute winter	20	8.000	6	1.2	0.561	0.065	0.0250	
60 minute winter	19	7.000	7	0.4	0.455	0.021	0.0146	
180 minute winter	18	6.000	8	0.8	0.507	0.045	0.0210	
60 minute winter	17	5.000	9	0.5	0.659	0.015	0.0058	
180 minute winter	16	4.000	10	0.8	0.723	0.025	0.0102	
30 minute winter	15	3.000	11	-6.7	0.592	-0.250	0.1936	
120 minute winter	14	2.000	12	0.8	0.493	0.042	0.0176	
180 minute winter	13	1.000	12	0.9	0.746	0.030	0.0178	
15 minute winter	12	1.001	11	34.7	0.949	0.869	0.9470	
15 minute winter	11	1.002	10	48.6	1.222	1.222	1.1141	
15 minute winter	10	1.003	9	76.3	1.084	1.079	1.1715	



Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	9	12	23.621	1.566	79.2	2.1411	0.0000	SURCHARGED
15 minute winter	8	12	23.562	1.590	99.1	2.8362	0.0000	SURCHARGED
15 minute winter	7	12	23.205	1.495	149.4	3.1732	0.0000	SURCHARGED
15 minute winter	6	12	23.081	1.423	251.7	5.0360	0.0000	SURCHARGED
15 minute winter	5	12	22.676	1.271	285.7	2.5717	0.0000	SURCHARGED
15 minute winter	4	12	22.431	1.077	293.6	1.7431	0.0000	SURCHARGED
15 minute winter	3	12	22.196	0.885	323.7	2.0671	0.0000	SURCHARGED
15 minute winter	2	12	21.770	1.201	398.7	4.3219	0.0000	FLOOD RISK
15 minute winter	1	12	21.278	1.328	416.2	2.8070	0.0000	OK
360 minute winter	36	368	21.171	1.213	31.4	2.2039	0.0000	OK
360 minute winter	37	368	21.131	1.431	10.1	1.6180	0.0000	OK
360 minute winter	38	360	21.170	1.370	77.1	2.3901	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	9	1.004	8	87.6	1.245	1.237	1.4243	
15 minute winter	8	1.005	7	111.3	1.581	1.572	3.2168	
15 minute winter	7	1.006	6	143.3	1.300	1.291	1.8419	
15 minute winter	6	1.007	5	229.3	2.079	1.275	2.4250	
15 minute winter	5	1.008	4	284.4	1.795	1.781	3.2717	
15 minute winter	4	1.009	3	293.7	1.944	1.844	2.7712	
15 minute winter	3	1.010	2	323.3	2.560	0.648	4.9599	
15 minute winter	2	1.011	1	395.0	2.493	0.726	3.4859	
15 minute winter	1	Flow through pond	38	562.4	0.499	0.018	359.8885	
360 minute winter	36	Flow through pond	38	73.9	0.115	0.002	974.6459	
360 minute winter	37	Hydro-Brake®		10.0				313.1
360 minute winter	38	15.000	37	10.1	0.576	0.589	0.1865	