

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

PROPOSED RESIDENTIAL DEVELOPMENT

Flood Risk Assessment

Prepared on Behalf of
Persimmon Homes

D1260/FRA 1.3

March 2020

DOCUMENT CONTROL

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

Document: **Flood Risk Assessment**

Client: Persimmon Homes

Reference: D1260/FRA 1.3

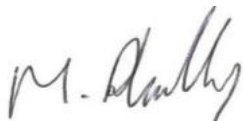
Document Checking:

Author: SPB



Date: 31/03/2020

Checked by: MJA



Date: 31/03/2020

Approved by: MJA



Date: 31/03/2020

Status:

Issue	Date	Status	Issued by
1.0	27/10/2017	DRAFT	SPB
1.1	25/11/2019	FIRST REVISION	SPB
1.2	18/02/2020	SECOND REVISION	SPB
1.3	31/03/2020	FINAL	SPB
1.4			
1.5			

© Copyright RGP Design Limited 2020

No part of this publication may be reproduced by any means without the prior permission of RGP Design Limited.

CONTENTS

1	Introduction	5
1.1	Background	5
1.2	Site Location and Description	6
1.3	Ground Conditions	6
1.4	Groundwater	8
1.5	Existing Drainage	10
2	Probability	13
2.1	Sources of Information	13
2.2	Flood Maps and Modelling	13
2.3	Strategic Flood Risk Assessment	17
2.4	Historic Flooding	17
2.5	Summary of Flood Risk	18
3	Proposed Development	19
3.1	Description of Development	19
4	Proposed Drainage Strategy	20
4.1	Surface Water	20
4.2	Treatment	22
4.3	Foul Water Drainage	23
4.4	Climate Change	23
4.5	Urban Creep	24
5	Residual Risk and Mitigation	25
5.1	Residual Risk	25
5.2	Mitigation	25
6	Sequential and Exception Tests	27
6.1	Sequential Test	27
6.2	Exception Test	27
7	Flood Risk Management	28
7.1	Safe Access and Egress	28
8	Maintenance	29
8.1	Proposed Maintenance Regime	29
9	Offsite Impacts	32
10	Summary	33

DRAWINGS

SK100	Site Location Plan
SK101	Existing Contours
SK200	Impermeable Areas Comparison
SK300	Drainage Strategy
SK301	Drainage Strategy (Alternative Solution)

APPENDICIES

Appendix A	Architectural Proposals
Appendix B	Southern Water Public Sewer Records
Appendix C	LEAP Environmental Geotechnical Investigation (Existing)
Appendix D	LEAP Environmental Geotechnical Invesitgation (Additional)
Appendix E	EEG (Ultraflow) Drainage Investigation (Culvert)
Appendix F	Arun District Council Correspondence
Appendix G	Environment Agency Correspondence
Appendix H	West Sussex County Council Correspondence (Lead Local Flood Authority)
Appendix I	Microdrainage Calculations
Appendix J	Causeway Flow Hydraulic Calculations

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'.

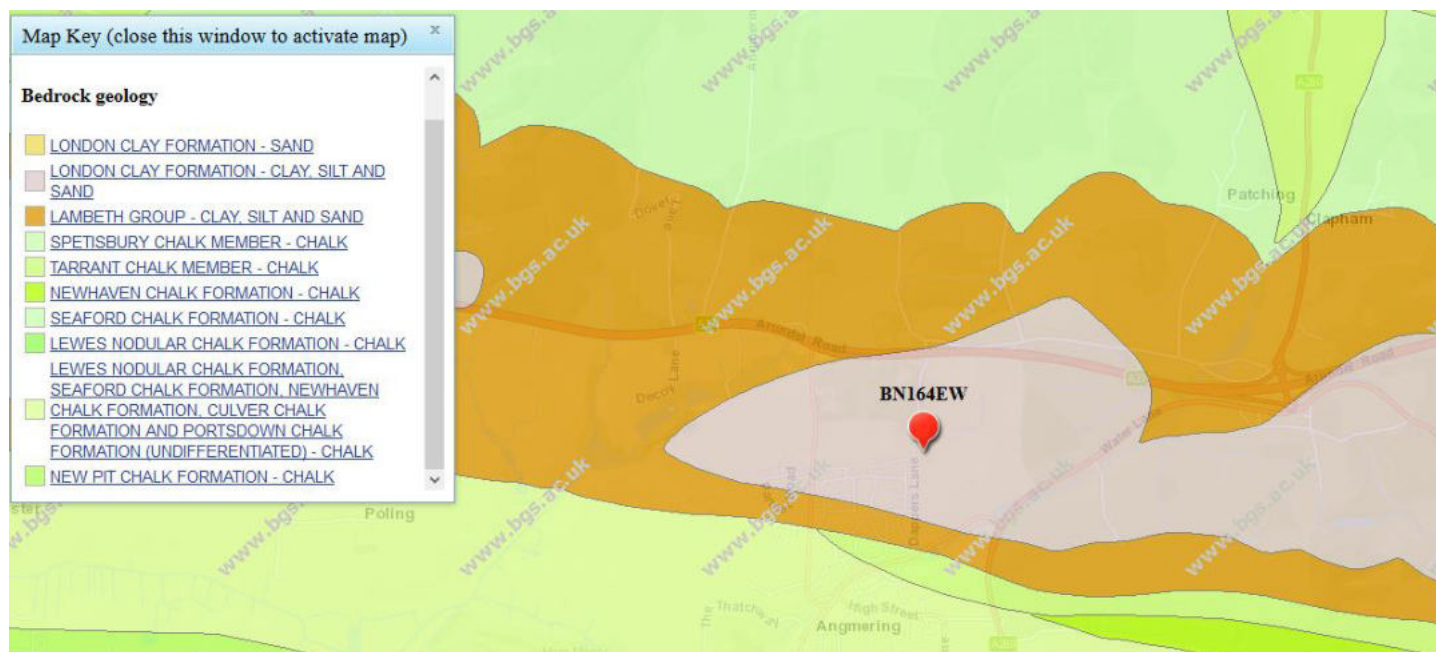


Figure 1. BGS – Bedrock Geology Map

- 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'.

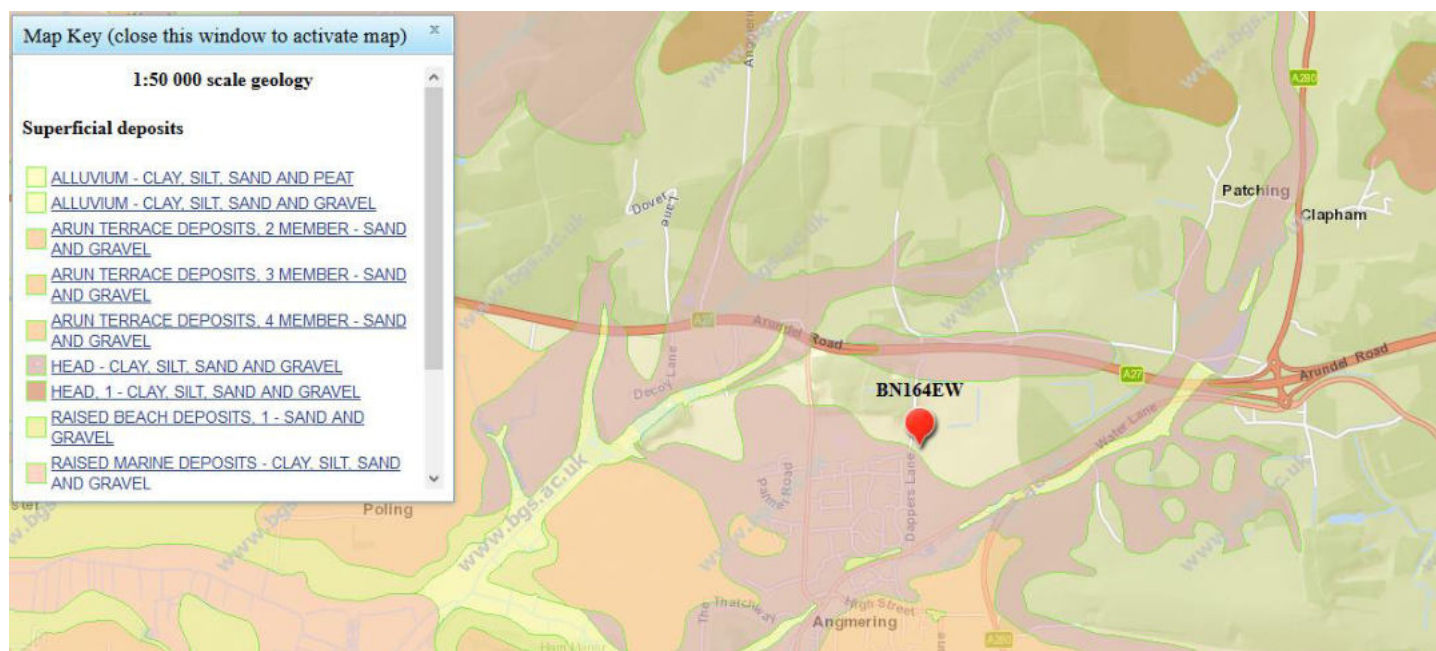


Figure 2. BGS – Superficial Deposits Map

- 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.

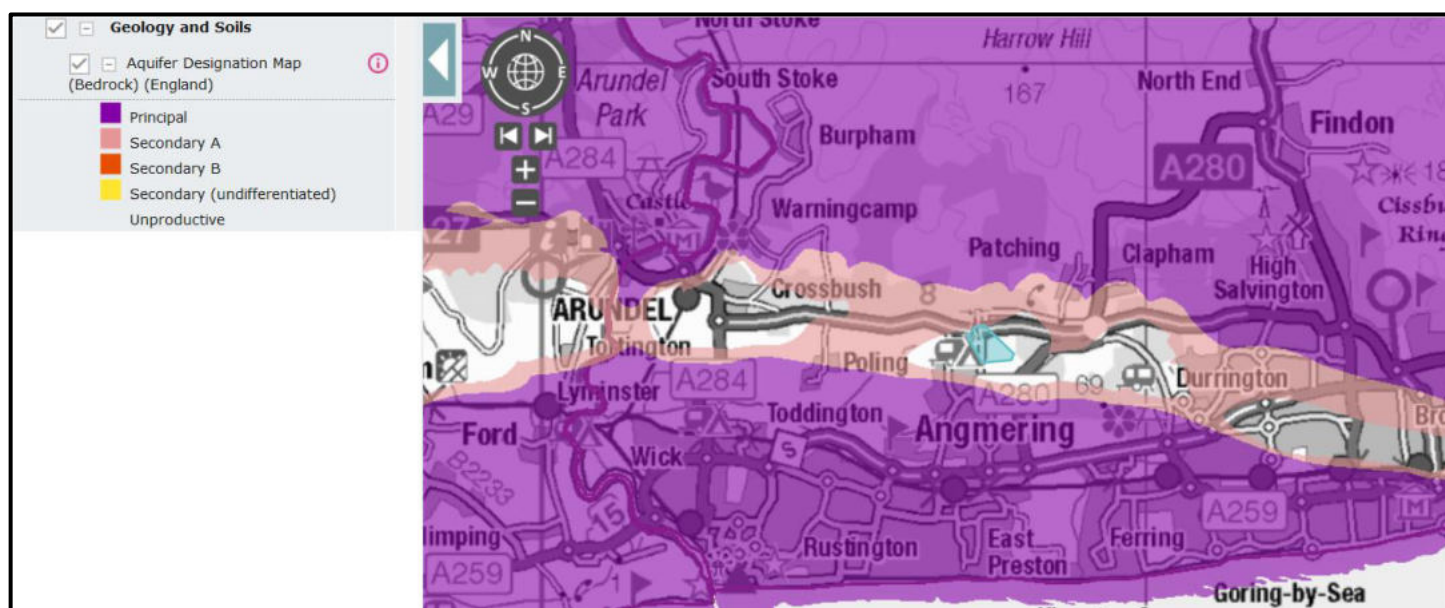


Figure 3. Bedrock Aquifer Designation Map

- 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.

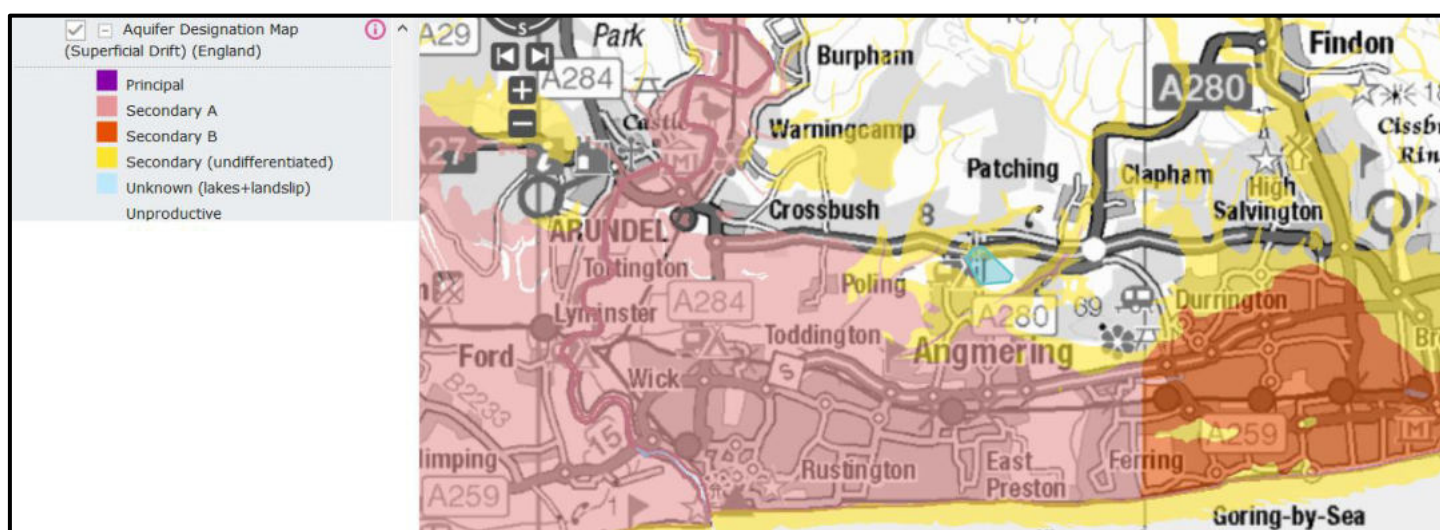


Figure 4. Superficial Drift Aquifer Designation Map

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.

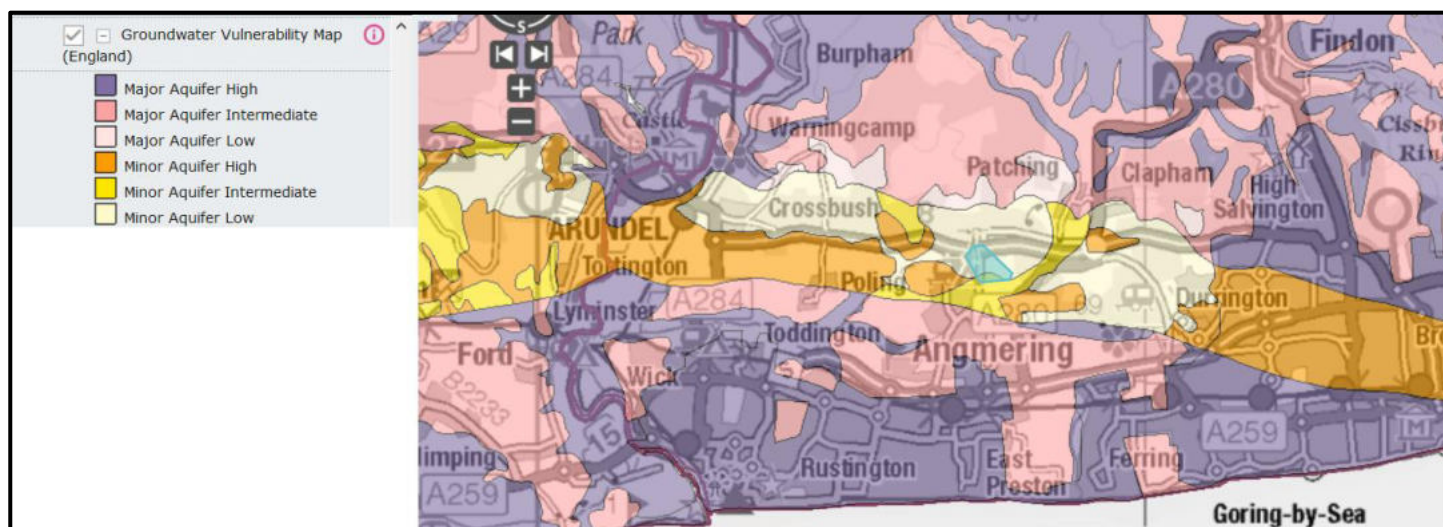


Figure 5. Groundwater Vulnerability Map

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

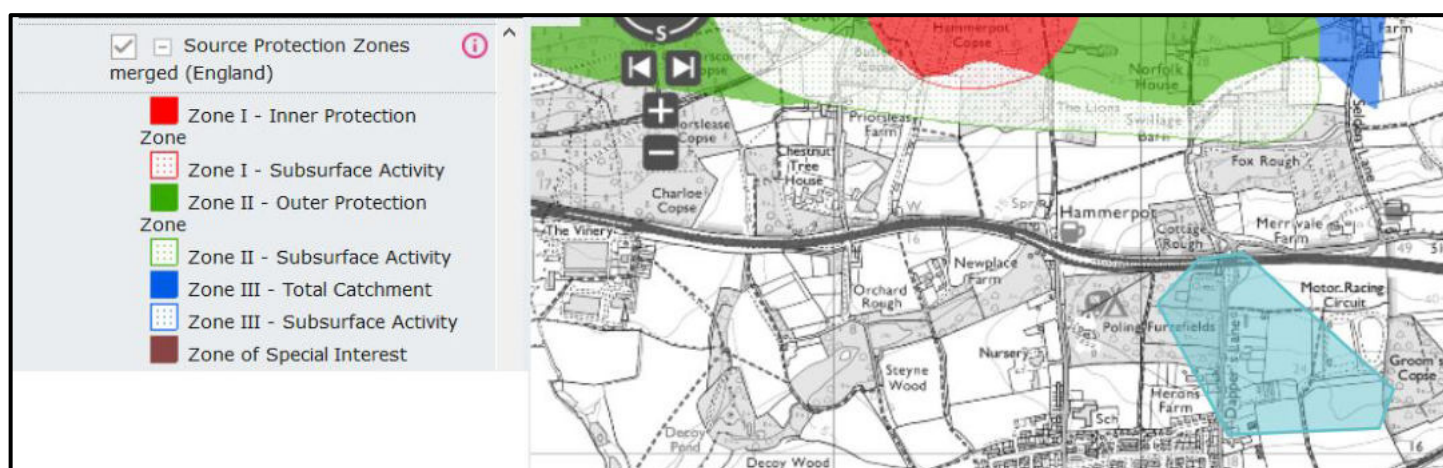


Figure 6. Groundwater Source Protection Zones

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 it is culverted through Furzefield Close.
- The greenfield run-off rate (Q_{bar}) has been calculated to be 13.6l/s ($Q_1 = 11.5l/s$, $Q_{30} = 30.8l/s$ and $Q_{100} = 43.3l/s$)
- 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.

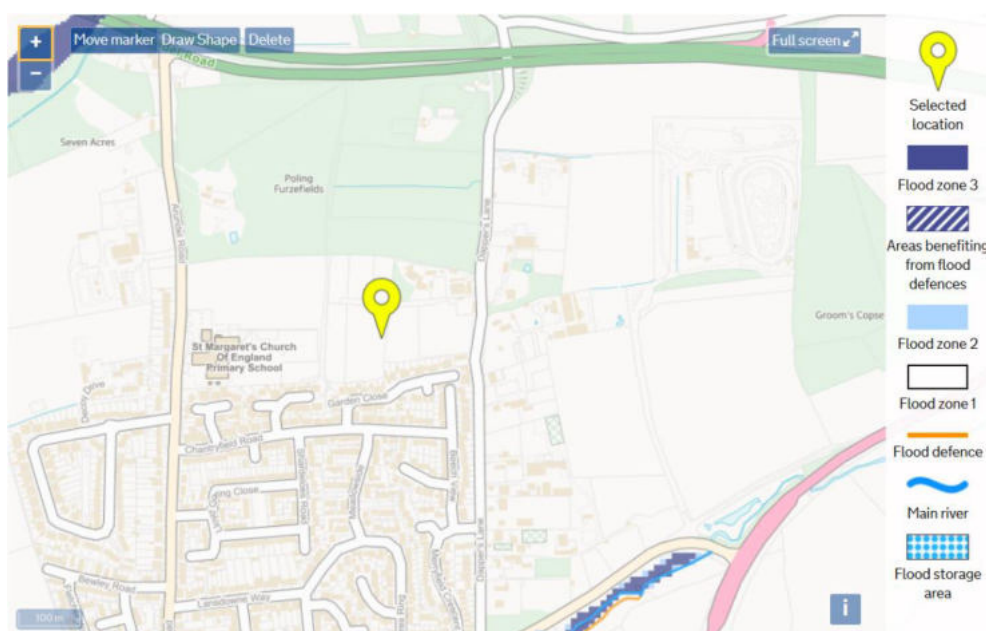


Figure 7 – Flood Maps for Planning (Gov.uk)

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.

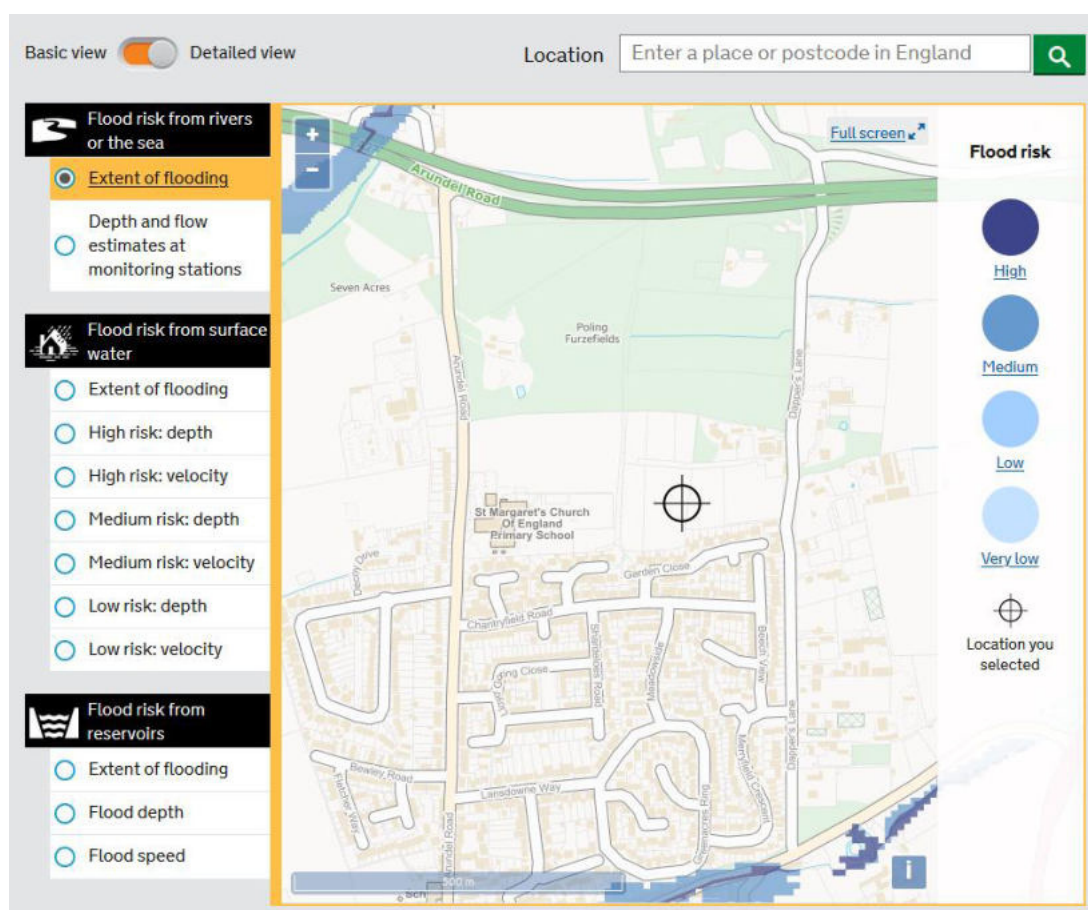


Figure 8. Long-Term Flood Risk Map (Rivers or the Sea)

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. |

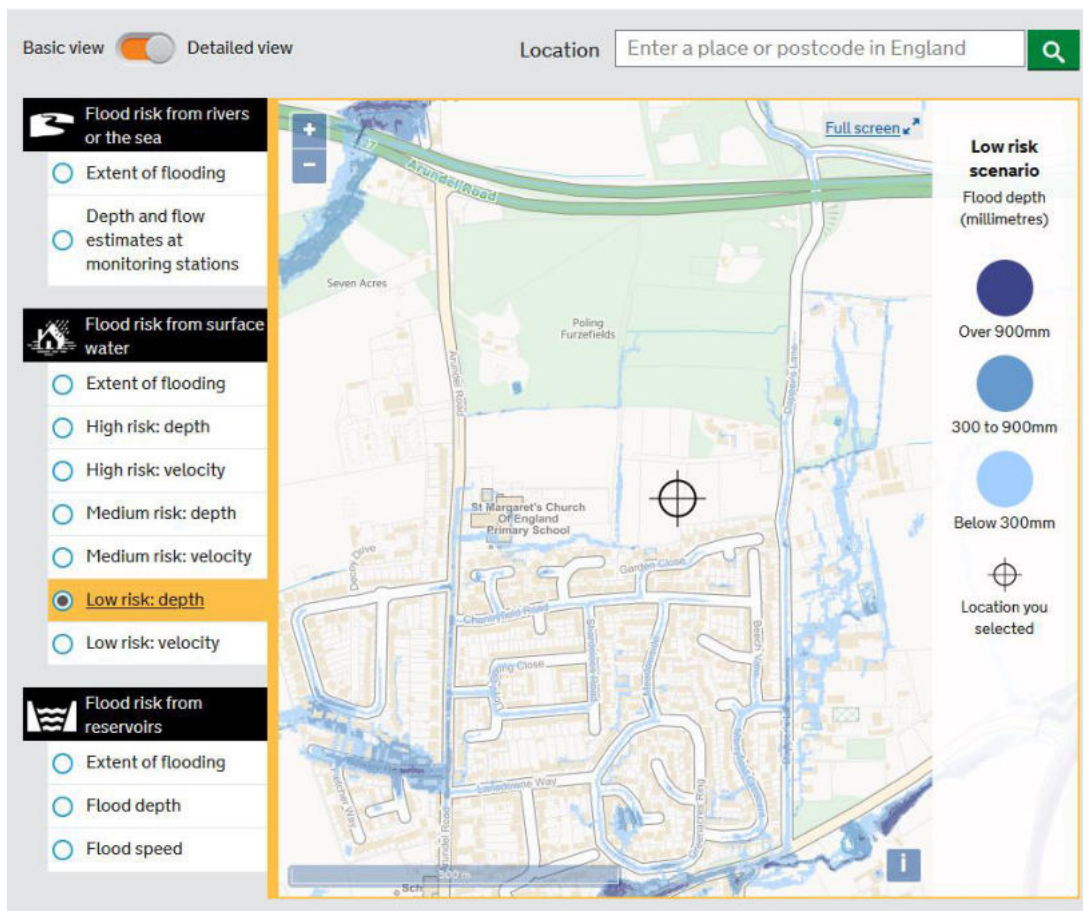


Figure 10. Long-Term Surface Water Flood Map – Low Risk Depths

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.

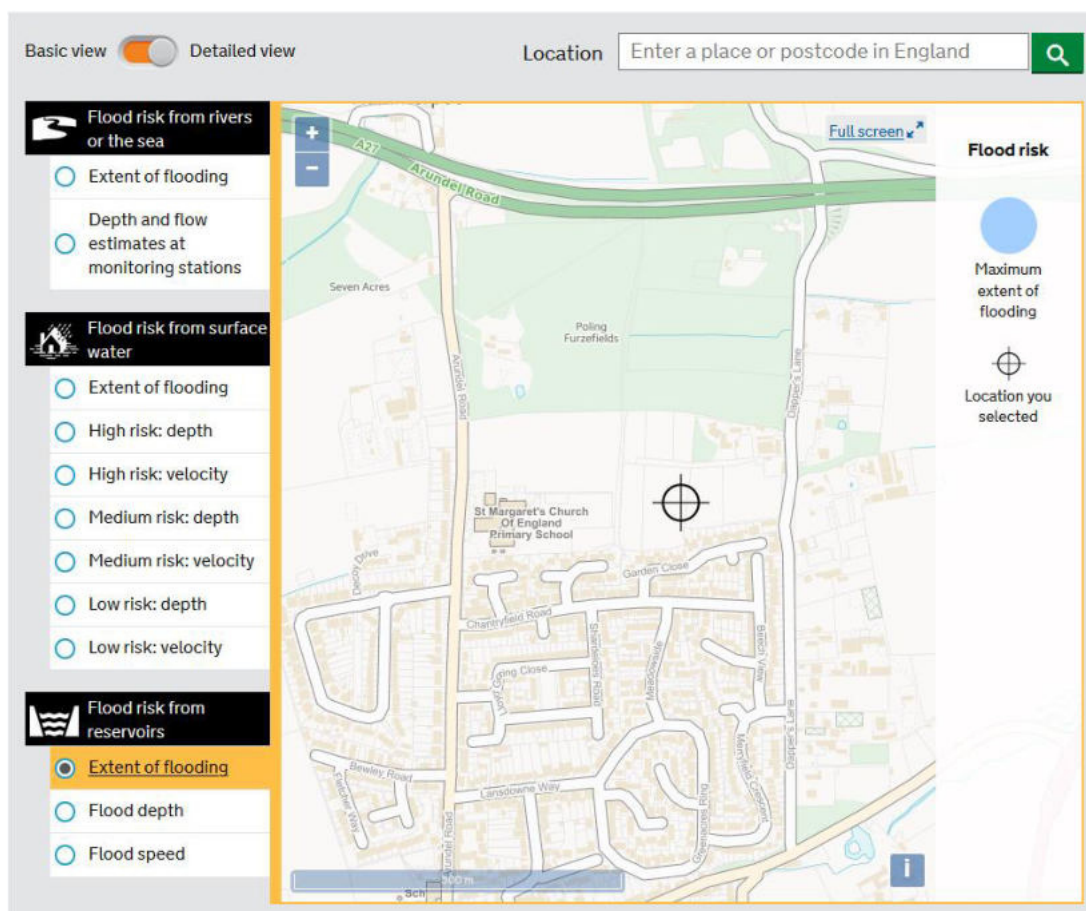


Figure 11. Long-Term Flood Risk Map - Reservoirs

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 15,857m² (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 652m² (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 3,618m² will provide an additional 'high level' volume

of storage, totalling 521m³ 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 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

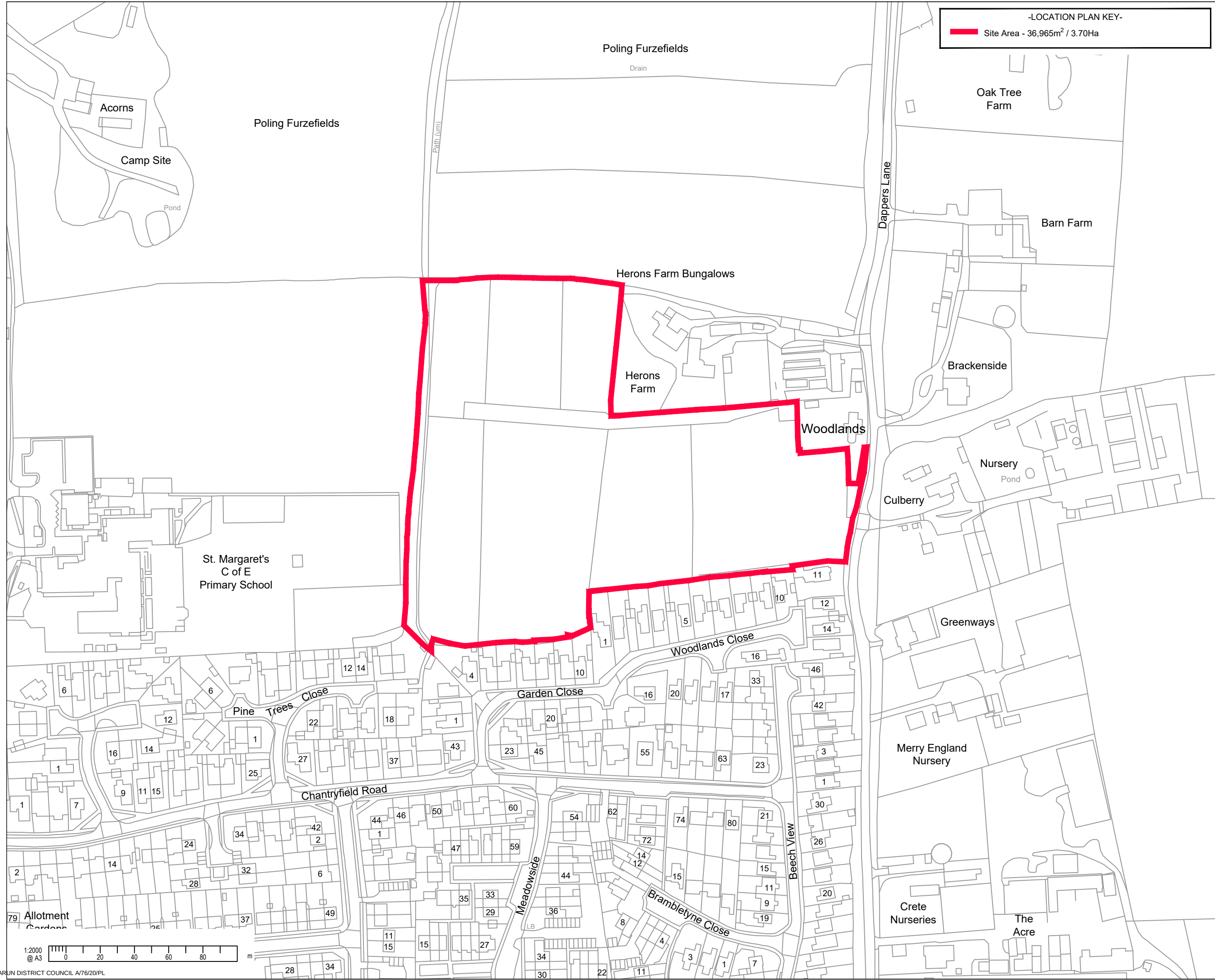
- 9.1.1 The proposed development will not result in any increase in run-off from the site, and therefore will not cause an increase in flood risk offsite.
- 9.1.2 Post development foul water flows will contribute an increase to the sewer network compared to the previous use – it is expected that the 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 15,857m² (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 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 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

PLANNING

This map is based on or reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the controller of Her Majesty's Stationary Office (c) Crown Copyright. Licence Number: 100022432

This drawing is based upon Ordnance Survey mapping. RGP accept no liability for any inaccuracies with the data.

		Original issue
Rev.	Date	Amendments

rgp

Design

Transport Planning and Infrastructure Design Consultants

2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF

Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

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.	-	

NOTES

- 1. This drawing is to be read in conjunction with all other RGP 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 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.



PLANNING

This map is based on or reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the controller of Her Majesty's Stationary Office (c) Crown Copyright. Licence Number: 100022432

This drawing is based upon Ordnance Survey mapping. RGP accept no liability for any inaccuracies with the data.

-	19/11/2019	Original issue
Rev.	Date	Amendments



Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

Client
Persimmon Homes

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

Drawing Title
Existing Contours

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

-LOCATION PLAN KEY-

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

Herons Farm Bungalows

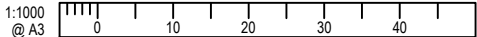
Herons Farm

Woodlands

Culberry

Woodlands Close

Garden Close





-IMPERMEABLE AREA KEY-

Existing Impermeable Area (0.00m² / 0.00Ha)

Proposed Impermeable Area (15,857m² / 1.58Ha)

NOTES

A3

1. This drawing is to be read in conjunction with all other RGP 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 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.



PLANNING

This map is based on or reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the controller of Her Majesty's Stationary Office (c) Crown Copyright. Licence Number: 100022432

This drawing is based upon Ordnance Survey mapping. RGP accept no liability for any inaccuracies with the data.

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

**rgp** Design

Transport Planning and Infrastructure Design Consultants
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

Client

Persimmon Homes

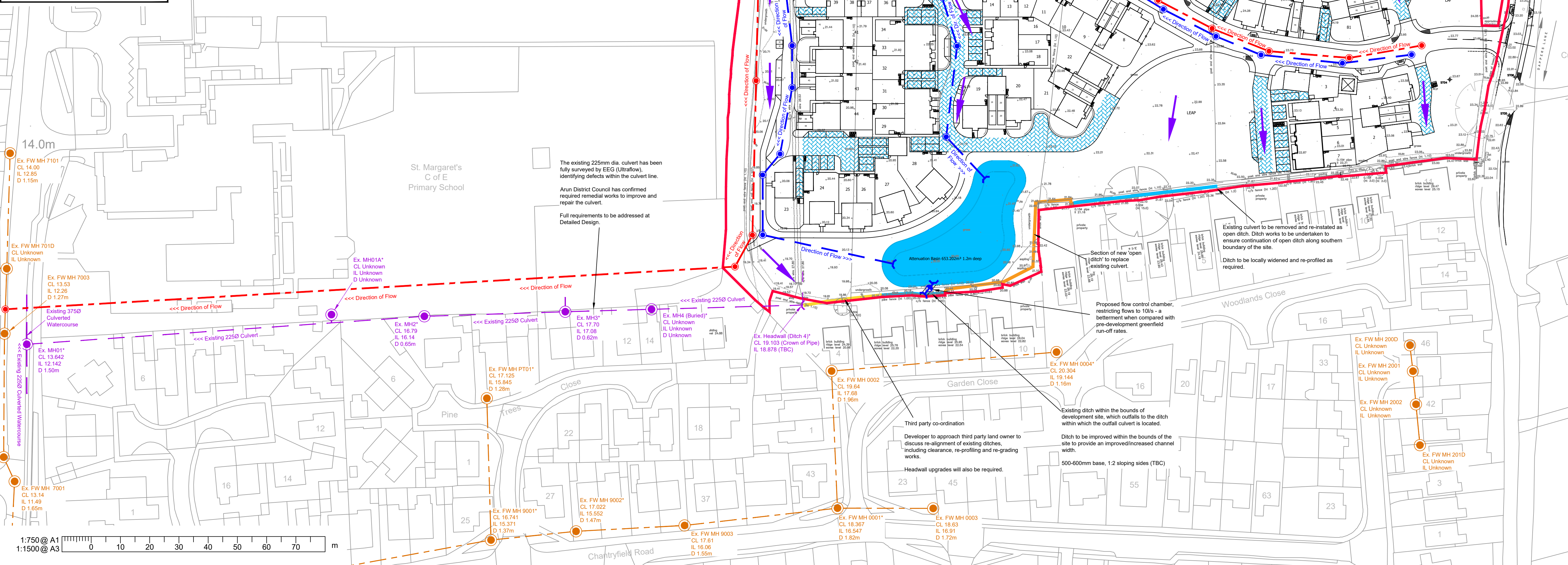
Project Land at Dappers Lane,
Angmering, West Sussex BN16 4EW

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.	B		

- 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 (Ultratrow), 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 3,618m² will provide a volume of storage to the order of 521m³ (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 652m³ (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**
- This drawing is to be read in conjunction with all other RGP Design drawings, and with all relevant Architects and Engineer's drawings and specification. Any discrepancies found are to be reported immediately to the Engineer.
 - RGP Design accepts no responsibility for inaccuracies in data provided by third parties such as topographic surveys or Ordnance Survey mapping.
 - 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.
 - Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not certain.

PLANNING

This map is based on or reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the controller of Her Majesty's Stationary Office (c) Crown Copyright. Licence Number: 100022432

This drawing is based upon Ordnance Survey mapping. RGP accept no liability for any inaccuracies with the data.

Rev.	Date	Amendments	Drawn	Appr.
B	31/03/2020	Minor adjustment to layout	SPB	MJA
A	18/02/2020	Minor adjustment to layout	SPB	MJA
-	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	B

rgp Design

Transport Planning and Infrastructure Design Consultants
2 West Born, Norton Lane, Chichester, West Sussex PO20 3AF
Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

- 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).
 - If it is not possible to implement the primary drainage strategy as proposed on drawing PL300, should repairs and upgrades to the existing 225mm dia. culvert not be possible or viable, an alternative strategy has been devised, through discussion with Arun District Council, to lay a surface water sewer parallel to the proposed foul water sewer routing, to outfall to a new manhole downstream of MH01 (culverted watercourse), located in Arundel Road (the outfall location of the existing 225mm dia. culvert).
 - 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 3,618m² will provide a volume of storage to the order of 521m³ (based on a 450mm sub-base, and 32% 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 652m³ (base) with 1:3 sloping sides.
 - Flows will discharge from the attenuation pond to the proposed surface water sewer - which will connect to a new manhole downstream of MH01 (culverted watercourse) located in Arundel Road.
 - 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 13.6/s, whilst it is proposed post-development flows will be restricted to 10/s.
 - An Ordinary Watercourse Consent (OWC) application will need to be submitted to Arun District Council in order for flows to discharge to the culverted watercourse located in Arundel Road.
 - 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 3.89/s (based on Sewers for Adoption, 4000/s/day).

