

**FORMER CHANDLERS BMW, WATER  
LANE, ANGMERING BN16 4EH**

**PROPOSED MIXED DEVELOPMENT**

Flood Risk Assessment  
and Drainage Strategy

Prepared on Behalf of  
  
Landspeed Homes Ltd

LAHL/18/D1623/FRA 2.0

8 March 2019

## DOCUMENT CONTROL

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Proposed Mixed Development

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2018/D1533/PL201 - Flood Zone & Extents  
2018/D1533/PL300 - Impermeable Areas Comparison  
2018/D1533/PL301 - Flood Compensation Appraisal  
2018/D1533/PL400 - Drainage Strategy  
2018/D1533/PL401 - Flood Event Access & Egress

## APPENDICIES

Appendix A Preliminary Site Layout  
Appendix B Topographical Survey  
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Appendix D Lead Planning Authority and Lead Local Flood Authority Consultation  
Appendix E Public Sewer Records  
Appendix F Environment Agency Product 4 Response  
Appendix G MicroDrainage Calculations

# 1 INTRODUCTION

## 1.1 Background

- 1.1.1 RGP Design Ltd (RGP) is instructed by Landspeed Homes Ltd to prepare a site-specific Flood Risk Assessment (FRA) and Drainage Strategy to support a planning application for a proposed mixed residential development at the former Chandlers BMW site on Water Lane, Angmering.
- 1.1.2 This FRA and Drainage Strategy 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 a mixed development building consisting of 4000 sq.ft of retail space and 5 No. apartments, as well as a further 11 No. homes, 3 No. apartments and a new parish council building - as demonstrated within the preliminary site layout, contained within **Appendix A** of this report.
- 1.1.4 In preparing this report, RGP has referred to the following documents and information:
- Environment Agency Flood Maps for Planning
  - Long Term Flood Risk Information; Flood Risk Maps
  - Local Authorities Strategic Flood Risk Assessment
  - Thames Water and Local Authority Drainage Records
  - Site-specific Environmental Investigation Report
  - British Geological Survey & Records
- 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 site is a former BMW garage in Angmering.
- 1.2.2 The site has a total area of 4374 m<sup>2</sup> (0.47 Ha) – as seen in Drawing **SK100**.
- 1.2.3 A topographical survey of the site has been undertaken by TruEye Ltd. A copy of this survey is included in **Appendix B** of this report.
- 1.2.4 The topographical survey shows that the site is between 6.34m AOD near the eastern border to 5.44m AOD in the eastern corner. The site generally falls gently northwards and eastwards. This influences the existing overland flow routes – as detailed in Drawing **PL103**.

1.2.5 The site drains into a twin-culverted section of the Water Lane Stream, which flows south-west into the Black Ditch. The Water Lane Stream runs out of Patching Pond south-westerly to Angmering Village, and is confined within twin culverts through the village which runs under Water Lane (A280) and The Square before emerging 160m downstream of the site. The stream is classified as a statutory Main River.

1.2.6 The existing site is predominantly hardstanding, however there is approximately 370m<sup>2</sup> of permeable areas in the rear garden of the existing building in the eastern corner – as seen in Drawing **PL200**.

### 1.3 Ground Conditions

1.3.1 A site-specific geotechnical investigation was undertaken by Ashdown Site Investigation Limited in December 2018, with extracts included in **Appendix C** of this report.

1.3.2 The GeoSmart Groundwater Flood Risk map indicates that there is Moderate to High groundwater flood risk on the site. Borehole logs found shallow layers of Head (clay and gravel) in the lower-lying north part of the site, with an underlying strata of Chalk found in the south of the site.

1.3.3 Infiltration results demonstrated negligible infiltration in the north of the site, with moderate infiltration in the south of the site. Based on the results, it is viable that infiltration could be utilised in the south of the site, however consideration should be made of the risks of shallow groundwater and emergence, as well as saturation due to localised flooding issues and the low lying elevation of the site.

1.3.4 In addition to the site-specific investigation, reference has been made to the British Geological Survey (BGS) website.

1.3.5 The BGS geology viewer states that the bedrock geology is likely to consist of 'Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation And Portsdown Chalk Formation (undifferentiated) - Chalk', as seen in **Figure 1**.

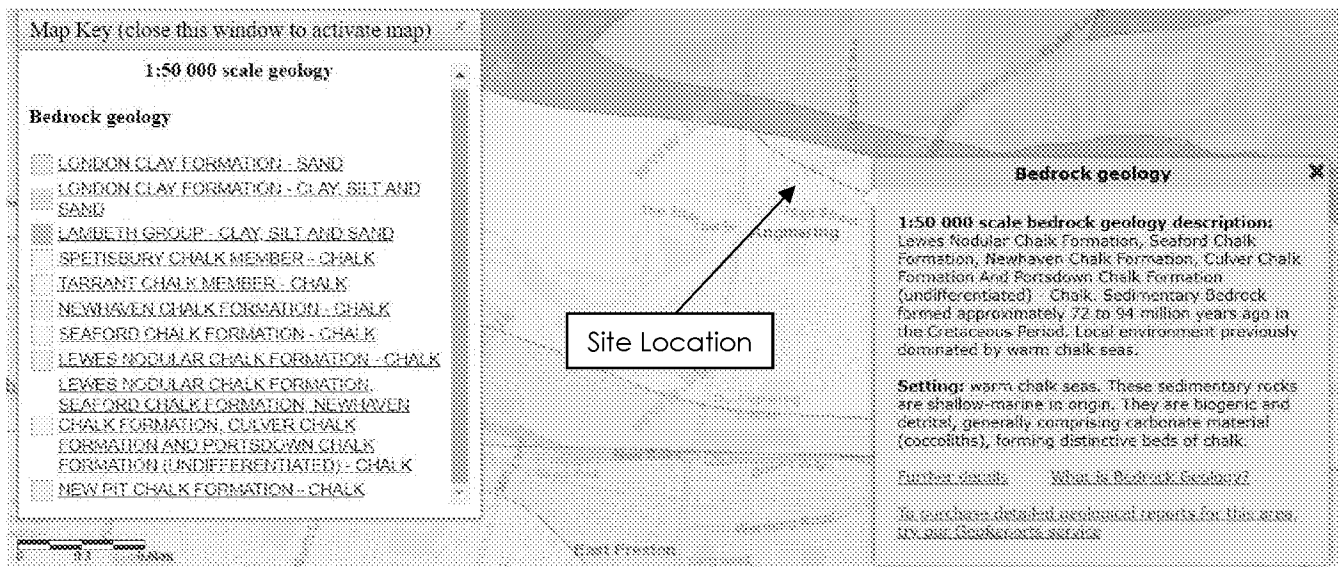


**Figure 1. BGS website Bedrock geology**

1.3.6 Superficial Deposits located at the site area are recorded as 'Head - Clay, Silt, Sand And Gravel', as seen in **Figure 2**.

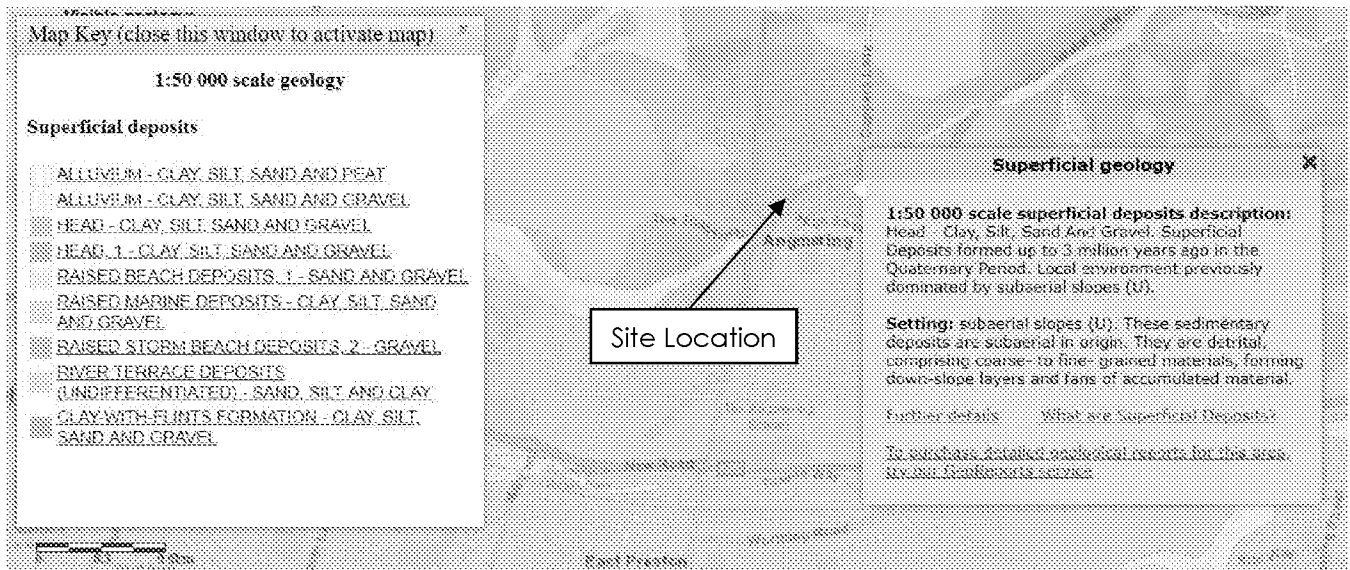


Figure 2. BGS website superficial deposits

- 1.3.7 Historic borehole records from the Single Onshore Boreholes Index (SOBI) on the BGS website have also been reviewed in the absence of a site-specific geotechnical investigation, as depicted in Figure 3.

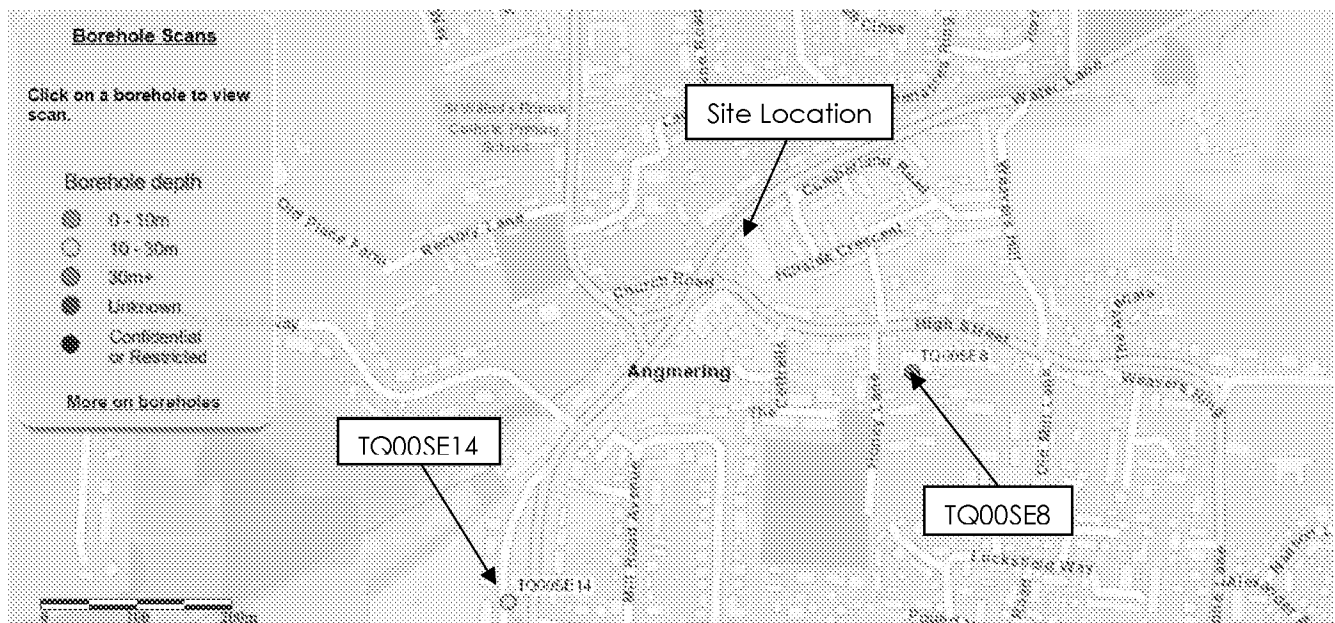


Figure 3. BGS website borehole locations

- 1.3.8 Two boreholes in relation to the site are a borehole located at Ham Manor Lodge (TQ00SE14) 400m to the southwest, and a borehole at Angmering Cottage (TQ00SE8) 150m southeast of the site, as seen in **Figure 3**. Both boreholes have similar geotechnical strata although TQ00SE8 is situated within River Terrace deposits according to the BGS online mapping.
- 1.3.9 The log at Ham Manor Lodge states that the geological composition encountered within each borehole undertaken consisted of 'Drift deposits', followed by 'Upper Chalk', with 'Middle Chalk' up to a depth of 19.8m.
- 1.3.10 The log at Angmering Cottage states that the geological composition encountered consisted of 'Drift deposits (valley gravel)' at the surface, followed by 'Upper Chalk' up to a depth of 47.7m bgl.
- 1.3.11 A copy of the BGS records reviewed can be found within **Appendix C** of this report.

## 1.4 Groundwater

- 1.4.1 Boreholes excavated at the site by Ashdown Site Investigation Limited encountered standing water levels upon completion of some of the shallow boreholes, between 2.30m and 3.00m bgl (below ground level). Some boreholes were dry upon completion however excavation depths varied from 1.00m to 10.00m bgl.
- 1.4.2 At the recorded borehole TQ0014 from the BGS records, rest water levels were at between 3.0 and 10.4m bgl.
- 1.4.3 Following consultation with West Sussex County Council, it has been confirmed that the site is situated within a high-risk area for groundwater, where there is potential for groundwater emergence, as seen in **Figure 4**. Correspondence can be found within **Appendix D**.

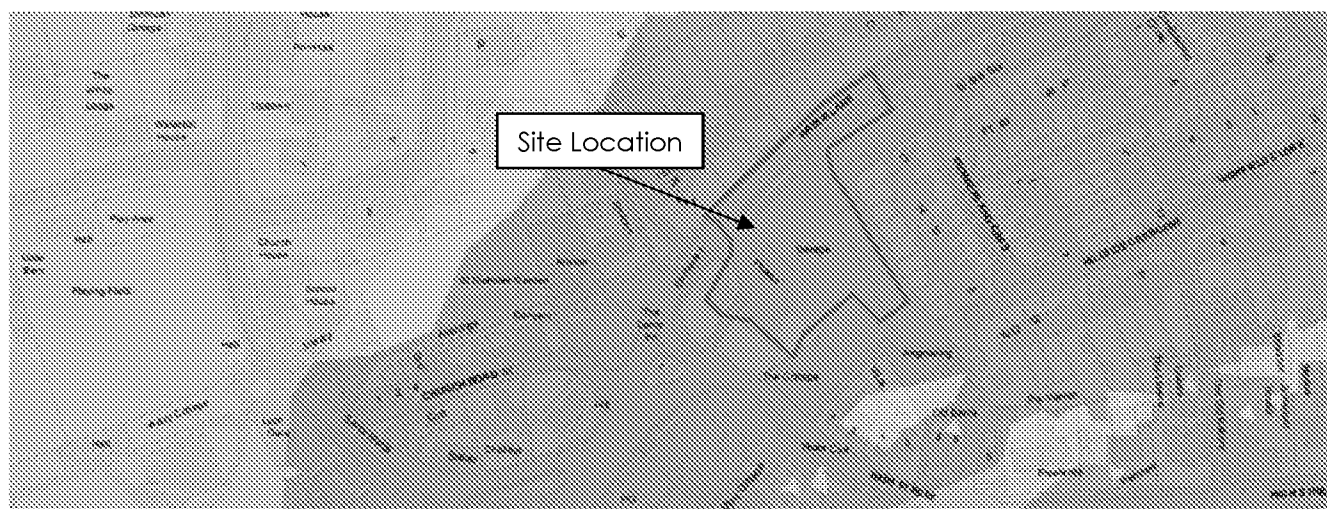


**Figure 4. WSCC Groundwater Flood Risk Mapping**

- 1.4.4 Mapping managed by MAGIC ([magic.defra.gov.uk](http://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. The site is situated within a 'Principal' Aquifer, as seen in **Figure 5**.
- 1.4.5 This refers to bedrock geology that exhibits high permeability and/or provides a high level of water storage. The bedrock may support water supply and/or river base flow on a strategic scale.

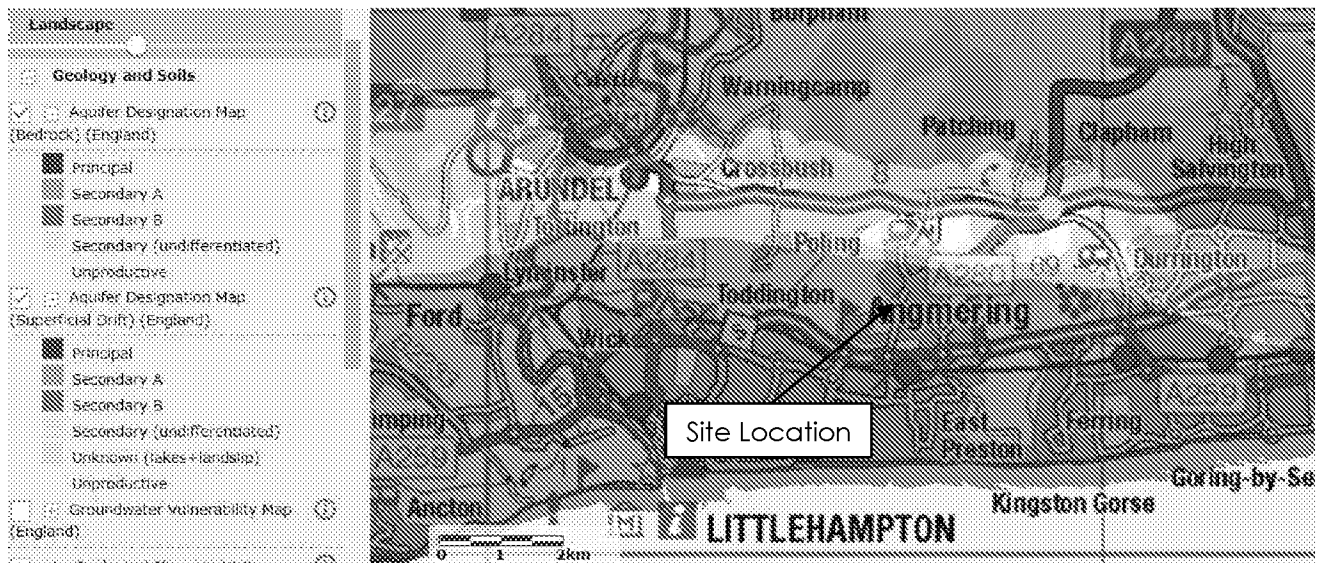


Figure 5. DEFRA Aquifer Designation Map

- 1.4.6 The Groundwater Vulnerability Map (**Figure 6**) confirms that the site falls within a 'Major Aquifer Low' groundwater vulnerability zone. This refers to highly permeable groundwater with low leaching potential.

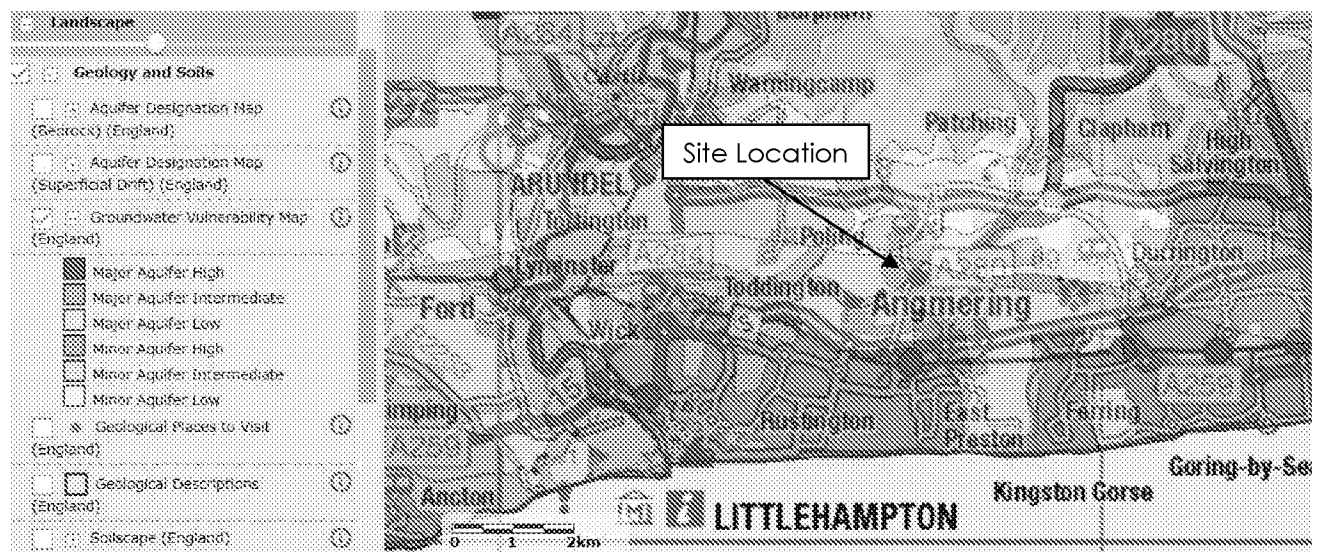


Figure 6. DEFRA Groundwater Vulnerability Map

## 1.5 Existing Drainage

- 1.5.1 The site falls within the administration of West Sussex County Council who have been consulted in view of the existing drainage infrastructure local to the site. A twin-culverted watercourse runs south-west along Water Lane, and it appears from the topographic survey that the site drains into the culvert via traditional gully and piped drainage. WSCC stated that the culverts consisted of a 1200 x 660mm box culvert and a 1330mm dia. pipe.
- 1.5.2 The local Water Authority is Southern Water, who provide sewerage services within the area. Public sewer records have been obtained from Thames Water, as contained within this report in **Appendix E**.
- 1.5.3 Surface Water:

- The Southern Water public sewer records (**Appendix E**) demonstrate that there are no public surface water sewers located within the boundaries of the site.
- The nearest water feature is the culverted Water Lane Stream along the north boundary of the site and is a designated Main River.
- Greenfield runoff rate ( $Q_{bar}$ ) has been calculated to be 1.7/s, which equates to 3.62l/s per hectare.
- The percentage Greenfield run-off has been determined to be 37.3%, whilst the Greenfield run-off volume is calculated to be 114m<sup>3</sup> (based on FEH, SPR of 37% and 1-in-100 year, 360-minute event).
- As the site is developed however, the existing runoff is expected to be approximately 55.6l/s (4004m<sup>2</sup> impermeable area x 50mm/hr rainfall / 3600s).

#### 1.5.4 Foul Water:

- The Thames Water public sewer records (**Appendix E**) demonstrate that there is a 175mm clay pipe foul sewer that runs south-west along Water Lane.

#### 1.5.5 Highway Drainage:

- Information provided by WSCC shows existing road gullies along Water Lane, which is assumed to flow into the culverted watercourse under the public highway.

## 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
- Local Authorities Strategic Flood Risk Assessment
- Consultation with Local Authority/Lead Local Flood Authority

### 2.2 Flood Maps and Modelling

2.2.1 The Environment Agency's Product 4 Response provided flood maps for rivers, sea and surface water as seen in **Appendix F**.

2.2.2 The Product 4 shows the site location partially within Flood Zone 2 and 3, with the south of the site within Flood Zone 1. The modelled food outlines show the majority of the site flooded in 1% AEP defended and undefended scenarios.

2.2.3 Flood levels for 4 No. nodes on the site have been taken from the Lower Tidal River Arun Strategy Study, completed by Atkins in 2010. These indicated undefended levels of up to 6.08m AOD for an undefended scenario and up to 6.23m AOD for a defended scenario for a 1% plus climate change fluvial event.

2.2.4 When the modelled flood levels are considered in comparison with the topographic survey, there is potential for flooding of up to 600mm at the site. The levels confirmed below correspond with the plan contained within the appendices of this report;

| Node Ref |          |           | Modelled Flood Levels (m AOD)            |            |            |                                        |            |            |
|----------|----------|-----------|------------------------------------------|------------|------------|----------------------------------------|------------|------------|
|          |          |           | Undefended Annual Exceedance Probability |            |            | Defended Annual Exceedance Probability |            |            |
|          | Eastings | Northings | 1%                                       | 1% + CC    | 0.1%       | 1%                                     | 1% + CC    | 0.1%       |
| 1        | 506961   | 104488    | 6.03                                     | 6.08       | 6.21       | 6.20                                   | 6.23       | 6.33       |
| 2        | 506897   | 104427    | 5.63                                     | 5.67       | 5.74       | 5.52                                   | 5.52       | 5.67       |
| 3        | 506896   | 104402    | 5.53                                     | 5.55       | 5.63       | 5.52                                   | 5.52       | 5.62       |
| 4        | 506931   | 104404    | Nil return                               | Nil return | Nil return | Nil return                             | Nil return | Nil return |

- 2.2.5 Of the information provided by the Environment Agency, as detailed above, Nodes 1 and 2 are situated along the Water Lane, Node 3 is in the west corner of the site and Node 4 is in the centre of the south of the site.
- 2.2.6 The Environment Agency's on-line Flood Maps for Planning (rivers and sea) show that the site is located within Flood Zone 3a. The flood zones are also confirmed by information and mapping obtained from The Environment Agency following consultation, which is consistent within other flood risk mapping reviewed.

| Flood Zone                               | Definition                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Zone 1 Low Probability</b>            | 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)                                                                                                                                                                                        |
| <b>Zone 2 Medium Probability</b>         | 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)                                                                                                                        |
| <b>Zone 3a High Probability</b>          | 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)                                                                                                                                                 |
| <b>Zone 3b The Functional Floodplain</b> | 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) |

- 2.2.7 **Figure 6** also shows that the site is partially at medium risk of flooding from rivers or sea. This is presumed to be due to the risk of surcharging or blockage of the culvert.

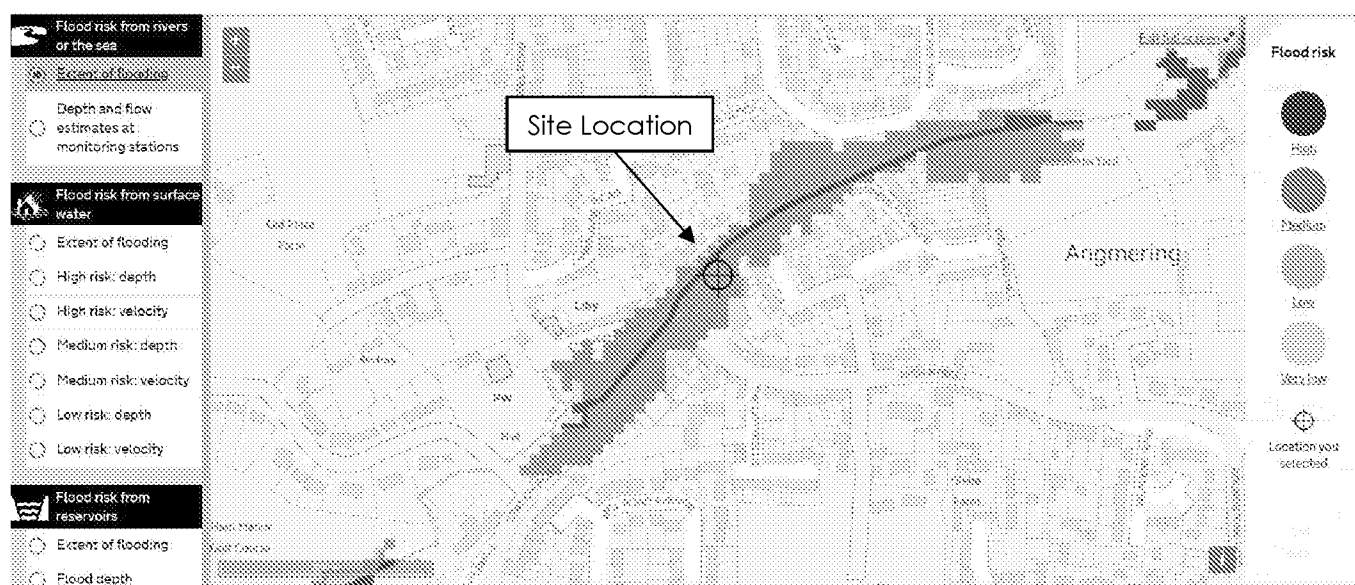


**Figure 6. Long Term Flood Risk Map; Flood risk from rivers or the sea**

- 2.2.8 **Figure 7** shows that the site at very low to high risk of surface water flooding. The northern boundary is at high risk of flooding, as well as an isolated area to the south of the site.

2.2.9 In a low risk scenario there is the potential for depths of between 300 to 900mm within the site and flows of over 0.25m/s.

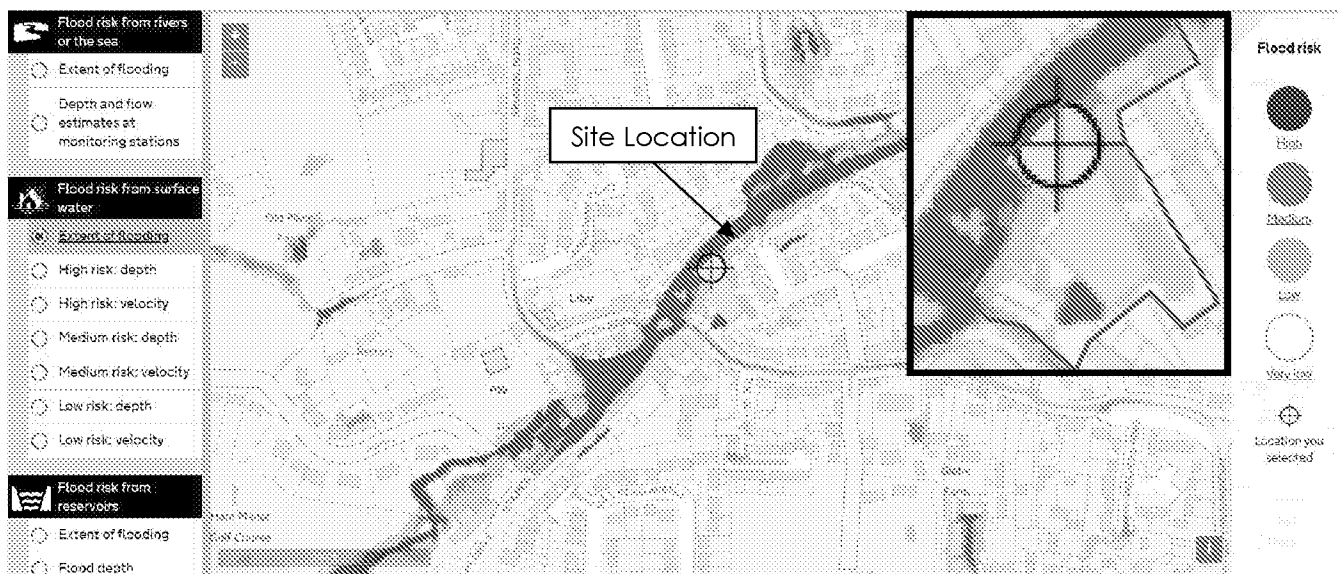


Figure 7. Long Term Flood Risk Map; Flood risk from surface water

2.2.10 Figure 8 shows that the site is not at risk of flooding from reservoirs.

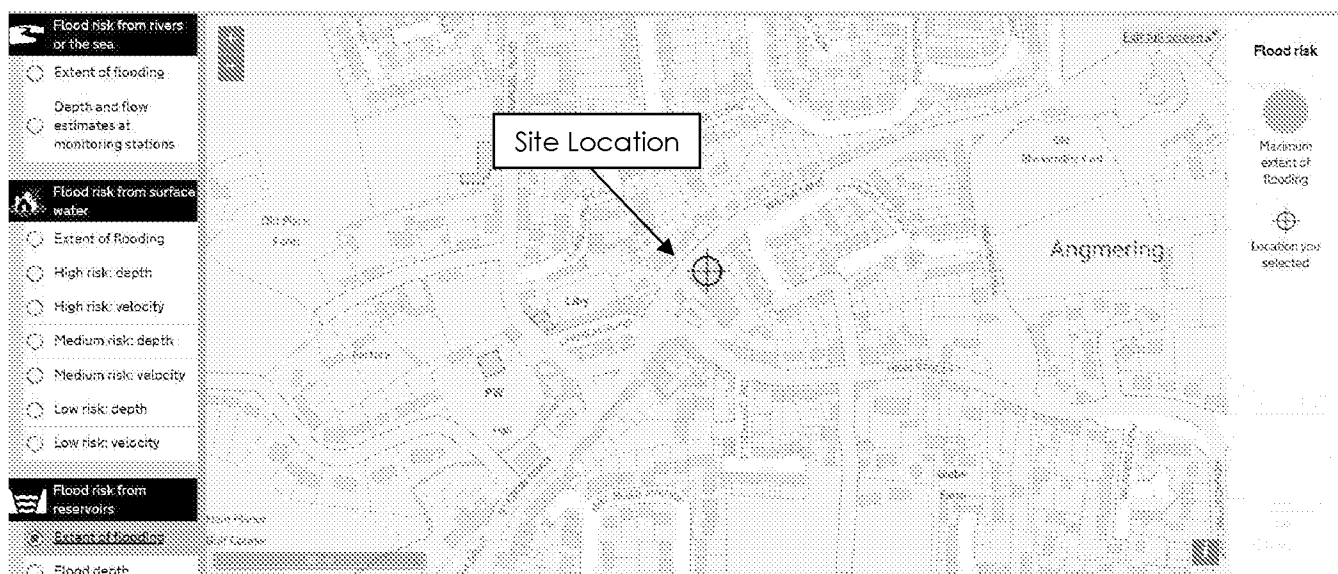


Figure 8. Long Term Flood Risk Map; Flood risk from reservoirs

## 2.3 Strategic Flood Risk Assessment

- 2.3.1 The Arun District Council SFRA identified the site location as at high susceptibility to groundwater, located partially within Flood Zone 3b, located wholly within a Flood Warning Area, and in proximity to numerous historic flooding records.
- 2.3.2 It is indicated that the Sequential Test would not be passed for this area and that the Exception test would therefore be required for developments within the vicinity of Water Lane due to the risk of flooding from fluvial, pluvial and groundwater sources.

## 2.4 Historic Flooding

- 2.4.1 West Sussex County Council (WSCC) and the Environment Agency were consulted regarding historic flooding at the site.
- 2.4.2 WSCC responded that Water Lane has experienced periodical flooding over a long period of time. This included flood events in:
- Winter 1960/61
  - November 1974
  - September-October 1980
  - June-August 1981
- 2.4.3 Environment Agency flood reports indicated that flood depths on Water Lane during the 1960/61 floods were to a depth of 300mm, and although culvert capacity works were undertaken in 1973, heavy rainfall in November 1974 caused flooding to the site garage showrooms to a depth of 225mm.
- 2.4.4 The flood event in June 1981 also caused flooding to the garage showroom, with eight cars written off. A threshold level of 5.51mAOD was recorded. Flood reports stated that the local drainage system surcharged, and 13 houses were also flooded.
- 2.4.5 It was noted that the culvert inlet was obstructed by debris, and maximum water level in The Square was up to 600mm depth.
- 2.4.6 Flooding of the area was also recorded in 1982, 1993, 2000 and 2012 however there are no records of the site for these events. The Environment Agency reported that much of the flooding which has occurred was due to blockages at the weed screen in Weavers Hill. From this point water overflows and runs down along Water Lane.
- 2.4.7 Improvements have been made to the weed screen so it is compliant with modern guidance, and access to clear blockages has been significantly improved. Furthermore the weed screen benefits from a camera, which is linked to the EA's telemetry systems, and enables the EA (subject to available resource and health and safety implications) to clear blockages in advance of predicted rainfall events, and/or during a flood event. However it does not eliminate surcharging risk from the culverts and manholes in an extreme flood event.
- 2.4.8 The Agency are currently looking at other options to alleviate flooding in Angmering, which include upstream storage, north of the village.
- 2.4.9 Angmering Parish Council provided detail of works funded by Operation Watershed and undertaken since 2012 to the Black Ditch, which runs through Angmering and is culverted under Water Lane. The remotely controlled webcam installed can be viewed from the parish council website and allows for the ditch to be monitored to ensure prompt action due to any damage or blockage. In addition, the entrance to the culvert was updated and a new grill was installed in order to prevent blockages.
- 2.4.10 Furthermore, the ditch was reinstated down Dappers Lane and the Black Ditch was unsilted downstream from the village centre to prevent back-up of flows. These mitigatory measures will ensure an improved conveyance of flows and a reduction in the risk of further flooding.

## 2.5 Summary of Flood Risk

- 2.5.1 The potential sources of flooding are:

| Source of Flooding        | Level of Risk                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Rivers and Coastal</b> | <p><b>High</b></p> <p>The north of the site is within Flood Zone 3 and there is a history of flooding along Water Lane.</p> <p>Despite improvement works to Black Ditch, further mitigatory measures will be required for the development in the event of flooding – presumed to be as a result of surcharging or blockage of the culverted watercourse.</p>                                                                                                                                                                                                                                                                    |
| <b>Surface Water</b>      | <p><b>High</b></p> <p>The long-term flood risk for surface water varies from 'Very Low' to 'High' at the site location.</p> <p>There is also high risk along Water Lane, so mitigation and access/egress will need to be considered.</p>                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Groundwater</b>        | <p><b>High</b></p> <p>Review of BGS records found the site to be situated above a Principal Aquifer with high groundwater vulnerability.</p> <p>Site investigation and borehole records show groundwater at 2-3m below ground level.</p> <p>Consultation with West Sussex County Council identified the site within an area at high risk of groundwater emergence.</p> <p>No deep excavation that could disturb groundwater flows is proposed. The use of infiltration SuDS will be limited by the presence of groundwater, however some infiltration may contribute to discharge in shallow SuDS in the south of the site.</p> |
| <b>Sewers</b>             | <p><b>Very Low</b></p> <p>Southern Water did not report any records of sewer flooding within the vicinity of the site, and no other records of sewer flooding have been found.</p> <p>In view of this information the risk of flooding from this source is deemed to be 'Very Low'.</p>                                                                                                                                                                                                                                                                                                                                         |
| <b>Artificial Sources</b> | <p><b>None</b></p> <p>The site is now shown to be at risk of flooding in the event of a breach of a reservoir.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

### 3 PROPOSED DEVELOPMENT

#### 3.1 Description of Development

- 3.1.1 The proposed development will involve the construction of 4000 sq. ft of retail space and 5 No. apartments, as well as a further 11 No. homes, 3 No. apartments and a new parish council building as demonstrated within **Appendix A**.
- 3.1.2 The type of development falls within the 'More Vulnerable' classification (Flood Risk and Coastal Change Table 2) and requires an Exception Test in Flood Zone 3a (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 will not increase the impermeable area of the site or increase the rate of run-off generated by the site.
- 3.1.4 The post-development impermeable area has been determined to be 4,012m<sup>2</sup> (0.40Ha).
- 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.
- 3.1.7 The proposed site layout is shown on drawing 17-1030-SK-03 H (**Appendix A**).

## 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 but not suitable due to client construction specification.                                                                             |
| Basins and Ponds                     |          | No initial constraints but not suitable due to the limited space available with the proposed layout.                                                          |
| - Constructed Wetlands               | Yes      |                                                                                                                                                               |
| - Balancing Ponds                    | Yes      |                                                                                                                                                               |
| - Detention Basins                   | Yes      |                                                                                                                                                               |
| - Retention Ponds                    | Yes      |                                                                                                                                                               |
| Filter strips and swales             | No       | Shallow groundwater and risk of emergence limits the use of infiltration techniques                                                                           |
| Infiltration Devices                 | No       | Shallow groundwater and risk of emergence limits the use of infiltration techniques                                                                           |
| - Soakaways                          |          |                                                                                                                                                               |
| - Infiltration trenches and basins   |          |                                                                                                                                                               |
| Permeable surfaces and filter drains |          | Shallow groundwater and risk of emergence limits the use of infiltration techniques, and surface water flooding would limit the viability of tanked permeable |
| - Gravelled areas                    | Yes      |                                                                                                                                                               |

|                       |     |                                                                                                                                      |
|-----------------------|-----|--------------------------------------------------------------------------------------------------------------------------------------|
| - Solid paving blocks | Yes | paving, however this could be considered in areas at lower risk of surface water or fluvial flooding to capture and attenuate flows. |
| - Porous pavers       | Yes |                                                                                                                                      |
| Tanked systems        |     | SuDS systems would be depth limited due to the presence of shallow groundwater and flood risk in some areas of the site.             |
| - Oversized pipes     | Yes |                                                                                                                                      |
| - Cellular tanks      | Yes |                                                                                                                                      |

- 4.1.2 As detailed in the MicroDrainage Calculations in **Appendix G**, the Greenfield mean annual maximum runoff rate (Qbar) has been calculated using MicroDrainage to be 1.7l/s (Q1 = 5.4l/s, Q30 = 3.8l/s, Q100 = 5.4l/s), with a Greenfield volume of 114m<sup>3</sup> for a 100-year six-hour event.
- 4.1.3 Areas of the site at high risk of fluvial or surface water flooding are also unsuitable for attenuation measures, as they would not provide any effective storage in times of flooding.
- 4.1.4 In view of 4.1.4, it is proposed to utilise a combination of shallow attenuation in areas of the site at lower risk of flooding in combination with mitigation measures to reduce the flood risk to proposed buildings on the site.
- 4.1.5 It is proposed that permeable paving will be introduced across the site for residential courtyards, private drives and shared parking areas in the south of the site. This area is above the design flood level and would use tanked permeable pavement with a controlled outflow of 5.0l/s to the existing surface water drain, providing a betterment compared to the existing area. This would provide a plan area of permeable paving totalling 892m<sup>2</sup>, with a sub-base thickness of 350mm.
- 4.1.6 Based upon site-specific geotechnical investigation, it is considered that infiltration may be viable for part of the site. This is subject to additional groundwater monitoring over the winter period, it may be feasible to provide upper level storage within the porous pavement which is discharged via ring soakaways which penetrate the underlying chalk bedrock. However this may require third party approval from the Environment Agency due to the local sensitivity.
- 4.1.7 Because the site is located in an area of shallow groundwater presence and at high risk of groundwater emergence, shallow infiltration methods may be more appropriate. The infiltration rate of the head deposits is considered to be considerably less; however it is proposed that the permeable paving outside of the flood zone allows for infiltration where possible via a permeable geotextile layer, which would alleviate the impact of runoff on the culverted watercourse.
- 4.1.8 A blue roof on the commercial building will capture and attenuate rainfall on this roof, providing 21.4 cubic metres of storage and discharged at a controlled outflow of 1.0l/s.
- 4.1.9 The remaining site will utilize existing gully and pipe drainage and connections to the surface water drain, with the contractor to assess existing site drainage and connection requirements. Maximum estimated outflow from the remaining hardstanding areas would be 20.9l/s (1507m<sup>2</sup> \* 50mm/hr / 3600 seconds).
- 4.1.10 Total site discharge will be 26.9l/s, which provides over 50% betterment compared to the existing site discharge – estimated to be 55.7 l/s (4013m<sup>2</sup> \* 50mm/hr / 3600 seconds).
- 4.1.11 If the site drainage investigation establishes that additional connections are required to the surface water drain, requirements for Land Drainage Consent will need to be established.

4.1.12 In addition, a geocellular storage tank is proposed underneath the shared private driveway to the residential properties, subject to CCTV survey of the culverted watercourse. This is in order to provide additional unsaturated attenuation outside of areas at risk of inundation, and would provide capacity in the event of a watercourse surcharge or exceedance event, as well as reducing overall site discharge rate. This is to be reviewed at detailed design stage.

4.1.13 The strategy above will ensure that there is no increase in the rate of run-off leaving the site, therefore no increase in the risk of flooding from this source.

## 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 and 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:

- Permavoid with Permafilter treatment geotextile - TSS=0.5/M=0.2/H=0.5
- Permeable Pavement – TSS=0.7/M=0.6/H=0.7

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

- 4.2.8 Further investigation is required into the existing site drainage due to the proposed connections for the rest of the site. If the existing drainage does not already utilize a catchpit or alternative form of treatment, the installation of measures will be required to ensure sufficient treatment is provided for the above land uses. Measures could include filter strips, permachannel gullies and silt traps.

### 4.3 Foul Water Drainage

- 4.3.1 There is presumed to be an existing connection to the public foul water sewer on Water Lane, and site investigation is required to establish whether existing connections could be utilized and if any additional connections are required. Connections to the public sewer network can be established by the developer, subject to approval.
- 4.3.2 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.
- 4.3.3 The topography of the site, as well as the location and depth of the existing foul sewers located within Water Lane, means that a gravity-based connection to the public foul sewer network is viable. The proposed points of connection are shown on Drawing **SK400** (Drainage Strategy).
- 4.3.4 Based on the design guidance provided in Sewers for Adoption, the proposed foul flow to the public foul sewer will be 0.59 l/s (based upon Sewers for Adoption).

### 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 small and urban catchments. 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                     | <b>10%</b>                                                        | <b>20%</b>                                                        | <b>40%</b>                                                        |
| Central                       | <b>5%</b>                                                         | <b>10%</b>                                                        | <b>20%</b>                                                        |

- 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.

- 4.4.4 The design flood levels as a result of fluvial flooding of the culvert have included climate change, which have been produced in the Lower Tidal River Arun Strategy Study provided by the Environment Agency.

## **4.5 Flood Compensation**

- 4.5.1 Flooding as a result of a blockage or surcharge of the culvert will result in flood waters flowing down Water Lane, and buildings within the flooded area will remove flood storage volume and compound flooding. In the area of the site below the undefended 1% AEP (plus CC) flood level of 6.08mAOD, the total building area will reduce from 983m<sup>2</sup> to 862m<sup>2</sup>, and therefore additional flood compensation volume is not required as shown on Drawing **SK301** (Flood Compensation Appraisal).
- 4.5.2 In addition, the existing retaining wall at the north-east corner of the site is expected to direct flows away from the site towards Water Lane, and this boundary will continue to provide this protection.

## **4.6 Urban Creep**

- 4.6.1 Although urban creep is expected on new residential developments through their lifetime, the existing and proposed site layout contains over 90% impermeable area, and therefore it is not expected that this will significantly increase.

## 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. Flooding of buildings within flood zone.
- ii. Increased flow through watercourses as a result of climate change causing flooding to the site.
- iii. Blockage of watercourses as a result of debris or otherwise, causing flooding to the site.
- iv. Extreme rainfall events that exceed the design criteria used for the drainage system causing surface water flooding.
- v. Blockage/failure of the proposed drainage system causing flooding to the site.
- vi. Groundwater flooding to the site caused by groundwater levels exceeding the ground surface level.
- vii. Surface water flooding of proposed buildings

### 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:

- i. The Environment Agency Product 4 response indicates that the maximum expected flood depth in a 100 year plus climate change event is 230mm at the selected nodes. The floor levels of these buildings have been set at least 250mm higher than the surrounding areas. In addition, it is recommended that flood proofing measures are utilized on the ground floors of buildings within Flood Zone 3. All residential ground floor levels are set above the defended 1% AEP (plus CC) flood level of 6.23mAOD;
  - (a) Building A: Residential properties within Flood Zone 3a, finished floor level set at 6.40mAOD, with stepped access to the second floor apartments and access with raised ground level provided at the rear of the property.
  - (b) Building B: Ground floor retail space within Flood Zone 3a, finished floor level set at 6.00mAOD, with stepped access to the second floor apartments and flood proofing proposed for shallow flooding of the ground floor in an extreme event.

- (c) Building C: Ground Floor Parish Council Building within Flood Zone 3a, finished floor level set at 6.40mAOD, with sloped access to the front entrance, accessible from the south corner in an extreme flood event.
  - (d) Building D: Residential properties partially within Flood Zone 3a, finished floor levels set at 6.40mAOD, with access via the site, and accessible from the south corner in an extreme flood event.
  - (e) Building E: Residential property not within a Flood Zone, finished floor level set at 6.40mAOD
  - (f) Building F: Residential properties not within a Flood Zone, finished floor levels set at 6.40mAOD
- ii. The Flood Risk Assessment and drainage design have taken into account predicted climate change impacts for the lifetime of the development, in account with the Environment Agency climate change allowances. These have been included in the assessment of drainage calculations and included within the design flood depths.
  - iii. Recent remedial works by Angmering Parish Council include a monitoring system and culvert improvement works. The fluvial flood risk to the site is presumed to be associated with blockage or surcharge of the culvert, and these remedial works should reduce the risk of flooding to the site.
  - iv. The drainage strategy has been developed to capture runoff 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. The existing topography of the site has been reviewed and the existing overland flow routes assessed. Flows currently following the existing topography – falling to the north and west towards the watercourse. Existing and proposed drainage infrastructure should also be considered which can intercept run-off in an exceedance event, including gullies and channel drains.
  - v. The proposed drainage system will attenuate and store runoff up to the design event. Blockage of the drainage system has the potential to cause flooding on the site. Surcharged flows will likely travel overland to the existing drainage system and watercourse, however maintenance measures proposed in Chapter 8 will mitigate the risk of the system becoming blocked.
  - vi. Due to the underlying ground conditions of the site and the presence of groundwater in the upper layers, there is a risk of groundwater exceeding the surface level and emerging on the site. There are no records of previous groundwater flooding, however. If groundwater flooding was to occur, it would flow away from the proposed buildings into the existing drainage gullies and the watercourse ditch, or via the proposed drainage system.
  - vii. The risk of surface water flooding will be mitigated by raised finished floor levels to provide freeboard and design of levels to convey overland flow away from buildings.

## 6 SEQUENTIAL AND EXCEPTION TESTS

### 6.1 Sequential Test

- 6.1.1 The area of proposed development is in Flood Zones 1 to 3 and is at risk of flooding. In view of this, the application of the sequential test is required.
- 6.1.2 The site lies within a central village location and is therefore considered a highly sustainable location for residential development. There are not alternative locations within the village available for significant development of mixed residential and commercial regeneration, especially given the Built-up Area Boundary set out in the West Sussex County Structure Plan and the Arun District Local Plan, whereby redevelopment will only be permitted within the boundaries.
- 6.1.3 In addition, the site arrangement has partially been set out sequentially so that residential buildings are set within areas at lowest risk of flooding in order to minimise the risk of potential flooding from the sources detailed within **Section 2.5 - Summary of Flood Risk**.

### 6.2 Exception Test

- 6.2.1 Table 3 within Paragraph 067 of Flood Risk and Coastal Change confirms that developments classified as "More Vulnerable" require an Exception Test for Flood Zone 3a. The proposed development is in Flood Zone 3a due to the risk of flooding from the culverted river.
- 6.2.2 In order to demonstrate the requirements are met with reference to Paragraphs 102 & 103 of NPPG Flood Risk and Coastal Change we summarise as follows:
- 6.2.3 Paragraph 102 quotes 'If, following application of the Sequential Test, it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied if appropriate. For the Exception Test to be passed:
- *it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared*
- 6.2.4 The development provides sustainability benefits to the community that outweigh the flood risk, including provision of new development, development and provision of infrastructure, sustainable drainage, reduction in noise pollution and affordable housing. On review the local area would appear to be predominantly residential and so the proposals would match the existing character.
- *a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall*
- 6.2.5 The extent of Zone 3 and the 1% AEP (plus CC) flood extent appears to coincide fairly well. The proposed ground levels off all properties of a more vulnerable use will be raised to comply with a minimum 300mm freeboard. This freeboard provides a level of protection against the effects of climate change for the lifetime of the development. The proposed development does not involve the creation of additional impermeable area and does not increase the rate or volume of run off generated by the site. This ensures that the development has no impact on flood risk either on or off the site.

- 6.2.6 The development also provides a reduction in site discharge and an increase in flood storage volume capacity which will reduce flood risk downstream; representing a reduction in flood risk overall for the affected area.
- 6.2.7 Paragraph 103 states 'When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, it can be demonstrated that:'
- *within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location*
- 6.2.8 The proposed residential buildings will be constructed within Flood Zone 1 (laid out sequentially), whilst the proposed apartments will be constructed at a higher elevation above the design flood level.
- *development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems'*
- 6.2.9 As discussed in Section 5, the proposals will include flood resilient construction. In addition, safe access and egress routes will be provided where necessary so that any residual risk to future residents can be safely managed.
- 6.2.10 As the development is partially within Zones 2 and 3. It is therefore recommended that the occupants of the development are subscribed to the Environment Agency's flood warning scheme and there is provision of a Flood Evacuation Plan to determine what actions occupants should take leading up to and during a nearby flood event. The Flood Plan would consider further the specific requirements with regard to access and egress.
- 6.2.11 The development has given priority to the use of sustainable drainage systems, in order to capture and attenuate rainfall above the design flood level and provide a sufficient level of treatment to captured flows.

## **FLOOD RISK MANAGEMENT**

### **6.3 Safe Access and Egress**

- 6.3.1 The north of the proposed development falls within Flood Zone 3, and the access to the site is primarily from Water Lane, which is also within Flood Zone 3.
- 6.3.2 The private residential area in the south of the site is located on higher ground, out of the flood zone and at minimal risk of fluvial or surface water flooding.
- 6.3.3 It is proposed that to the rear of Building A raised ground levels allow alternative access/egress from the ground floor apartment to Cumberland Crescent during flood events.
- 6.3.4 Access/egress from Building B is generally via Water Lane however there is direct access to higher ground to the south of the site.
- 6.3.5 Access/egress from Building C and Building D is generally via the west corner of the site to High Street; however an alternative route is proposed via the southern corner of the site to High Street.
- 6.3.6 Building E and Building F are situated outside of the flood extents and are situated in an area of higher proposed ground.
- 6.3.7 It is also recommended that provision be considered for emergency access and egress from the area of higher ground off the site; to be viable via the walkway through Building D to an available access point in the southern corner of the site, on the High Street.
- 6.3.8 All residential properties will be raised sufficiently above the flood level so that immediate access or egress is not a safety requirement, and it considered likely that flooding across the site and potential access routes are limited to below 300mm depth.

### **6.4 Flood Warning**

- 6.4.1 The site is at risk of fluvial and surface water flooding therefore there is a need for a Flood Evacuation Plan (FEP). This should consider the provision of a Flood Warning System.

## 7 MAINTENANCE

### 7.1 Proposed Maintenance Regime

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

7.1.2 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                   |
|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| <b>Permeable Paving</b>                                        | 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 |
| <b>Diffuser units &amp; catch pits, gully sumps and drains</b> | Inspection and additional cleansing as required.                                                                       | Annual                                        |
|                                                                | Desilting                                                                                                              | Year 1, Year 3, then every 5 years            |
| <b>Pipework</b>                                                | Jetting to clear blockages                                                                                             | As required                                   |
| <b>Hydrobrake</b>                                              | As specified by manufacturer                                                                                           | As specified by manufacturer                  |

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

#### Permeable Paving / Diffuser Units

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

7.1.5 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.

7.1.6 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

### **Permavoid System**

- 7.1.7 The Permavoid sustainable drainage system which incorporates the blue roofing should be inspected regularly and correctly maintained. This includes routine maintenance and a pre-handover inspection and clean.
- 7.1.8 In accordance with the Permavoid Technical Manual, routine inspection and maintenance of the blue roof system should include:
- Inspection of systems
  - Removal of silts
  - Decanting of oils and hydrocarbons
  - Channel jetting
  - Manual clearance of excess silt or debris within gullies.
  - Removal / management of weed growth, as required. Typically, once or twice a year for regularly used areas
- 7.1.9 Further detail of maintenance tasks and regularity required should be established with the manufacturer according to their system requirements.

### **HydroBrake (Flow Control Chamber)**

- 7.1.10 The HydroBrake flow control system 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.

- 7.1.11 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.
- 7.1.12 The HydroBrake flow control chamber will require additional maintenance measures to ensure it operates as designed. The additional measures are as follow:
- 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

### **Remedial/Repair Actions**

- 7.1.13 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.
- 7.1.14 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**

- 7.1.15 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.
- 7.1.16 Minor spillages of fuels and oils from motor vehicles 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**

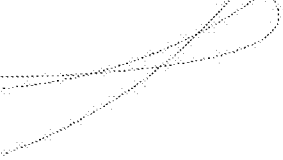
- 7.1.17 Any future alterations to the permeable paving should be confirmed by a specialist. Where possible any future services are to avoid being located through areas of permeable paving. If new services are required to run through areas of permeable paving, services should be installed below the depth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

## **8 OFFSITE IMPACTS**

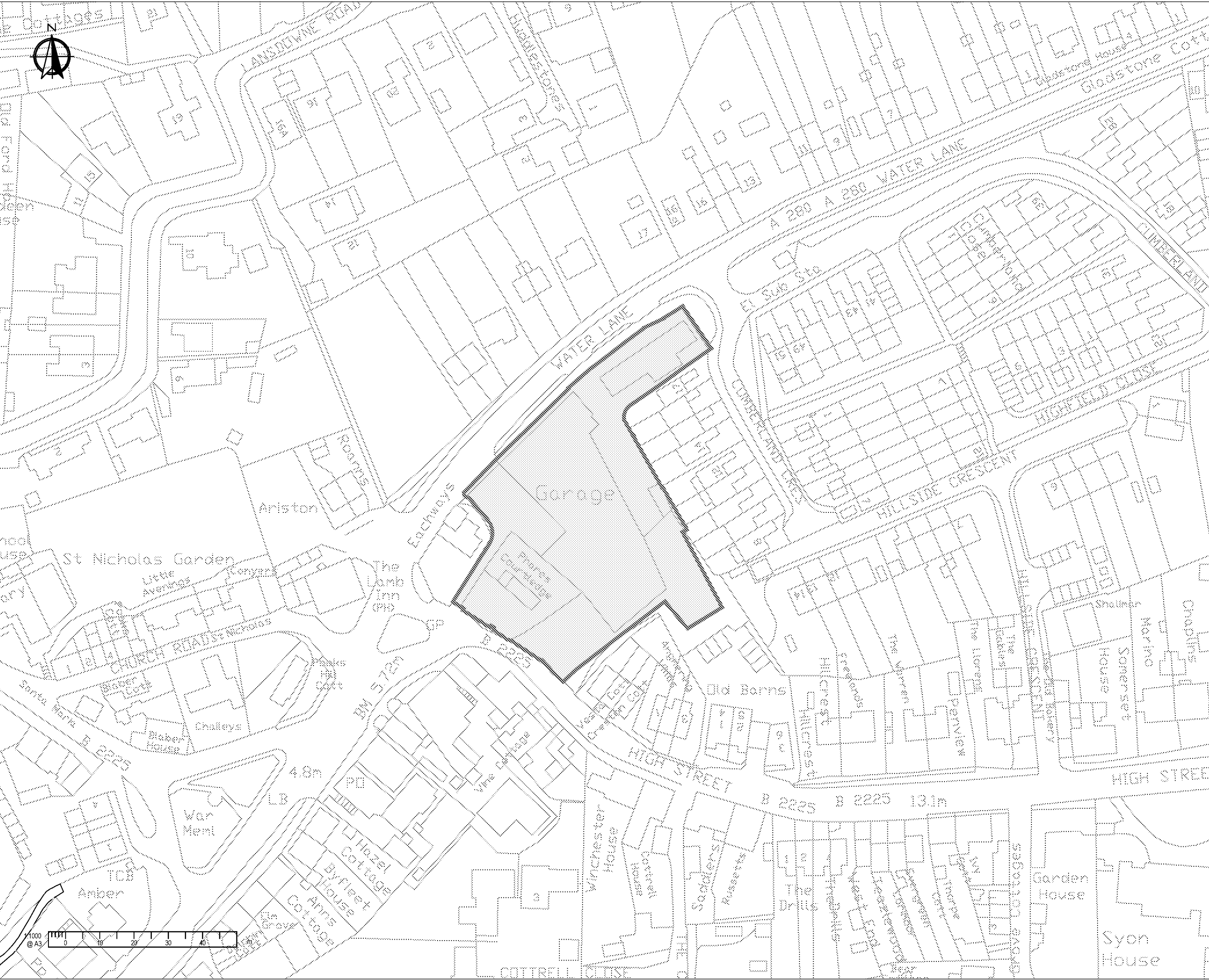
- 8.1.1 The proposed development will have a positive impact on flooding issues off-site by reducing run-off rates and discharge to the surface water drain via attenuation within sustainable drainage systems and infiltration where possible.
- 8.1.2 Post development foul water flows will contribute an increase to the sewer network compared to the previous use – it is expected that the foul sewer flow will be 0.59l/s.
- 8.1.3 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.

## 9 SUMMARY

- 9.1.1 This site-specific flood risk assessment is based on Flood Maps, the Local Authority's Strategic Flood Risk Assessment and Public Sewer Records.
- 9.1.2 The site is currently a previous garage site with mainly hardstanding impermeable area.
- 9.1.3 The development lies within Flood Zones 1 to 3. The existing run-off from the site is collected by a gully and pipe drainage system and discharged un-controlled to the surface water drain on Water Lane.
- 9.1.4 Post-development surface water run-off will be managed through sustainable drainage measures, with the installation of permeable paving, blue roofing and a controlled outfall meaning overland flows can be attenuated on site and released to the drain at a rate of over 60% betterment, without causing surface water flooding on site.
- 9.1.5 The wastewater from the proposed development will discharge to the existing system via a proposed pumping station. A S106 application will be required in order to establish connection, although existing foul water drainage on site should also be investigated for existing connections.
- 9.1.6 The completion of the development will not increase flood risk on or off the site.
- 9.1.7 Information has been provided to state why this development passes the Sequential Test and the Exception Test.
- 9.1.8 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.

-SITE LOCATION LEGEND-

Site Boundary - 4374 m<sup>2</sup> (0.437 Ha.)

Site Grid Reference: TQ 06930 04438

PLANNING

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|     | 14-2-19 | Draft      | DIL   |
| Rev | Date    | Amendments | Drawn |



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  
Landspeed Homes

Project  
Former Chandlers Garage  
Water Lane, Angmering

Drawing Title  
Site Location Plan

|                 |                 |                  |                |
|-----------------|-----------------|------------------|----------------|
| Scale<br>1:1000 | Drawn By<br>DJL | Checked By<br>MA | Approved<br>MA |
|-----------------|-----------------|------------------|----------------|

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| Date<br>February 2019 | Drawing No.<br>2018-D1623-PL100 | Rev<br>P |
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ARUN DISTRICT COUNCIL A45/19PL

- # PLANNING

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| PI   | 20/02/19 | Initial Issue | DJJ   |
| Rev. | Date     | Amendments    | Drawn |



**Transport Planning and Infrastructure Design Consultants**  
2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF  
Tel: 01243 210418 Fax: 01483 861682 [www.rqp.co.uk](http://www.rqp.co.uk)

Client

Landspeed Homes

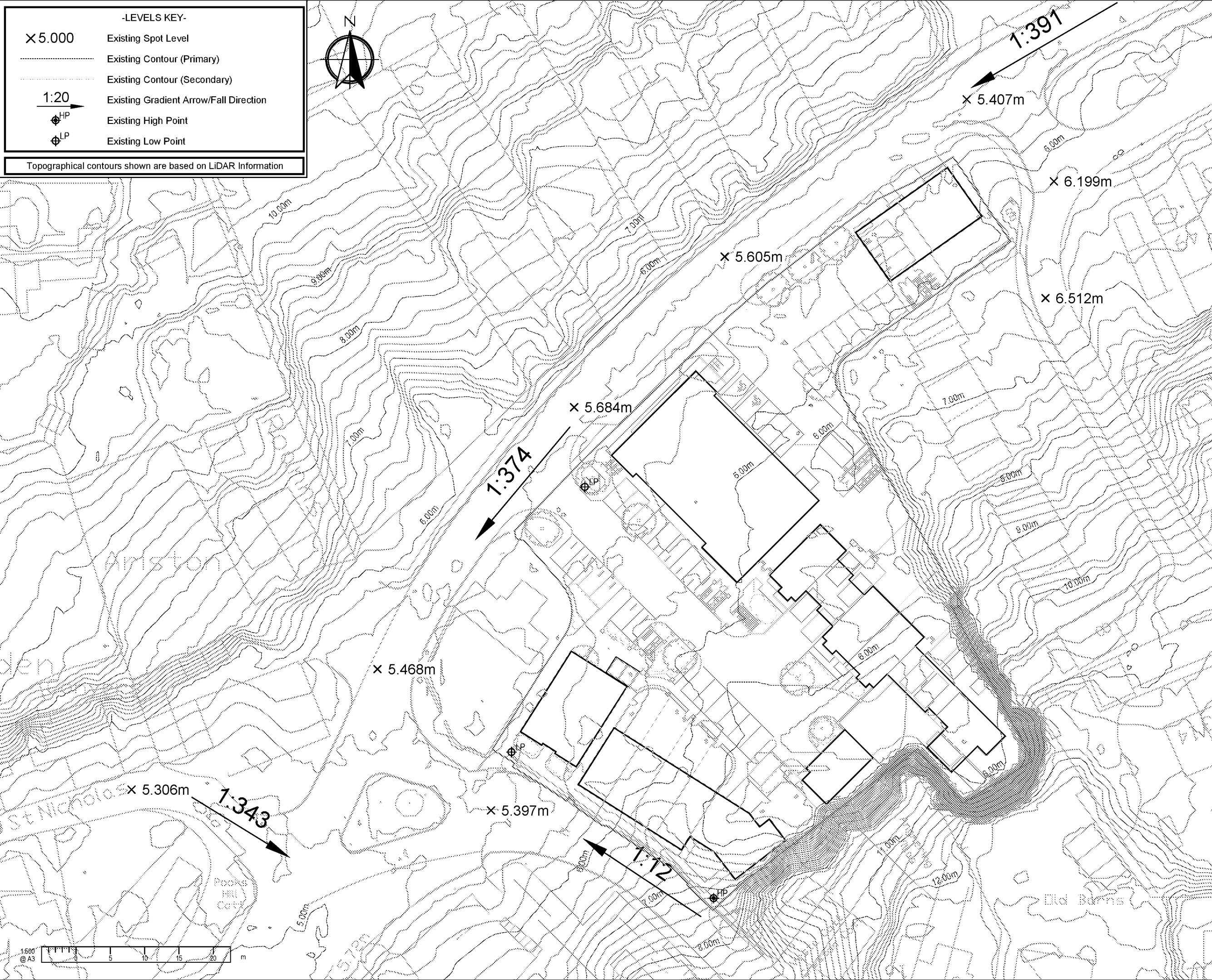
Project

Former Chandler's Garage  
Water Lane, Angmering

Drawing Title

## LiDAR Banding

|                       |                                 |                  |                   |
|-----------------------|---------------------------------|------------------|-------------------|
| Scale<br>1:500        | Drawn By<br>DJL                 | Checked By<br>MA | Approved By<br>MA |
| Date<br>February 2019 | Drawing No.<br>2018-D1623-PL101 |                  | Revised By<br>PND |



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|-----|----------|---------------|-------|
| PI  | 19/02/19 | Initial Issue | DJL   |
| Rev | Date     | Amendments    | Drawn |



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2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF  
Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

Client

Landspeed Homes

Project

Former Chandlers Garage  
Water Lane, Angmering

Drawing Title

LIDAR Contours

|       |               |             |                  |            |    |          |    |
|-------|---------------|-------------|------------------|------------|----|----------|----|
| Scale | 1:500         | Drawn By    | DJL              | Checked By | MA | Approved | MA |
| Date  | February 2019 | Drawing No. | 2018-D1623-PL102 | Rev        | P  | Rev      | P  |

ARUNDEL DISTRICT COUNCIL A45/19/PL



## A3

- PLANNING
- 
- NOT FOR CONSTRUCTION

|      |         |            |       |
|------|---------|------------|-------|
| -    | 14-2-19 | Draft      | DJL   |
| Rev. | Date    | Amendments | Drawn |

|                                                                                       |                                        |
|---------------------------------------------------------------------------------------|----------------------------------------|
|  | Site Boundary                          |
|  | Existing Spot Level                    |
|  | Existing Contour (Primary)             |
|  | Existing Contour (Secondary)           |
|  | Existing Gradient Arrow/Fall Direction |
|  | Existing High Point                    |
|  | Existing Low Point                     |

Contours are only as accurate as the initial land survey information.  
Contours are approximate only and spot levels may vary slightly on site.  
Local survey translated to Newlyn and OSGB36 by direct acquisition of control stations using RTK GPS to accuracy +/-25mm RMS

| Station | Easting(m) | Northing(m) | Level(m) |
|---------|------------|-------------|----------|
| 1       | 506933.323 | 104468.956  | 5.71     |
| 2       | 506941.587 | 104444.475  | 5.94     |
| 3       | 506955.414 | 104486.201  | 5.60     |
| 4       | 506970.991 | 104483.578  | 6.19     |
| 5       | 506958.052 | 104414.470  | 5.80     |
| 6       | 506961.932 | 104406.335  | 5.75     |
| 7       | 506928.587 | 104390.676  | 5.77     |
| 8       | 506923.341 | 104382.963  | 6.79     |
| 9       | 506905.566 | 104384.081  | 6.02     |
| 10      | 506926.167 | 104377.053  | 7.52     |
| 11      | 506887.013 | 104391.961  | 5.48     |
| 12      | 506913.536 | 104393.653  | 6.08     |
| 13      | 506872.622 | 104409.870  | 5.58     |
| 14      | 506904.157 | 104439.886  | 5.48     |
| 15      | 506911.184 | 104421.244  | 5.73     |
| 16      | 506926.742 | 104405.155  | 6.16     |



|         |                                                   |        |
|---------|---------------------------------------------------|--------|
| Project | Former Chandler's Garage<br>Water Lane, Angmering | 7/1/17 |
|---------|---------------------------------------------------|--------|

Drawing Title

Existing Overland  
Flow Routes

|                |                 |                  |                   |
|----------------|-----------------|------------------|-------------------|
| Scale<br>1:500 | Drawn By<br>DJL | Checked By<br>MA | Approved By<br>MA |
|----------------|-----------------|------------------|-------------------|

|                       |                                 |          |
|-----------------------|---------------------------------|----------|
| Date<br>February 2018 | Drawing No.<br>2018-D1623-PL200 | Rev<br>P |
|-----------------------|---------------------------------|----------|

PARUNDISTRICTCOUNCIL A/45/19/PL



-KEY-

Site Boundary

Flood Zone 3

Flood Zone 2

1% AEP (plus CC) Flood Extent

0.1% AEP Flood Extent

Model Design Flood Level (6.08m AOD)

Information provided within the Environment Agency's Site-Specific Product 4 Response: Flood Zone Outlines from the Flood Map for Planning (Rivers & Sea) & Flood Extents from the Modelled Flood Outlines map from the Lower Tidal River Arun Strategy Study, completed in 2010 by Atkins.

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P1

26/02/19

Initial Issue

D.J.L.

Rev

Date

Amendments

Drawn

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

Landspeed Homes

Project

Former Chandlers Garage  
Water Lane, Angmering

Drawing Title

Flood Zones & Flood Extents

Scale

1:500

Drawn By

DJL

Checked By

MA

Approved

MA

Date

February 2019

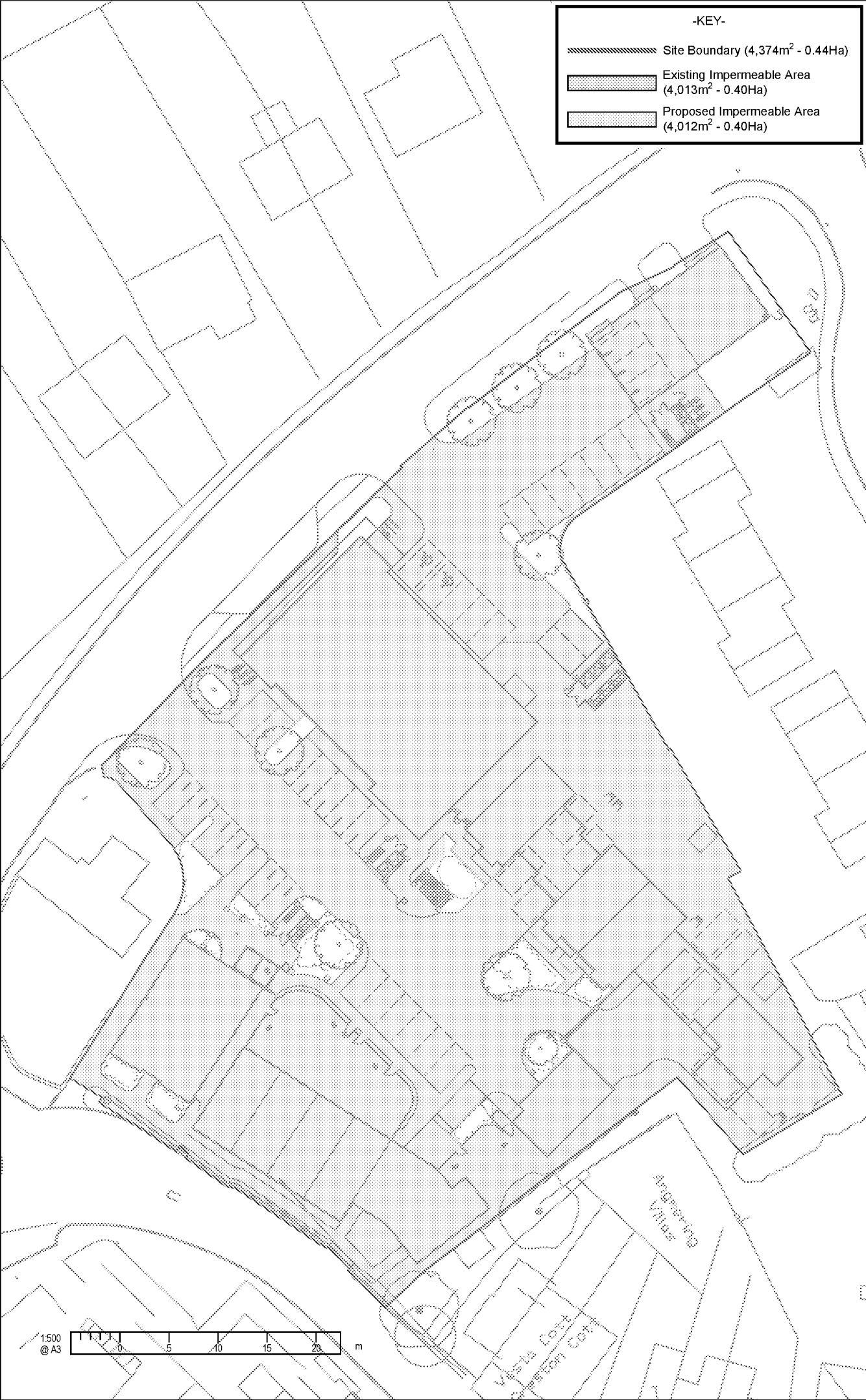
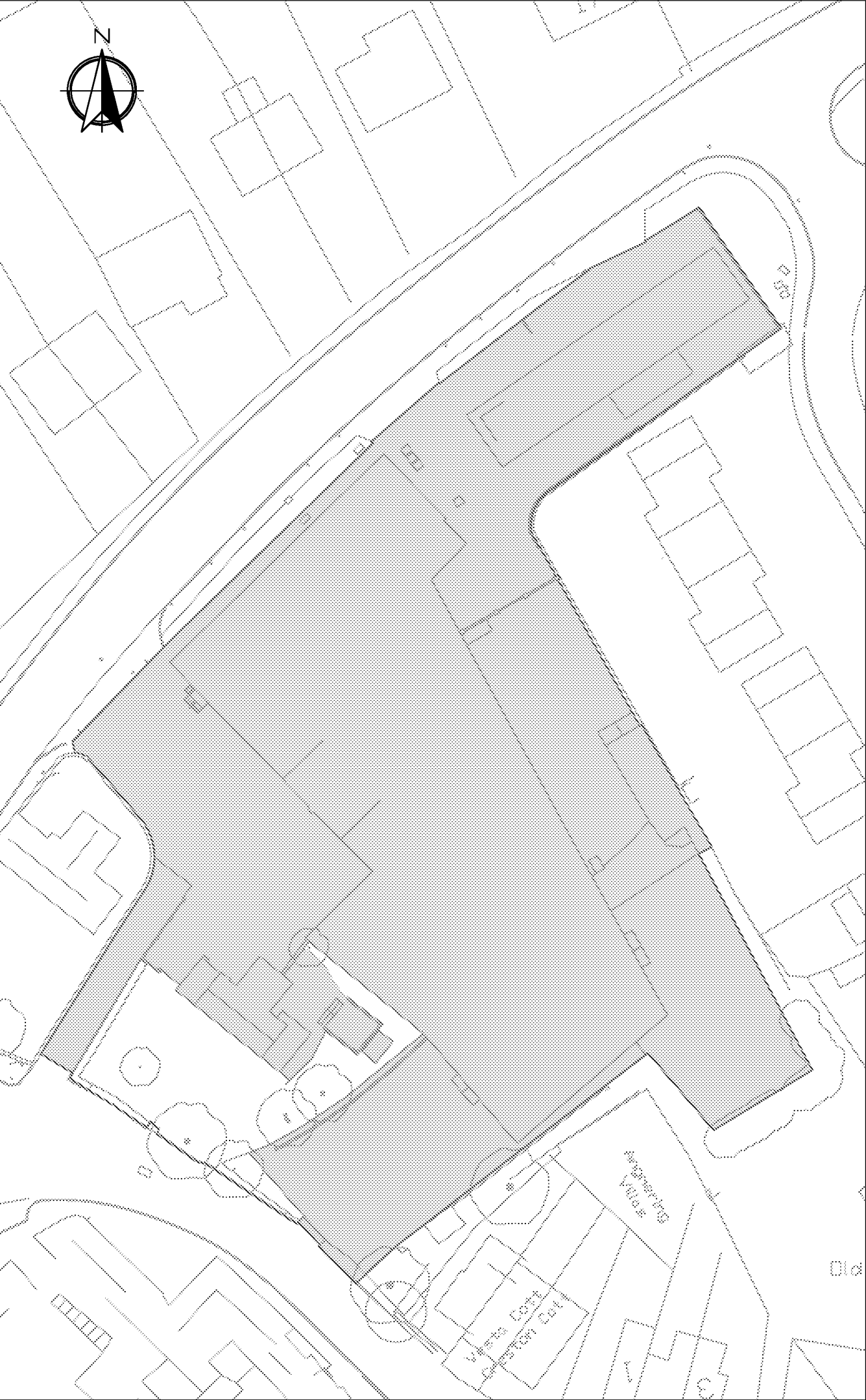
Drawing No.

2018-D1620-PL201

Rev

P1

ARUN DISTRICT COUNCIL A45/19PL



-KEY-

Site Boundary (4,374m<sup>2</sup> - 0.44Ha)

Existing Impermeable Area (4,013m<sup>2</sup> - 0.40Ha)

Proposed Impermeable Area (4,012m<sup>2</sup> - 0.40Ha)

NOTES

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5. Topographic information shown is based on survey undertaken by Offington Land Surveys in August 2012.

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| -   | 14-2-19 | Draft      | DJL   |
| Rev | Date    | Amendments | Drawn |

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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  
Landspeed Homes

Project  
Former Chandlers Garage  
Water Lane, Angmering

Drawing Title  
Impermeable Areas Comparison

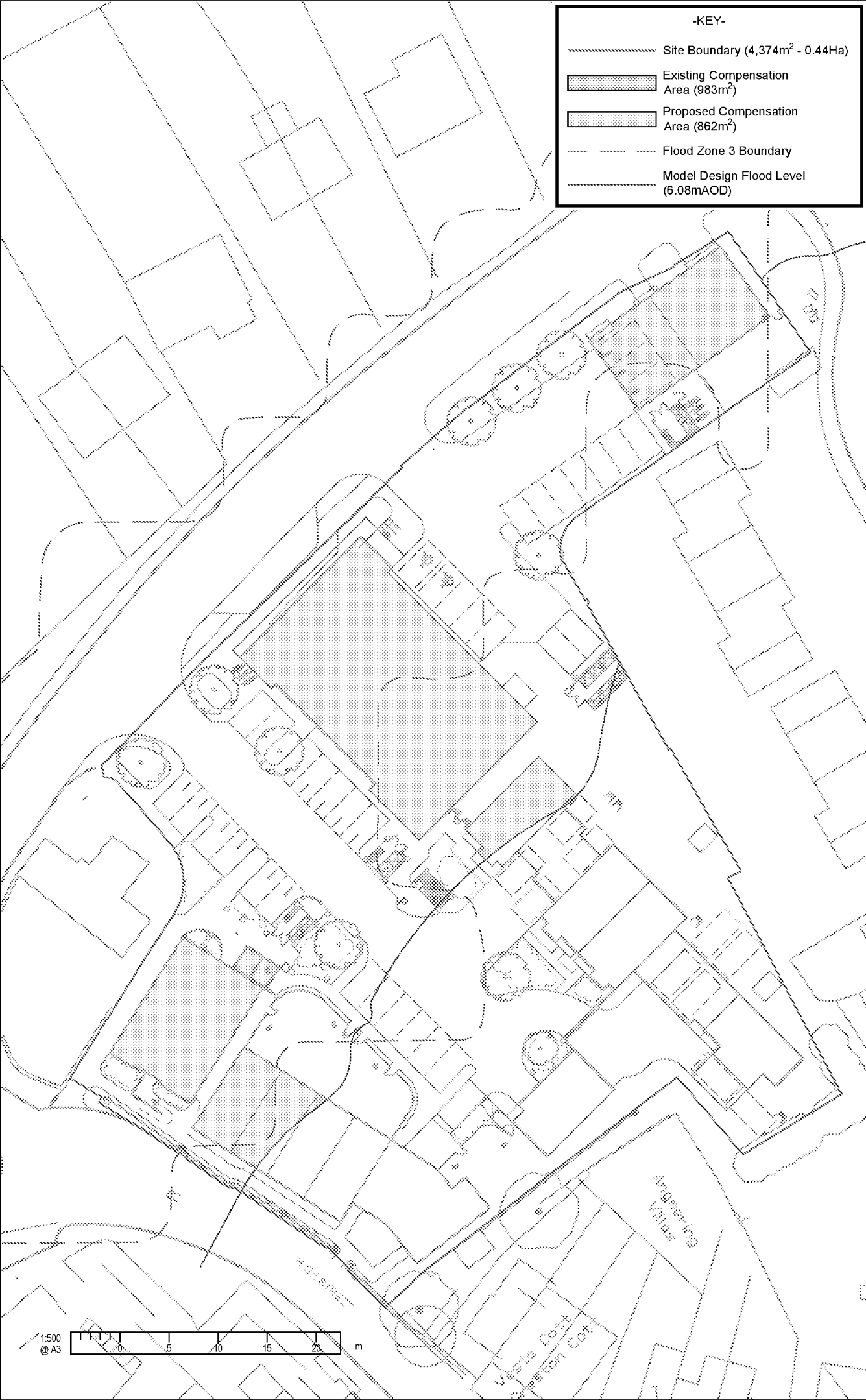
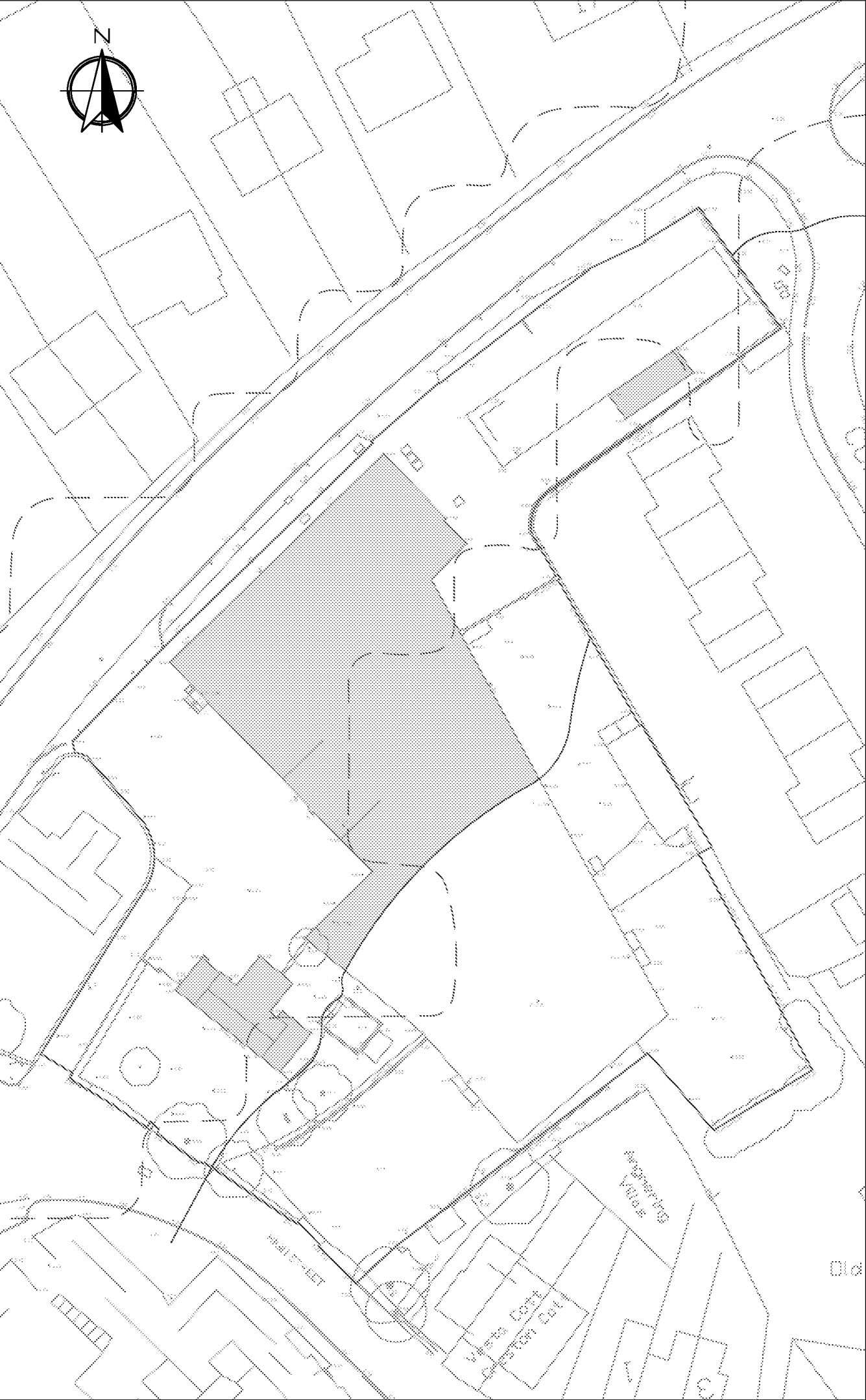
|                       |                                 |                  |                |
|-----------------------|---------------------------------|------------------|----------------|
| Scale<br>1:500        | Drawn By<br>DJL                 | Checked By<br>MA | Approved<br>MA |
| Date<br>February 2019 | Drawing No.<br>2018-D1623-PL300 | Rev<br>P         | Rev<br>P       |

1500  
@ A3

0 5 10 15 20

m

ARUN DISTRICT COUNCIL A45/19/PL



-KEY-

Site Boundary (4,374m<sup>2</sup> - 0.44Ha)

Existing Compensation Area (983m<sup>2</sup>)

Proposed Compensation Area (862m<sup>2</sup>)

Flood Zone 3 Boundary

Model Design Flood Level (6.08m AOD)

NOTES

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|-----|---------|------------|-------|
|     | 25-2-19 | Draft      | DJL   |
| Rev | Date    | Amendments | Drawn |

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Transport Planning and Infrastructure Design Consultants

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

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www.rgp.co.uk

Client

Landspeed Homes

Project

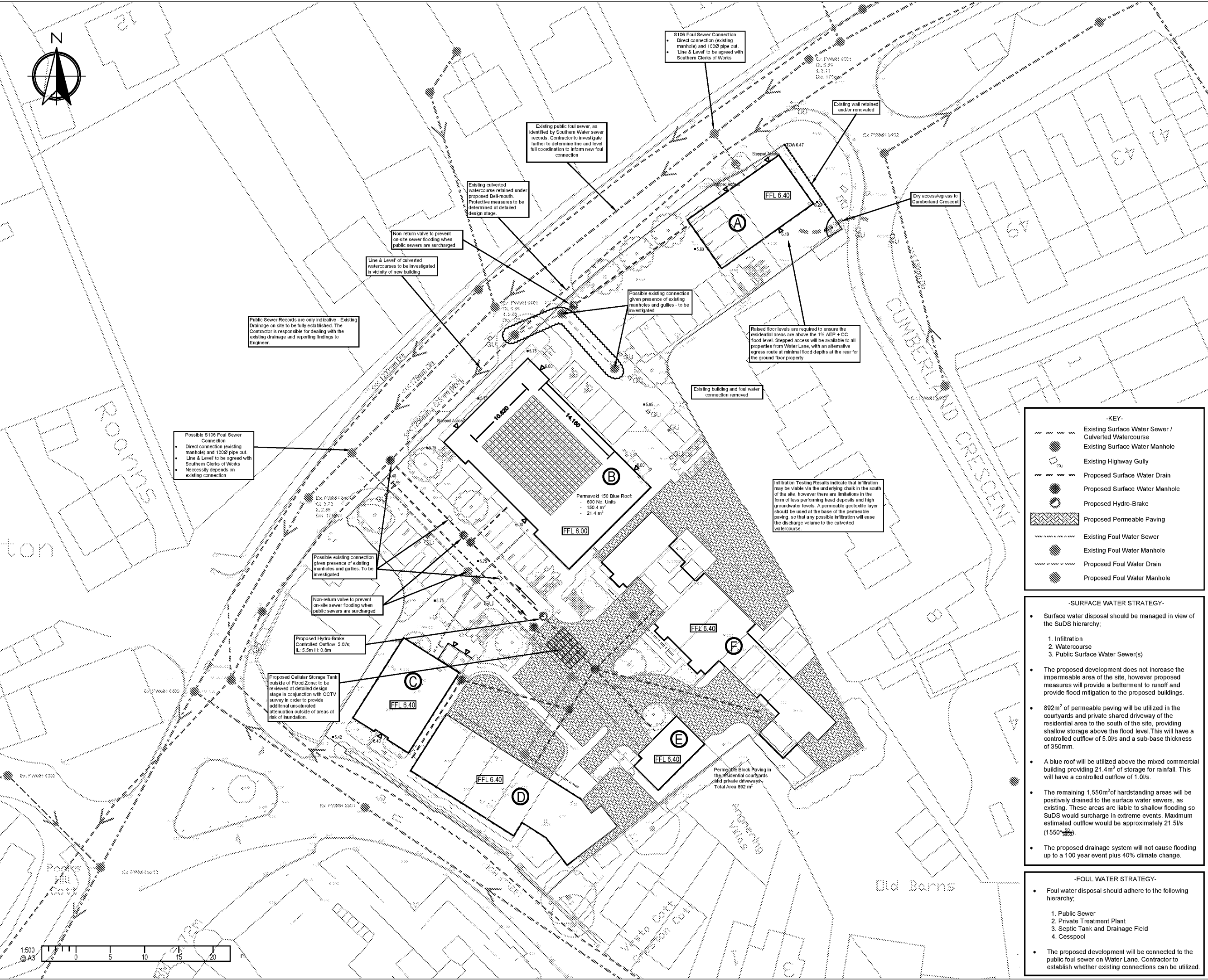
Former Chandlers Garage  
Water Lane, Angmering

Drawing Title

Flood Compensation Appraisal

|       |               |             |                  |            |    |          |    |
|-------|---------------|-------------|------------------|------------|----|----------|----|
| Scale | 1:500         | Drawn By    | DJL              | Checked By | MA | Approved | MA |
| Date  | February 2019 | Drawing No. | 2018-D1623-PL301 | Rev        |    |          |    |

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A3

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|-----|----------|---------------|-------|
| P2  | 05/03/19 | Revised Issue | DUL   |
| P1  | 26/02/19 | Initial Issue | DUL   |
| Rev | Date     | Amendments    | Drawn |



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2 West Barn, Norton Lane, Chichester, West Sussex PO20 3AF  
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Client  
Landspeed Homes

Project  
Former Chandlers Garage  
Water Lane, Angmering

Drawing Title  
Drainage Strategy

|       |            |             |                  |            |    |          |    |
|-------|------------|-------------|------------------|------------|----|----------|----|
| Scale | 1:500      | Drawn By    | DJL              | Checked By | MA | Approved | MA |
| Date  | March 2019 | Drawing No. | 2018-D1620-PL400 | Rev        |    |          |    |

-KEY-

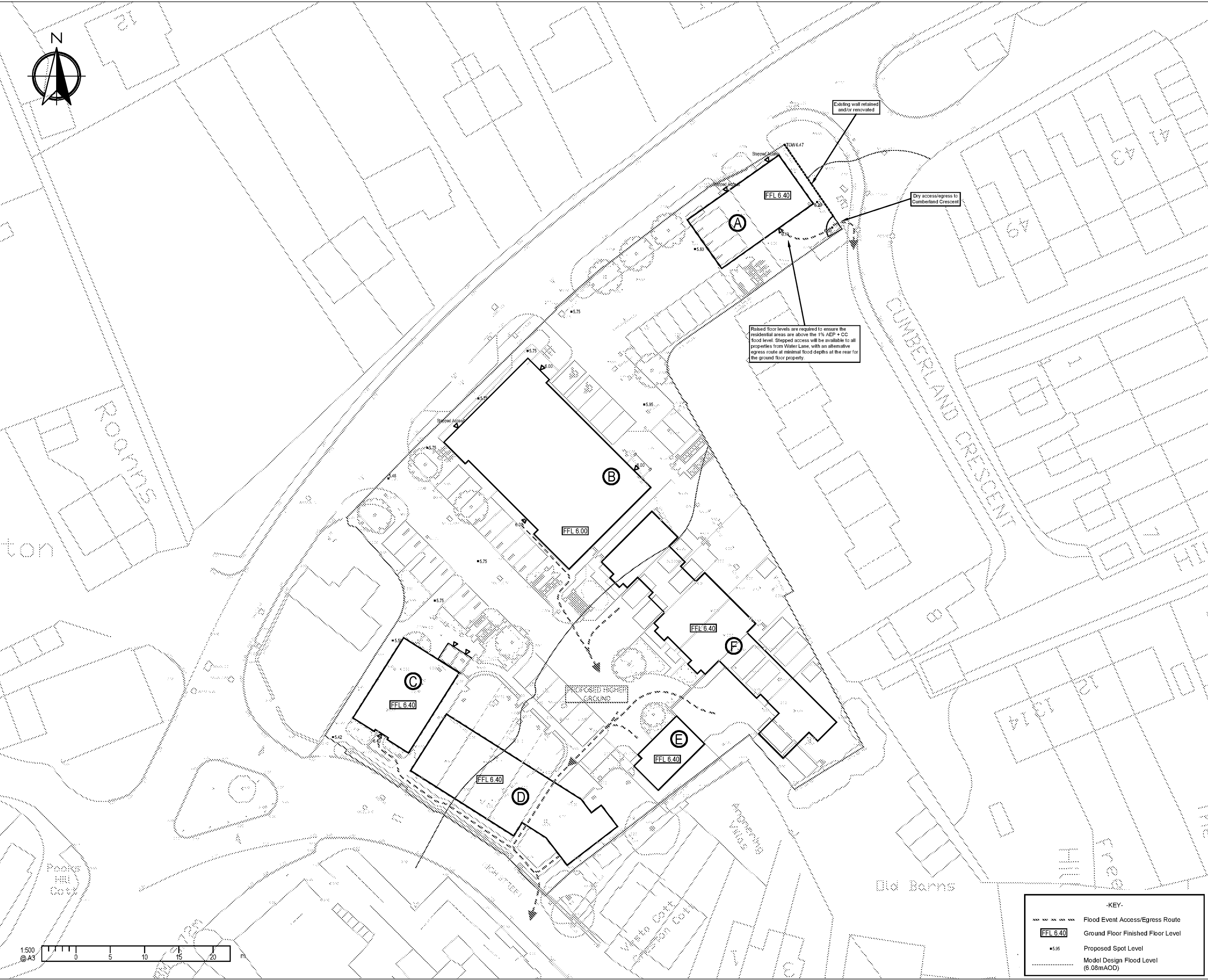
- Existing Surface Water Sewer / Culverted Watercourse
- Existing Surface Water Manhole
- Existing Highway Gully
- Proposed Surface Water Drain
- Proposed Surface Water Manhole
- Proposed Hydro-Brake
- Proposed Permeable Paving
- Existing Foul Water Sewer
- Existing Foul Water Manhole
- Proposed Foul Water Drain
- Proposed Foul Water Manhole

-SURFACE WATER STRATEGY-

- Surface water disposal should be managed in view of the SuDS hierarchy;
  1. Infiltration
  2. Watercourse
  3. Public Surface Water Sewer(s)
- The proposed development does not increase the impermeable area of the site, however proposed measures will provide a betterment to runoff and provide flood mitigation to the proposed buildings.
- 892m<sup>2</sup> of permeable paving will be utilized in the courtyards and private shared driveway of the residential area to the south of the site, providing shallow storage above the flood level. This will have a controlled outflow of 5.0/s and a sub-base thickness of 350mm.
- A blue roof will be utilized above the mixed commercial building providing 21.4m<sup>3</sup> of storage for rainfall. This will have a controlled outflow of 1.0/s.
- The remaining 1,550m<sup>2</sup> of hardstanding areas will be positively drained to the surface water sewers, as existing. These areas are liable to shallow flooding so SuDS would surcharge in extreme events. Maximum estimated outflow would be approximately 21.5/s (1550 x 0.001).
- The proposed drainage system will not cause flooding up to a 100 year event plus 40% climate change.

-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
- The proposed development will be connected to the public foul sewer on Water Lane. Contractor to establish whether existing connections can be utilized.



NOTES

A3

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| P2  | 08/03/19 | Revised Issue | DJL   |
| P1  | 25/02/19 | Initial Issue | DJL   |
| Rev | Date     | Amendments    | Drawn |



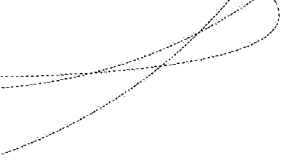
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Tel: 01243 210418 Fax: 01483 861682 www.rgp.co.uk

Client  
Landspeed Homes

Project  
Former Chandlers Garage  
Water Lane, Angmering

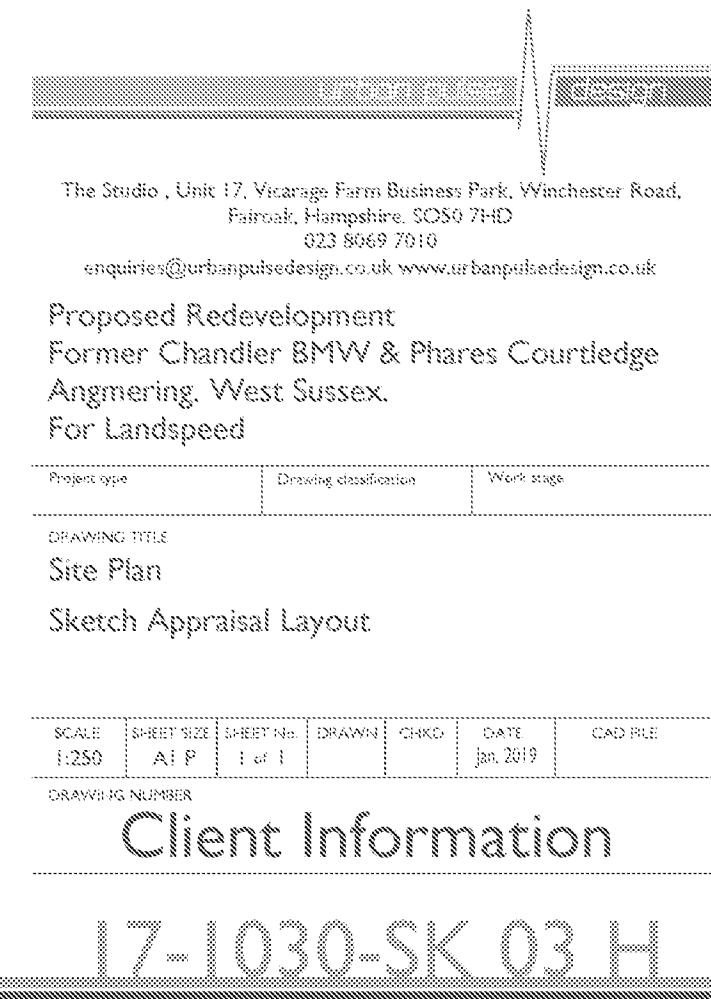
Drawing Title  
Flood Event Access and Egress

|       |            |             |                  |            |    |          |    |
|-------|------------|-------------|------------------|------------|----|----------|----|
| Scale | 1:500      | Drawn By    | DJL              | Checked By | MA | Approved | MA |
| Date  | March 2019 | Drawing No. | 2018-D1620-PL401 | Rev        | P1 | Rev      | P1 |



## APPENDICIES

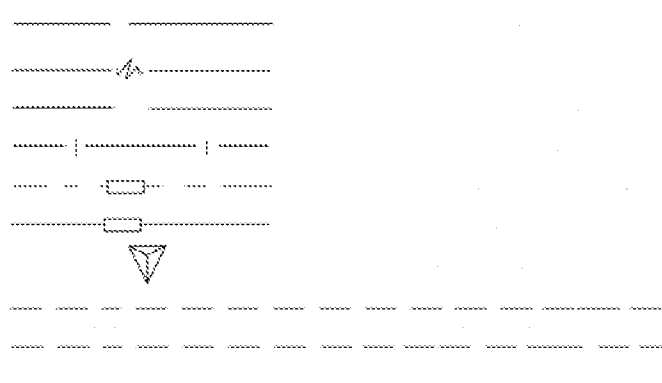
## Appendix A Preliminary Site Layout



## Appendix B Topographical Survey

TrueEye Ltd  
Grange Farm  
Turners Hill Road  
Crawley Down  
West Sussex  
RH10 4EY  
Tel: 07702 749060  
Email: dean.taylor@trueye.com  
www.trueye.com

|       |            |            |
|-------|------------|------------|
| 5.519 | 104501.116 | 506976.337 |
| 5.504 | 104476.897 | 506928.403 |
| 5.591 | 104444.632 | 506898.512 |
| 5.245 | 104382.081 | 506850.594 |
| 6.899 | 104350.845 | 506813.446 |



CLIENT:BEDARO

PROJECT: AngmeringBMW

TITLE: Site Plan

ZoltanSaroka

SCALE: 1:200 @ A0

ZS-BED-ANG-001

PROJECT NO. \_\_\_\_\_

## Appendix C Geotechnical Information

TP00 SE 1/4  
071 043

31/201

ANGMERING

Angmering Cottage. Old well. Cleaned out Dec. 1903 by Duke & Delander.  
Depth 156 1/2 ft., with 8 1/2 ft. of water. Rise 18 inches from  
the bottom yielding about 1000 gallons per hour. i.e. RWL 148'65.

6" Dross 63 SE/W.

Exact site not determined, but probably on south side of High Street  
about half way between Roundstone Lane and Station Road. OD 76

S. Buchanan  
27.2.91

Estimated classification

|                       |   |         |
|-----------------------|---|---------|
| Drift (valley gravel) | } | 156 1/2 |
| Upper chalk           |   |         |

MH  
5/2/73

DATA Bank

W.S. 52. 11E p. 154

ANGLING

HAM

TQ 00 SE 13-14

317

239

a) 0588 0389  
b) 0562 0379  
c) 0568 0371  
d) 0668 0405

Sir H. Fletcher

(a)  
10/1893

TQ 00 SE 11  
0588.0389

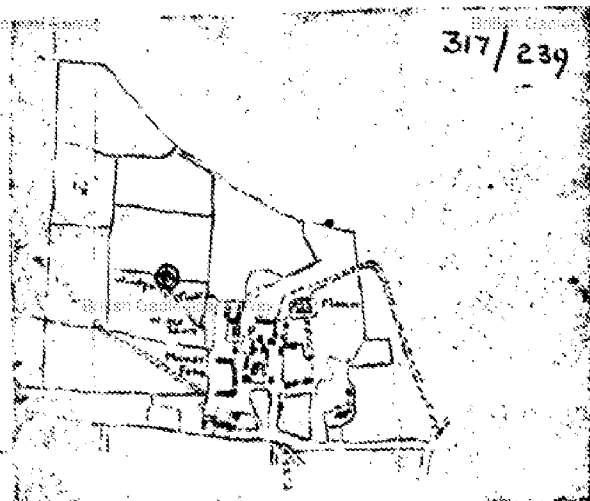
Bore 3in.  
Depth 116ft.  
Water 19ft.

Estimated classification

Drift 7  
O. chalk 116  
A. chalk 116

Brickwork  
Clytha River Bank

M.H.  
20/1/13



F.W. Ockenden

Information from F.W.O. records at Easington  
May 1941  
S.O.A.H.

6" Survey 63 SE (W)

Occupiers (Hickes Estate Ltd) written to 27/9/41 before following records obtained & site

marked by them on tracing may not possibly refer to (a). Tied 400 g.p.h. using other wind pump  
over engine power, see letter 4/9/41.

Information from Duke & Ockenden per 23/1/39.41: —

(a) No 1 At Ham House. Bore 116. R.W.L. 19ft By D & O 1893.

(c) No 2 In Park Bore 2 in to 57ft R.W.L. 16 1/2 ft By D & O 1898.

(d) No 3 Ham Manor at Lodge. Bore 6 to 65ft By D & O 1898

(e) For Sir H. H. Fletcher, 1887. Boring to 62ft also boring to 7 1/2 ft  
By D & O. 1887.

(b) For Sir H. H. Fletcher at Ham Manor. By D & O. 1898.

Bore 6 to 68ft. Lined with 2in tubes to 32ft R.W.L. 23 1/2 ft

Sites of 3 boreholes obtained but could not ascertain which was  
was which. The one 200 yds North of the Manor (near Golf Club Hse)  
is used for watering the golf course. Visited 17.10.57 P.T.O.