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LAND EAST OF SHRIPNEY ROAD, SHRIPNEY FLOOD RISK ASSESSMENT, AND FOUL AND SURFACE WATER DRAINAGE STRATEGIES

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1. INTRODUCTION

1.0.1 Ramboll UK Limited (Ramboll) was appointed by Hanbury (PM) Ltd on behalf of Ashmarden Ltd Retirement Benefit Scheme ('client') to undertake a Flood Risk Assessment (FRA) and develop an outline surface water and outline foul water drainage design strategy for a proposed residential development at Land East of Shripney Road, Shripney, West Sussex.

1.0.2 The key sources of information used to prepare this report include:

- i. Topographical site survey information provided by Siteline Geomatic Surveyors (Drawing No. 657SH02, May 2018);
- ii. Site Investigation information provided by Ashdown Site Investigation Ltd (Reference: R18-13442-4, April 2019);
- iii. Proposed site layout plans provided by Davies Landscape Architects;
- iv. CIRIA – C753 The SuDS Manual (2015);
- v. The British Geological Survey (BGS) maps;
- vi. National Planning Policy Framework (NPPF) (updated February 2019);
- vii. National Planning Practice Guidance (NPPG): Flood Risk and Coastal Change (April 2015);
- viii. Sewers for Adoption: A Design and Construction Guide for Developers (7th Edition, August 2012);
- ix. Arun District Council level 1 Strategic Flood Risk Assessment (August 2016);
- x. West Sussex County Council (WSCC) Surface Water Management Guidance; and
- xi. The Environment Agency's (EA) online database of indicative floodplain and hydrogeological maps and detailed flood modelling data.

1.0.3 Ramboll cannot accept liability for the accuracy or otherwise of any information derived from third party sources.

1.1 Scope and Objectives

1.1.1 This document considers the risks of various sources of flooding to the site and the consequent risk of flooding to downstream receptors (such as people, property, habitats, infrastructure and statutory sites) from the proposed development as a result of surface water runoff. A comparison is made between the current situation and the proposed future development.

1.1.2 This FRA has been carried out in accordance with the National Planning Policy Framework (NPPF)¹. It is to be used to assist the Local Planning Authority (LPA) and EA, when considering the flooding issues of the proposed development, as part of a planning application. An FRA is required as parts of the site have been identified to be at potential risk of flooding.

1.1.3 This report provides the following information:

- i. An assessment of the flood risk to the site based upon flood data and the flood maps provided by the EA and Strategic Flood Risk Assessment (SFRA) and;
- ii. An assessment of the impact of the new development in terms of surface water runoff and foul water;
- iii. Proposals for measures to mitigate the generation of surface water runoff water as well as foul water generated by the proposed development; and
- iv. Proposals to mitigate any residual flood risks to the development (if any).

2. SITE CONTEXT

2.1 Application Site Description

- 2.1.1 The site is located within Shripney, north of Bognor Regis, UK, centred at National Grid reference 493891E, 102136N. It is approximately 2.1 hectares (ha) in area and lies adjacent to A29, which runs along the western boundary of the site. Aside from an unmarked access track leading into the site from the A29 and a small field shelter, the site comprises entirely undeveloped grassland, with hedgerows and trees forming the boundaries of the site. A public sewer pumping station and electricity substation are located immediately northwest of the site. A drainage watercourse is situated in the western part of the site, parallel to the site boundary and a second watercourse is located immediately east of the site in the form of a roadside ditch.
- 2.1.2 The site location plan is provided in Figure 1, at the rear of this report.

2.2 Site Topography

- 2.2.1 A topographic survey was undertaken in May 2018 by Siteline Geomatic Surveyors (Drawing No. 657SH02). Site ground levels vary between approximately 1.9 mAOD and 3.5 mAOD. Although there is an overall fall broadly across the site towards the south, there is a drainage watercourse situated along part of the western site boundary. Levels in the western part of the site fall towards the watercourse, and vary from approximately 1.9 mAOD along parts of the western site boundary, immediately west of the watercourse, to 2.5 mAOD to the east of the watercourse.

2.3 Geological Setting

- 2.3.1 The British Geological Survey (BGS) map of the area (1:50,000 scale map series) indicates the site is underlain by River Terrace Deposits (RTD) (typically sands, silts and clays), which in turn are underlain by the Lewes Nodular Chalk Formation of the White Chalk Subgroup.
- 2.3.2 There are no BGS historic borehole records situated within the site. The closest BGS borehole record to the site (BGS Reference SU905W74) is located approximately 100 m northwest of the site, at National Grid Reference 493690E, 102550N. This confirms the presence of sandy clay with chalk beneath.
- 2.3.3 In addition to BGS records, Ashdown Site Investigation Ltd have provided details of two borehole logs of 5 m depth within the site (dated December 2018) and completing groundwater monitoring for these two logs between December 2018 and April 2019 (Site Reference R18-13442-4). Both borehole logs confirmed the presence of sandy clay on site up to depths of 3 m and 3.5 mbgl underlain by chalk. The groundwater monitoring results show groundwater levels to vary between 0.8 m and 1.85 mbgl for one borehole and 0.6 m and 1.25 mbgl for the second. At the time of writing further groundwater monitoring is currently in process at the site.

2.4 Hydrological Settings

- 2.4.1 A drainage watercourse is located along the south-eastern site boundary. This flows in a broadly south east direction to join with Lidsey Rife, a main river, approximately 1 km southeast of the site.
- 2.4.2 A second drainage watercourse is located along part of the western site boundary. This is understood to pass out of the site boundary and beneath the A29 via a culvert and flow in a broadly southwest direction to join with Aldingbourne Rife, also a main river, approximately 850 m southwest of the site. Lidsey Rife joins with Aldingbourne Rife approximately 1.85 km south of the site.

2.5 Hydrogeological Settings

- 2.5.1 The EA website shows aquifers and provides designations which are in line with the Water Framework Directive and are based on maps produced by the BGS. Groundwater bodies have been identified in both the superficial strata and in the bedrock beneath the site. The River Terrace Deposits are classified as 'Secondary A aquifer' (i.e. permeable strata capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers). The Lewes Nodular Chalk Formation is classified as a 'Principal Aquifer' (i.e. rock strata of rock or drift deposits that have high intergranular and/or fracture permeability meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale).
- 2.5.2 The EA has developed Groundwater Source Protection Zones (SPZs) to assist in the assessment of risk to groundwater supplies taken from an abstraction point. The site does not lie within a Groundwater Source Protection Zone; however, the aquifers beneath the site are classified as having 'Major Aquifer Intermediate' and (in the southern portion of the site) 'Major Aquifer High' vulnerability classifications.

2.6 Existing Drainage Regime and Surface Water Runoff

- 2.6.1 As discussed in Section 2.1, the site comprises almost entirely undeveloped greenfield land. Greenfield runoff rates for the site have been calculated for the planning application area (2.1 ha) using the Interim Code of Practice for Sustainable Drainage Systems (ICP SuDS) method in MicroDrainage 2018. The results of the calculations are shown in Table 2.1. The outputs from MicroDrainage are provided in Appendix B located at the rear of this report.

Table 2.1: Greenfield Runoff Rate Calculations

Return Period (years)	1-in-1	1-in-2	1-in-10	1-in-30	1-in-100
Greenfield runoff rates (l/s)	6.5	6.8	12.4	17.4	24.5

2.7 Existing Flood Risk

Fluvial and Tidal Flood Risk

- 2.7.1 The flood risk zones shown on the flood maps for planning are defined in Table 2 of the Technical Guidance to the NPPF and these are:

Zone 1: Low Probability

According to the NPPF, land in this zone is considered to have less than 1-in-1000 annual probability of river or sea flooding in any year. This is < 0.1%.

Zone 2: Medium Probability

According to the NPPF, land in this zone is considered to have between a 1-in-100 and 1-in-1000 annual probability of river flooding in any year (between 1% and 0.1%) or between a 1-in-200 and 1-in-1000 annual probability of sea flooding in any year (0.5%-0.1%).

Zone 3a: High Probability

According to the NPPF, land in this zone is considered to have a 1-in-100 or greater annual probability of river flooding in any year (>1%) or a 1-in-200 or greater annual probability of flooding from the sea in any year (>0.5%).

Zone 3b: The Functional Floodplain

According to the NPPF, land in this zone is used for water flow or storage in times of flood. This flood zone should be identified by a Strategic Flood Risk Assessment (SFRA). It is considered to

have a 1-in-20 or greater chance of river flooding in any year which is >5%. Another probability however can also be agreed between the LPA and the EA.

- 2.7.2 The EA flood map for planning shows the vast majority of the site to be situated within Flood Zone 1, with a very small area along the western site boundary situated within Flood Zone 2 and a very small area along the south eastern site boundary within Flood Zone 3. This pattern of flooding follows the topography of the site, with flooding in the very low ground levels along the south eastern site boundary and along the western site boundary where the drainage watercourse is location, prior to ground levels rising steeply immediately east of the watercourse.
- 2.7.3 The EA has also provided detailed flood modelling data, including flood levels for three node points across the site and corresponding modelling flood outlines, for both tidal and fluvial flood events. The EA flood modelling data is included in Appendix B, at the rear of this report.
- 2.7.4 Data is provided for both the present-day scenario and when taking into account the predicted effects of climate change. For fluvial flood events, scenarios are provided using allowances for increases in rainfall intensity due to climate change of 35%, 45% and 105%. For tidal flood events, scenarios are provided for both the 2070 and the year 2115.
- 2.7.5 The EA also confirm that flood defences are present in the area in the form of high ground. Due to the permanent nature of the defences. i.e. the level of defence provided is not able to be adjusted, such as with a sluice gate, the modelled defended scenario is considered to be appropriate when assessing flood risk to the site.
- 2.7.6 For the tidal defended scenario, there is no flooding at all within or adjacent to the site, even when accounting for all climate change scenarios.
- 2.7.7 For the fluvial defended scenario, in line with the indicative flood maps for planning and site topography, there is flooding shown at the very perimeters of the site when taking into account all climate change scenarios for the 1-in-100 year flood event and also the 1-in-1000 year flood event. This occurs in the lowest areas along part of the western site boundary and part of the south eastern site boundary. The maximum water depth anticipated is 0.56 m for the extreme +105% climate change scenario.
- 2.7.8 In conclusion, the vast majority of the site is at low risk of tidal and fluvial flooding, with very small parts of the site borders at medium-high risk of fluvial flooding.

Surface Water and Sewer Drainage Flood Risk

- 2.7.9 The EA's indicative surface water flood mapping, available via the online long-term flood risk assessment service, identifies areas in England and Wales at potential risk of surface water (pluvial) flooding. The surface water flood maps define flood risk as follows:

High Risk

Considered to have a greater than 1-in-30 annual probability of surface water flooding in any year (>3.3%).

Medium Risk

Considered to have between a 1-in-30 and 1-in-100 annual probability of surface water flooding in any year (between 3.3% and 1%).

Low Risk

Considered to have between a 1-in-100 and 1-in-1000 annual probability of surface water flooding in any year (between 1% and 0.1%).

Very Low Risk

Considered to have a less than 1-in-1000 annual probability surface water flooding in any year (>0.1%).

- 2.7.10 The EA surface water mapping shows the vast majority of the site to have a very low susceptibility. Very small parts of the western and south eastern site boundaries are shown to range from low-high susceptibility. These correspond largely with areas of lower ground level adjacent to drainage watercourses present in these areas and follow the flooding pattern shown on the tidal and fluvial mapping. Therefore, overall surface water flood risk is considered to be low, with small areas along the site boundary susceptible to ponding.

Groundwater Flood Risk

- 2.7.11 Groundwater flooding is caused by the emergence of water originating from sub-surface permeable strata. A groundwater flood event results from a rise in groundwater level sufficient for the water table to intersect the ground surface and inundate low lying land. Groundwater floods may emerge from either point or diffuse locations. They tend to be long in duration developing over weeks or months and prevailing for days or weeks.
- 2.7.12 There are no known records of groundwater flooding or groundwater flood risk susceptibility at the site. However, as discussed in Section 2.3, groundwater levels measured across the site have been recorded to be as high as 0.6 mbgl. Although groundwater monitoring is currently ongoing it is considered unlikely that these levels would rise above ground level within the site other than within the watercourses. Given these groundwater levels and the fact that the site is higher than surrounding ground the risk of flooding from groundwater is considered to be low.

Artificial Water Bodies

- 2.7.13 The EA's indicative reservoir flood risk maps show that the site is not at risk of reservoir flooding. There are no known artificial waterbodies within or adjacent to the site; therefore flood risk to the site from artificial sources is considered to be low.

Flood Risk Summary

- 2.7.14 A summary of the existing risk of flooding from all sources is provided in Table 2.2.

Table 2.2: Flooding Sources at the Proposed Development Site

Sources of Flooding	High	Medium	Low	Comments
Tidal/fluvial			x	The vast majority of the site is at low risk of fluvial flooding, with very small parts of the site borders at medium-high risk of fluvial flooding. The site is protected against tidal flooding by defences in the form of raised ground.
Surface water and drainage flood risk			x	Overall surface water flood risk is considered to be low, with small areas along the site boundary susceptible to ponding.
Groundwater			x	No known historic groundwater flooding or susceptibility, however groundwater levels are known to be high, but the site levels are higher than surrounding ground.
Artificial Sources			x	Not at risk of reservoir flooding, no known artificial sources

3. ASSESSMENT OF NEW DEVELOPMENT

3.1 Development Proposal

- 3.1.1 Outline planning permission is sought for a new residential development at the site comprising 46 new residential properties, along with access via the A29, resident parking provision and associated soft landscaping. The proposed site layout plan is shown in Figure 2, at the rear of this report.

3.2 Flood Risk Vulnerability

- 3.2.1 According to Table 2 (Flood Risk Vulnerability Classification) in the Planning Practice Guidance to NPPF, buildings used for residential purposes are classified as "More Vulnerable".

3.3 Sequential Test

- 3.3.1 The Sequential Test aims to steer development to areas with the lowest probability of flooding.
- 3.3.2 Table 3 (Flood Risk Vulnerability and Flood Zone Compatibility) in the Planning Practice Guidance to NPPF, states that "More Vulnerable" developments are appropriate to locate in Flood Zones 1 and 2, however for residential development to take place within Flood Zone 3a, the Exception Test is to be applied to assess development suitability. Given no residential properties are proposed within Flood Zone 3a, the Sequential Test is deemed to be passed in this instance, however, given parts of the site fall within Flood Zone 3a, for completely, the Exception Test requirements are detailed below.
- 3.3.3 According to the NPPF Planning Practice Guidance to, in order for the Exception Test to be passed the development must meet the following criteria:
- 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; and
 - 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.
- 3.3.4 On the basis that the proposed development will provide needed residential properties within Shripney, the first criteria is deemed to be passed. Site occupant safety is discussed in the following section.

3.4 Site Occupant Safety

- 3.4.1 The peripheral parts of the site at risk of flooding do not impact upon any of the proposed residential properties. There are no new buildings proposed in areas at risk of flooding and, aside from the site access road, parts of the site boundary that fall in areas at risk of fluvial flooding are to remain as soft landscaping in line with the existing topography. The site access road is also to be located where an existing unmade access track is already present and again constructed in line with existing topography to tie in with ground levels along the A29; therefore, there will be no loss of floodplain as a result of the proposed development.
- 3.4.2 An existing unmade track into the site from the A29 is to be resurfaced to provide vehicular access/ egress to the site. The EA provide a flood level of 2.25 mAOD for the 1-in-100 year fluvial flood event including allowances for climate change of 45% at the node point within the site nearest to this location. Ground levels at this location vary between approximately 2.1 m and 2.4 mAOD, therefore it is likely there may be shallow flood water present at the main entrance to the site during extreme flood events when climate change is taken into consideration. Deeper flood depths are anticipated along the A29 itself, where ground levels are lower. However, the site is able to be accessed on foot

onto the A29 further north along the western site boundary, to the north of the drainage watercourse, where ground levels are higher and no flooding is anticipated either within the site, along the site boundary or along the A29. Therefore, safe access/ egress to/ from the site remains present even during extreme flood events.

- 3.4.3 On this basis, the second criteria of the Exception Test is also deemed to be passed and the proposed development will be safe to site occupants during a flood event.
- 3.4.4 Despite the overall low flood risk to the site, given areas immediately adjacent to the site are at high risk of flooding, it is recommended that site residents sign up to the EA's Flood Warning Scheme to make sure that they receive advanced notice of anticipated flood events.

3.5 Surface Water Runoff

- 3.5.1 As the site currently comprises almost entirely greenfield land, the proposed development will result in an increase in impermeable area within the site. Furthermore, the NPPF identifies that rainfall intensities will increase in the future as a result of climate change (CC), thereby increasing surface water runoff rates and volumes. The updated EA CC allowance guidance (2016) shows the recommended national precautionary sensitivity ranges for various parameters including peak rainfall intensity. The design life of the new development is considered to be 100 years, therefore an allowance for increases in rainfall intensity of 40% due to the predicted climate change has been applied throughout the surface water drainage strategy development.
- 3.5.2 Table 3.1 summarises the predicted change in peak flows as a result of the development considering a 40% allowance for the predicted effects of climate change. The critical storm duration for runoff is 15 minutes. Calculations are provided in Appendix B, at the rear of this report.

Post-development impermeable area is taken as approximately 16,800 m² (equating to 80% impermeable)

Table 3.1: Surface Water Runoff Rate Calculations

Return Period (years)	1-in-1	1-in-2	1-in-10	1-in-30	1-in-100
Pre-development runoff rates	4.4	5.7	8.8	10.8	14.0
Post-development runoff rates + 40% CC (l/s)	202.8	259.3	399.7	494.5	647.2

3.6 Assessment of Attenuation Options

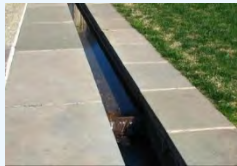
- 3.6.1 In line with WSCC guidance as the Lead Local Flood Authority (LLFA), the use of SuDS is required to be assessed for the sustainable management of surface water runoff from a new development. All SuDS options available for attenuating surface water runoff on site are discussed in Table 3.2 below.

Table 3.2: Sustainable Drainage Options

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for Use at Site?
Retention	Balancing pond		Provides both storm water attenuation and treatment. Runoff from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation	Good removal of pollutants can be used where groundwater is vulnerable, good community acceptability, high ecological, and amenity benefits	No reduction in runoff volume, land take may limit use in high density sites	✗ Limited space available space within the proposed development site
	Sub-surface storage		Oversized pipes, tank systems and modular geocellular systems that can be used to create a below ground storage structure	Modular and flexible, dual usage (infiltration/storage, high void ratios), can be installed beneath trafficked and soft landscaped areas	No water quality treatment	✓ Sub-surface storage is appropriate for use though consideration needs to be given to potentially high groundwater levels
Wetland	Shallow wetland		Wetlands provide stormwater attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands detain flows for an extended period to allow sediments to settle and to remove contaminants They can provide significant ecological benefits	Good pollutant removal and if lined can be used where groundwater is vulnerable. Good community acceptability, ecological and amenity benefits	Land take is high, requires baseflow, little reduction in runoff volume, not suitable for steep sites	✗ Limited space available space within the proposed development site
	Extended detention wetland					
	Pond wetland					
	Pocket wetland					
	Submerged gravel wetland					
	Wetland channel					
Infiltration	Infiltration trench		Surface water runoff can be discharged directly to ground for infiltration by soakaways, basins, or trenches. A prerequisite is that both groundwater and ground conditions are appropriate to	Reduces the volume of runoff, effective at pollutant removal, contributes to groundwater recharge, simple and cost-effective, easy performance observation	Requires appropriate pre-treatment, basins require a large flat area, offset from foundations	✗ Limited permeability due to underlying clay geology and potentially high groundwater levels
	Infiltration basin					
	Soakaway					

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for Use at Site?
			receive the quality and quantity of water generated			
	Porous paving		Block or porous paving allows runoff to infiltrate through to sub base layer	Reduces the volume of runoff and if designed for infiltration contributes towards groundwater recharge. Easy to install and retrofit. Simple to manage. If lined can be used where groundwater is sensitive, or high.	Not suitable for heavily trafficked areas or adoptable roads. Requires regular sweeping to prevent clogging with dirt	✓ Permeable paving could be utilised on the site across areas of hard surfacing. A tanked system should be considered at detailed design stage due to potentially high groundwater levels.
	Permeable paving		Water can then be infiltrated into ground or conveyed into storage or drainage systems			
Filtration	Surface sand filter		Structures designed to treat surface water runoff through filtration using a sand bed filter medium. The filters can be designed with or without infiltration.	Flexibility of design, efficient in removing pollutants, suitable for retrofits and in tightly constrained urban locations	Not for high sediment content, detention times can support algae growth, minimum hydraulic head of 1.2 m required, possible odour problems, high capital and maintenance cost	✗ There is no requirement for high pollution reduction at the site
	Sub-surface sand filter		Temporary storage of runoff is achieved through ponding above the filter layer. They are used where particularly high pollutant removal is required			
	Perimeter sand filter					
	Bioretention /filter swale		Vegetated strips of land designed to accept runoff as overland sheet flow between a hard-surfaced area and a receiving system	Landscaping features, effective in removing pollutants, flexible layout to fit into landscape, suited for highly impervious areas, good retrofit capability, effective pre-treatment option	Requires landscaping and management, large land requirement, not suitable for steep sites; no significant attenuation or reduction of flows	✗ Limited space available space within the proposed development site
	Filter trench /drain		Shallow excavations filled with rubble or stone that create temporary subsurface	Hydraulic benefits achieved with filter trenches, trenches can be incorporated into site	High clogging potential without effective pre-treatment, limited to small	✓ This may be a feasible option.

Land East of Shripney Road, Shripney

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for Use at Site?
			storage for filtration of storm water runoff Receive lateral inflow from an adjacent impermeable surface	landscaping and fit well beside roads and car parks	catchments, high cost of replacing filter material	
Detention	Detention basin		Surface storage basins that provide flow control through attenuation. Normally dry and in certain situations the land may also function as a recreational facility.	Cater for a wide range of rainfall events, can be used where groundwater is vulnerable, potential for dual land use, easy to maintain	Land take, little reduction in runoff volume, detention depths constrained by levels	✗ Limited space available space within the proposed development site.
	Enhanced dry swale		Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate.	Incorporate into landscaping, good removal of pollutants, reduces runoff rates and volumes, low cost	Not suitable for steep areas, significant land take, not suitable in areas with roadside parking	✗ Limited space available space within the proposed development site.
	Enhanced wet swale					
Conveyance	Conveyance swales		Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate.	Negate the need for underground pipework. Can provide some attenuation Possible reduction in runoff volume via plant uptake and infiltration	Potential trip/wheel hazard, disabled access issues	✓ This may be a feasible option.
	Rills					
Source control	Green/brown roof		Multi-layered system that covers the roof of a building with vegetation cover/landscaping over a drainage layer. Designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.	Mimics greenfield state of building footprint for high density developments, good removal of pollutants, ecological benefits, insulates buildings, sound absorption	Additional weight, not appropriate for steep roofs, maintenance of roof vegetation	✗ This is unlikely to be a feasible option due to weight and maintenance issues.

3.7 Outline Surface Water Drainage Strategy

- 3.7.1 WSCC has specific guidance with regards to the implementation of SuDS into new developments. The SuDS hierarchy is to be considered throughout the design of new drainage systems. The considerations given to the hierarchy is summarised in Table 3.3 below.

Table 3.3: Considerations to the SuDS Hierarchy

SuDS Hierarchy	Comments
Discharge into the ground	Due to the limited permeability of the soil and the potential for high groundwater levels, discharging runoff into the ground is not considered to be a suitable option for the proposed development.
Controlled discharge to a water body	There are two drainage watercourses adjacent to the site – one situated along the western site boundary, and one situated along the south eastern site boundary. Due to the natural fall in levels across the site and the surface water flood risk along the A29, it is preferable to discharge as much surface water runoff as possible (post attenuation) to the watercourse situated to the southeast.
Controlled discharge to surface water sewer	Southern Water sewers are present in close proximity to the site, however discharge of surface water to a watercourse is considered to be preferable.

- 3.7.2 In line with WSCC guidance, it is proposed to restrict surface water runoff from the proposed development site to a low return period greenfield rate prior to discharge to the local watercourses. To follow the natural fall across the site and alleviate surface water flood risk along the western site boundary, it is proposed to discharge as much runoff as possible to the watercourse situated immediately south east of the site, with any small area of remaining runoff discharging to the western boundary drainage ditch.
- 3.7.3 To provide the restriction in peak rates, attenuation of surface water is to be provided on site for up to the 1-in-100 year return period, including allowances for increase in rainfall intensity of 40% due to the predicted effects of climate change.
- 3.7.4 Attenuation is proposed in the form of permeable paving with a granular sub-base. Depending upon the results of on-going groundwater monitoring within the site, the sub-base will either need to be lined to prevent ingress of groundwater to the surface water storage network or allow free variation in groundwater levels whilst also having a positive drainage (and land drainage) route that outfalls to the local watercourse.
- 3.7.5 An indicative layout of the surface water drainage strategy and associated details are provided in Figures 3 and 4, at the rear of this report.
- 3.7.6 The surface water drainage strategy will need to be developed at the appropriate design stage however on the basis of the above, there will be no increase in flood risk to downstream receptors following the development. Indeed, as runoff rates will be reduced to low return period greenfield rates and also directed to the west wherever possible, the impact of existing flood risk on the A29 should be reduced albeit by a minor amount.

3.8 Outline Foul Water Drainage Strategy

- 3.8.1 Southern Water sewer records, included in Appendix C, show the presence of a Southern Water foul sewer situated along the western site boundary, flowing in a northerly direction to a Southern Water pumping station situated immediately northwest of the site boundary. Flows are then pumped to the wider Southern Water network. It is proposed to discharge foul water flows from the proposed

development into the Southern Water network at the existing manhole adjacent to the pumping station.

- 3.8.2 A capacity check submitted to Southern Water in June 2019 has confirmed that the Southern Water network at this location is able to accept peak flows from eight residential properties. Based on Sewers for Adoptions guidance of 4000 l per dwelling per day, this equates to a peak rate of 0.4 l/s.
- 3.8.3 Based on the proposed number and size of residential dwellings, peak foul flows have been calculated using British Water Code of Practice. It is therefore proposed to attenuate foul flows within the site prior to pumping flows to the Southern Water sewer network at this reduced peak rate equating to eight residential properties. At the time of writing consultation with Southern Water is currently on going with regards to gaining acceptance for the proposed foul drainage strategy and agreeing the best location with regards to attenuation of flows in conjunction with the existing Southern Water pumping station.
- 3.8.4 An indicative layout of the foul water drainage strategy is provided in Figure 5, at the rear of this report.

4. SUMMARY

- i. It is proposed to construct a new 46 unit residential development at Land East of Shripney Road, a 2.1 ha greenfield site situated off the A29, Shripney. A drainage watercourse is located along the western site boundary. A second drainage watercourse/roadside ditch is also present immediately southeast of the site.
- ii. The vast majority of the site is situated within Flood Zone 1, at low risk of tidal and fluvial flooding, however small parts of the site along the Western and south eastern boundaries are situated within Flood Zones 2 and 3, at medium-high risk of fluvial flooding, when taking into account the predicted effects of climate change. The site is protected against tidal flooding by defences in the form of raised ground.
- iii. Surface water flood risk within the site follows a similar pattern to that of fluvial flooding risk, with areas of lower ground along the western site boundary and south-eastern corner of the site shown to be at risk of ponding.
- iv. Although there are no known records of groundwater flooding or groundwater flooding susceptibility at the site, groundwater levels are known to be high, with levels recorded at 0.6 mbgl on site. Despite the relatively high groundwater levels groundwater flood risk is considered to be a low risk as the site levels are at a higher elevation than the surrounding area. At the time of writing ground water monitoring at the site is ongoing.
- v. All proposed residential properties are to be located in Flood Zone 1. There will be no loss of floodplain volume as a result of the proposed development and dry access/ egress to/from the site is possible during an extreme flood event.
- vi. To ensure the safety of site occupants, it is proposed that residents join the EA Flood Warning Scheme, so that they will be informed of extreme flood events that may impact the immediate off-site areas prior to their occurrence.
- vii. It is proposed to discharge surface water runoff from the site to the drainage watercourses situated both immediately southeast of the site and along the western boundary, with as much runoff as possible directed towards the southeast to aid in reducing surface water flood risk at the A29.
- viii. To ensure there is no increase in flood risk to downstream receptors following development, it is proposed to restrict surface water runoff from the development to low return period greenfield rates, in accordance with WSCC guidance. Attenuation of surface water is to be provided within the site for up to the 1-in-100-year return period, including allowances for increases in rainfall intensity over the lifetime of the development due to climate change.
- ix. Further information regarding the proposed foul and surface water drainage strategies for the site will need to be provided at the appropriate design stage; however, on the basis of the above, flood risk to downstream receptors will not increase following development.

FIGURES

- FIGURE 1 SITE LOCATION PLAN
- FIGURE 2 PROPOSED SITE LAYOUT PLAN
- FIGURE 3 SURFACE WATER DRAINAGE STRATEGY
- FIGURE 4 SURFACE WATER DRAINAGE DETAILS
- FIGURE 5 FOUL WATER DRAINAGE STRATEGY

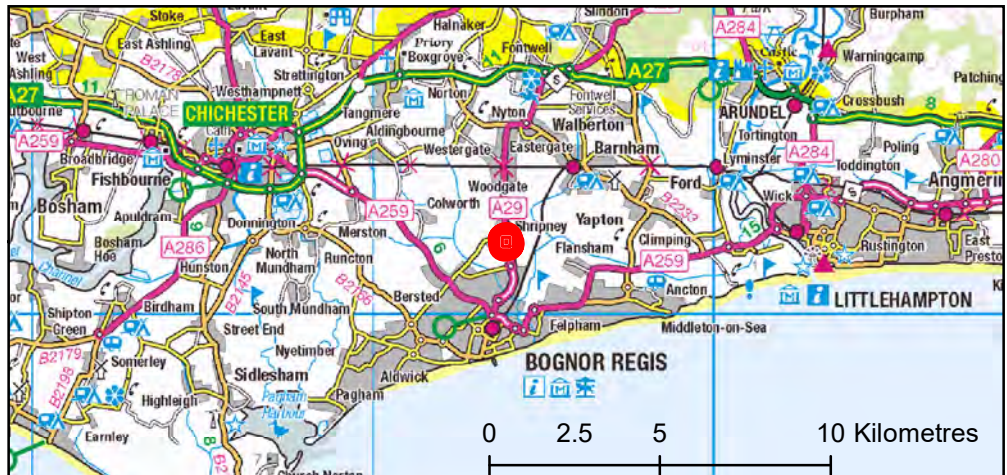


Figure Title Figure 1: Site Location	Project Name Land East of Shripney Road, Shripney	Date September 2019	
Project Number 1620004241	Client Ashmarden Ltd Retirement Benefit Scheme	Scale As shown	
		Issue 1	



Residential			
	Affordable	Market	Total
1 Bedroom	4	4	8
2 Bedroom	5	12	17
3 Bedroom	4	12	16
4 Bedroom	1	4	5
			46
Site Area		1.72ha	
Open Space		0.4ha	
Net Density (Ex Open Space)		30.6dph	
Net Density (inc Open Space)		26.7dph	

THIS DRAWING SHOULD NOT BE SCALED.
THIS DRAWING IS COPYRIGHT.

CLIENT :
Hanbury Properties

PROJECT :
Land East of Shripney Road, Shripney

DRAWING TITLE :

Preliminary Illustrative Layout

DAVIESLANDSCAPE
ARCHITECTS

Suite F1, Stroud House, Russell Street, Stroud, Gloucestershire, GL5 3AN

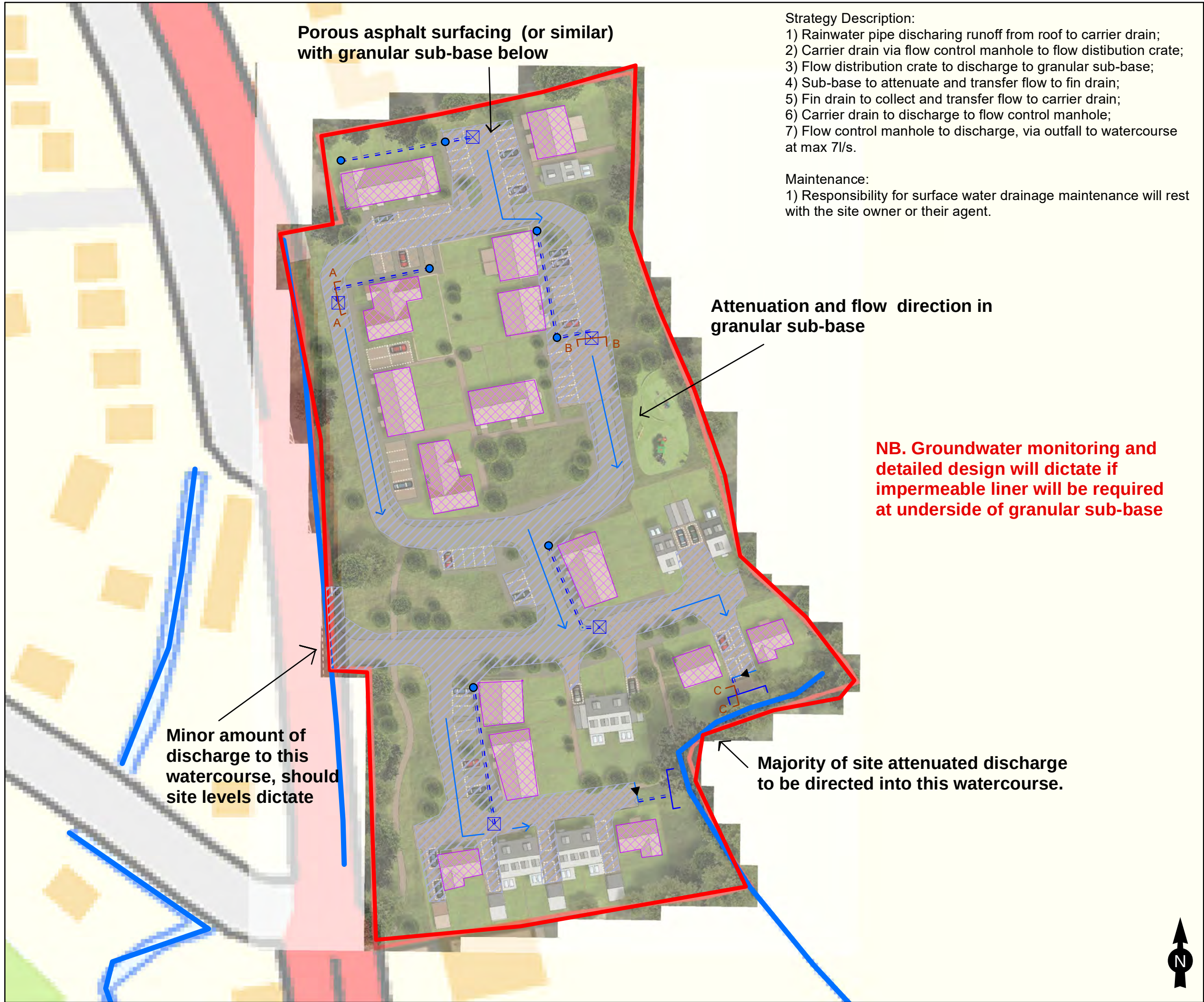
t. 01453 760380 e. info@d-l-a.co.uk w. www.d-l-a.co.uk

DATE: 13.08.2019	SCALE: 1:1000@A3
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JOB NO. :	1948	DRAWN BY :	MD
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DWG NO. :	DLA.1948.L06.	REV : S08
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V:\Server DATA\PROJECT FILES\1948 Land East of Shripney Rd\Landscape\Drawings\Sketch\DLA.1948.L.06.S - Cad Layout Plan\DLA.1948.L.06.S08 Cad Layout Plan.dwg



Strategy Description:
1) Rainwater pipe discharging runoff from roof to carrier drain;
2) Carrier drain via flow control manhole to flow distribution crate;
3) Flow distribution crate to discharge to granular sub-base;
4) Sub-base to attenuate and transfer flow to fin drain;
5) Fin drain to collect and transfer flow to carrier drain;
6) Carrier drain to discharge to flow control manhole;
7) Flow control manhole to discharge, via outfall to watercourse at max 7l/s.

Maintenance:
1) Responsibility for surface water drainage maintenance will rest with the site owner or their agent.

Legend

- Site Boundary
- Roof Areas
- Carrier Drain
- Surface Water Manhole
- Flow Distribution Crate
- Permeable Paving
- Fin Drain
- Flow Control Manhole
- Outlet
- Surface Water Features

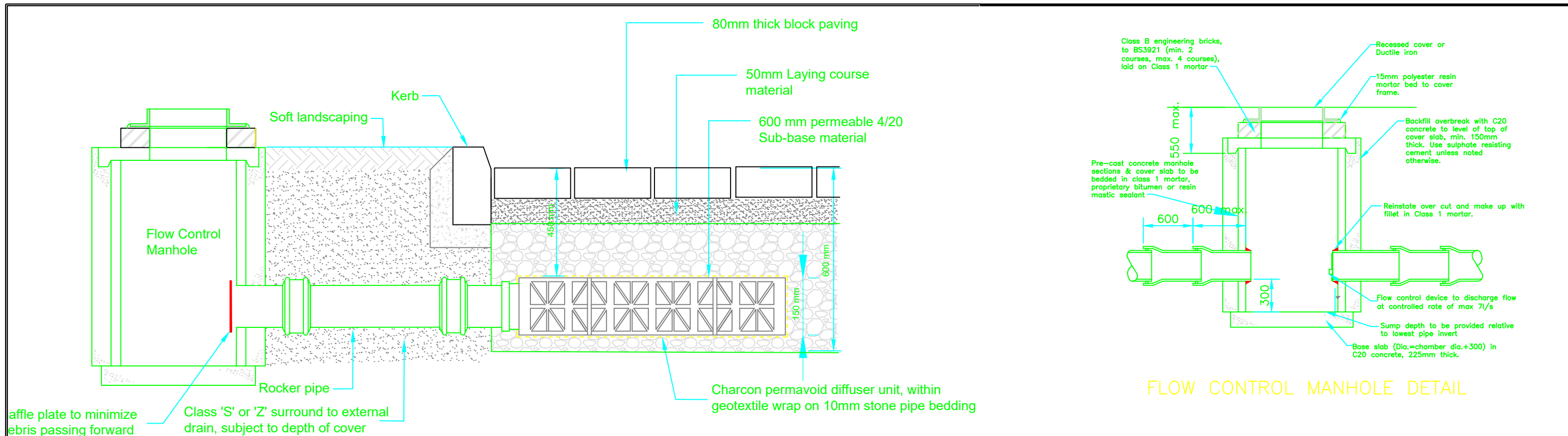
Figure Title
Surface Water Drainage Strategy

Project Name
Land East of Shripney Road

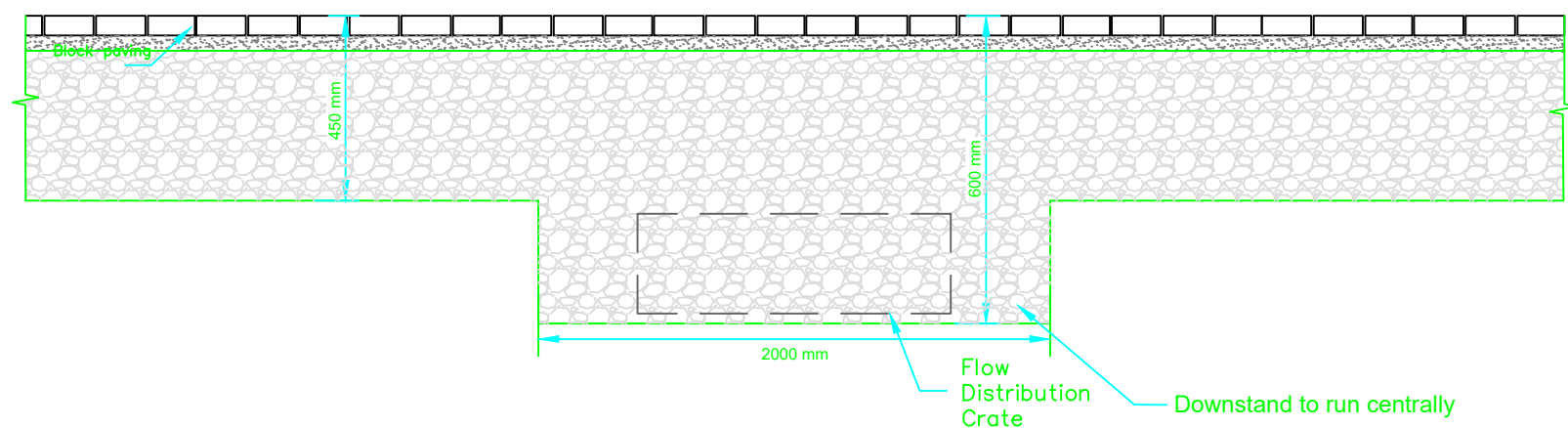
Project Number 1620004241	Figure No. 03
Date September 2019	Prepared By MA
Scale 1:917 @A3	Issue -

Client
Ashmarden Ltd Retirement Benefit Scheme

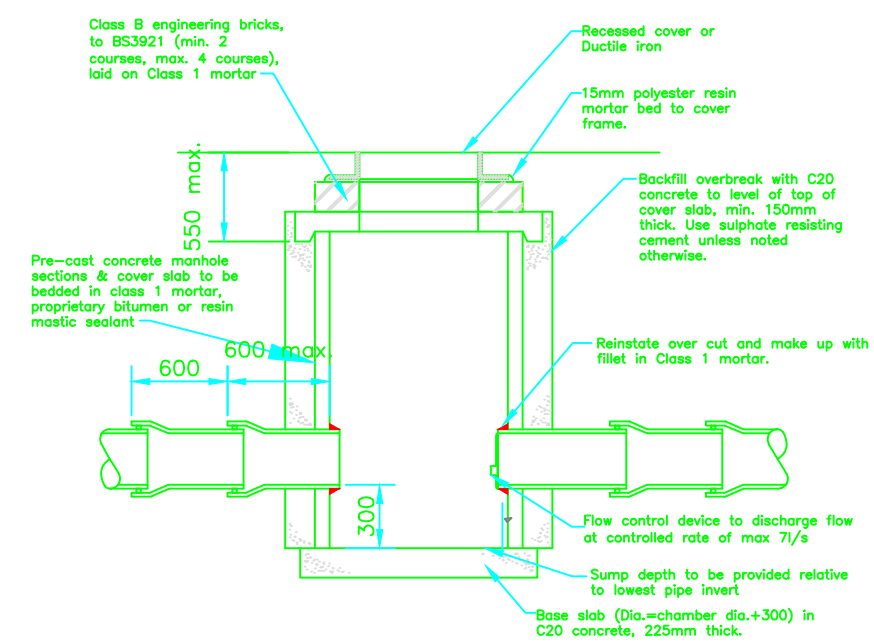
RAMBOLL



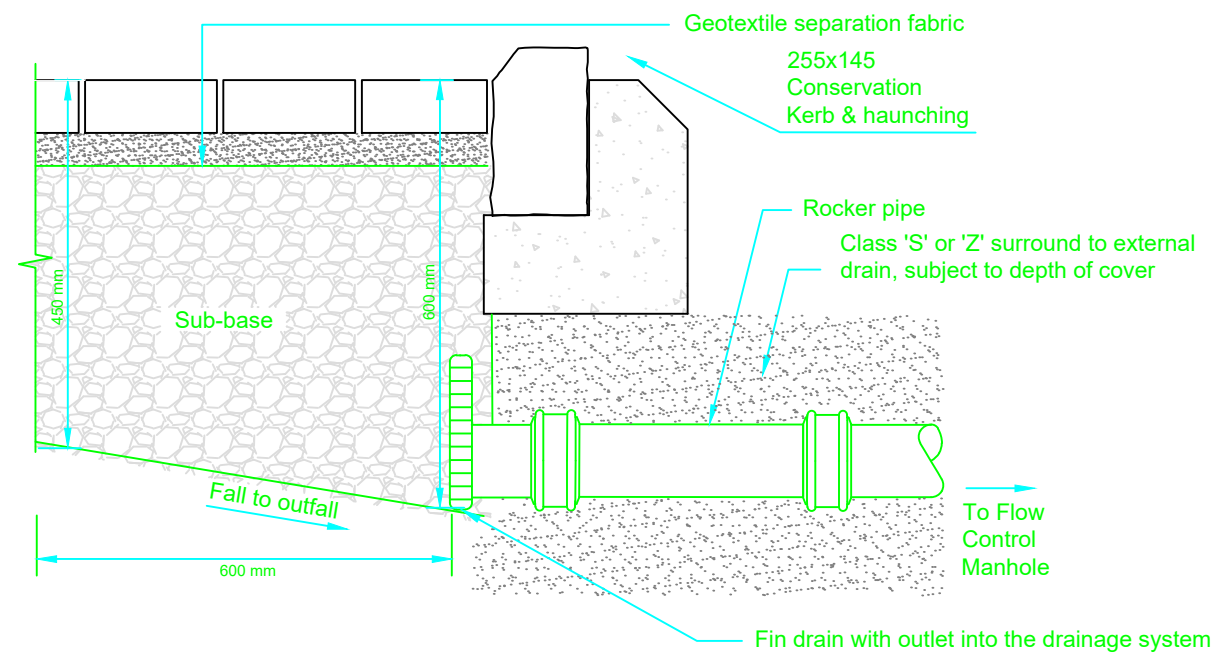
FLOW DISTRIBUTION CRATE DETAIL
SECTION A-A
See Figure 3 for location



TYPICAL DETAIL
SECTION B-B
See Figure 3 for location



FLOW CONTROL MANHOLE DETAIL



OUTLET DETAIL
SECTION C-C
See Figure 3 for location



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Land East of Shripney Road Surface Water Drainage Strategy

Drainage Details

Rev	Description	Date	By	App
			Chk	
Project No:		Scale (@A3):	Drawn:	Date:
1620004241		NTS	MA	19/09/19
Drawing No:				Rev:
4				-



Legend

-  Site Boundary
-  Public Foul Sewer
-  Private Foul Manhole
-  Private Foul Water Sewer
-  Pumping Chamber
-  Storage Chamber
-  Private Foul Water Pumping Station Compound
-  Southern Water Pumping Station Compound

Figure Title
Foul Water Drainage Strategy

Project Name
Land East of Shripney Road

Project Number 1620004241	Figure No. 5
------------------------------	-----------------

Date September 2019	Prepared By MA
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Scale 1:917 @A3	Issue -
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Client **Ashmarden Ltd Retirement Benefit Scheme**

RAMBOLL



APPENDIX A

SURFACE WATER RUNOFF CALCULATIONS

Ramboll UK Ltd		Page 1
240 Blackfriars Road London SE1 8NW		
Date 17/09/2019 11:39 File	Designed by MANGU Checked by	
Micro Drainage		Source Control 2018.1.1
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 2 SAAR (mm) 745 Urban 0.000 Area (ha) 2.100 Soil 0.400 Region Number Region 7 Results l/s QBAR Rural 7.7 QBAR Urban 7.7 Q2 years 6.8 Q1 year 6.5 Q30 years 17.4 Q100 years 24.5		
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Ramboll UK Ltd		Page 1
240 Blackfriars Road London SE1 8NW		
Date 17/09/2019 11:42 File	Designed by MANGU Checked by	
Micro Drainage		Source Control 2018.1.1
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 10 SAAR (mm) 745 Urban 0.000 Area (ha) 2.100 Soil 0.400 Region Number Region 7 Results l/s QBAR Rural 7.7 QBAR Urban 7.7 Q10 years 12.4 Q1 year 6.5 Q30 years 17.4 Q100 years 24.5		
©1982-2018 Innovyze		



Project				Job no.	
Calcs for				Start page no./Revision 1	
Calcs by M	Calcs date 17/09/2019	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = 15 min
Return period	Period = 1 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.350
5-year return period rainfall of 60 minutes duration	M5_60min = 20.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 0 %
Factor Z1 (Wallingford procedure)	Z1 = 0.62
Rainfall for 15min storm with 5 year return period	M5_15mini = Z1 × M5_60min = 12.3 mm
Factor Z2 (Wallingford procedure)	Z2 = 0.61
Rainfall for 15min storm with 1 year return period	M1_15min = Z2 × M5_15mini = 7.6 mm
Design rainfall intensity	I _{max} = M1_15min / D = 30.3 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 21000 m ²
Percentage of area that is impermeable	p = 3 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 4.4 l/s



Project				Job no.	
Calcs for				Start page no./Revision 1	
Calcs by M	Calcs date 17/09/2019	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = 15 min
Return period	Period = 2 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.350
5-year return period rainfall of 60 minutes duration	M5_60min = 20.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 0 %
Factor Z1 (Wallingford procedure)	Z1 = 0.62
Rainfall for 15min storm with 5 year return period	M5_15min _i = Z1 × M5_60min = 12.3 mm
Factor Z2 (Wallingford procedure)	Z2 = 0.79
Rainfall for 15min storm with 2 year return period	M2_15min = Z2 × M5_15min _i = 9.8 mm
Design rainfall intensity	I _{max} = M2_15min / D = 39.2 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 21000 m ²
Percentage of area that is impermeable	p = 3 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 5.7 l/s



Project				Job no.	
Calcs for				Start page no./Revision 1	
Calcs by M	Calcs date 17/09/2019	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = 15 min
Return period	Period = 10 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.350
5-year return period rainfall of 60 minutes duration	M5_60min = 20.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 0 %
Factor Z1 (Wallingford procedure)	Z1 = 0.62
Rainfall for 15min storm with 5 year return period	M5_15min _i = Z1 × M5_60min = 12.3 mm
Factor Z2 (Wallingford procedure)	Z2 = 1.23
Rainfall for 15min storm with 10 year return period	M10_15min = Z2 × M5_15min _i = 15.2 mm
Design rainfall intensity	I _{max} = M10_15min / D = 60.6 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 21000 m ²
Percentage of area that is impermeable	p = 3 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 8.8 l/s



Project				Job no.	
Calcs for				Start page no./Revision 1	
Calcs by M	Calcs date 17/09/2019	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = 15 min
Return period	Period = 30 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.350
5-year return period rainfall of 60 minutes duration	M5_60min = 20.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 0 %
Factor Z1 (Wallingford procedure)	Z1 = 0.62
Rainfall for 15min storm with 5 year return period	M5_15min _i = Z1 × M5_60min = 12.3 mm
Factor Z2 (Wallingford procedure)	Z2 = 1.51
Rainfall for 15min storm with 30 year return period	M30_15min = Z2 × M5_15min _i = 18.6 mm
Design rainfall intensity	I _{max} = M30_15min / D = 74.4 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 21000 m ²
Percentage of area that is impermeable	p = 3 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 10.8 l/s



Project				Job no.	
Calcs for				Start page no./Revision 1	
Calcs by M	Calcs date 17/09/2019	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = 15 min
Return period	Period = 100 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.350
5-year return period rainfall of 60 minutes duration	M5_60min = 20.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 0 %
Factor Z1 (Wallingford procedure)	Z1 = 0.62
Rainfall for 15min storm with 5 year return period	M5_15min _i = Z1 × M5_60min = 12.3 mm
Factor Z2 (Wallingford procedure)	Z2 = 1.95
Rainfall for 15min storm with 100 year return period	M100_15min = Z2 × M5_15min _i = 24.0 mm
Design rainfall intensity	I _{max} = M100_15min / D = 96.1 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 21000 m ²
Percentage of area that is impermeable	p = 3 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 14.0 l/s



Project				Job no.	
Calcs for				Start page no./Revision 1	
Calcs by M	Calcs date 17/09/2019	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = 15 min
Return period	Period = 1 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.350
5-year return period rainfall of 60 minutes duration	M5_60min = 20.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 40 %
Factor Z1 (Wallingford procedure)	Z1 = 0.62
Rainfall for 15min storm with 5 year return period	M5_15min _i = Z1 × M5_60min × (1 + p _{climate}) = 17.3 mm
Factor Z2 (Wallingford procedure)	Z2 = 0.63
Rainfall for 15min storm with 1 year return period	M1_15min = Z2 × M5_15min _i = 10.9 mm
Design rainfall intensity	I _{max} = M1_15min / D = 43.4 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 21000 m ²
Percentage of area that is impermeable	p = 80 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 202.8 l/s



Project				Job no.	
Calcs for				Start page no./Revision 1	
Calcs by M	Calcs date 17/09/2019	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = 15 min
Return period	Period = 2 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.350
5-year return period rainfall of 60 minutes duration	M5_60min = 20.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 40 %
Factor Z1 (Wallingford procedure)	Z1 = 0.62
Rainfall for 15min storm with 5 year return period	M5_15min _i = Z1 × M5_60min × (1 + p _{climate}) = 17.3 mm
Factor Z2 (Wallingford procedure)	Z2 = 0.80
Rainfall for 15min storm with 2 year return period	M2_15min = Z2 × M5_15min _i = 13.9 mm
Design rainfall intensity	I _{max} = M2_15min / D = 55.6 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 21000 m ²
Percentage of area that is impermeable	p = 80 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 259.3 l/s



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Calcs by M	Calcs date 17/09/2019	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = 15 min
Return period	Period = 10 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.350
5-year return period rainfall of 60 minutes duration	M5_60min = 20.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 40 %
Factor Z1 (Wallingford procedure)	Z1 = 0.62
Rainfall for 15min storm with 5 year return period	M5_15min _i = Z1 × M5_60min × (1 + p _{climate}) = 17.3 mm
Factor Z2 (Wallingford procedure)	Z2 = 1.24
Rainfall for 15min storm with 10 year return period	M10_15min = Z2 × M5_15min _i = 21.4 mm
Design rainfall intensity	I _{max} = M10_15min / D = 85.6 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 21000 m ²
Percentage of area that is impermeable	p = 80 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 399.7 l/s



Project				Job no.	
Calcs for				Start page no./Revision 1	
Calcs by M	Calcs date 17/09/2019	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area	Brighton
Storm duration	D = 15 min
Return period	Period = 10 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = 0.350
5-year return period rainfall of 60 minutes duration	M5_60min = 20.0 mm
Increase of rainfall intensity due to global warming	p _{climate} = 40 %
Factor Z1 (Wallingford procedure)	Z1 = 0.62
Rainfall for 15min storm with 5 year return period	M5_15min _i = Z1 × M5_60min × (1 + p _{climate}) = 17.3 mm
Factor Z2 (Wallingford procedure)	Z2 = 1.24
Rainfall for 15min storm with 10 year return period	M10_15min = Z2 × M5_15min _i = 21.4 mm
Design rainfall intensity	I _{max} = M10_15min / D = 85.6 mm/hr

Maximum surface water runoff

Catchment area	A _{catch} = 21000 m ²
Percentage of area that is impermeable	p = 80 %
Maximum surface water runoff	Q _{max} = A _{catch} × p × I _{max} = 399.7 l/s



Project				Job no.	
Calcs for				Start page no./Revision 1	
Calcs by M	Calcs date 17/09/2019	Checked by	Checked date	Approved by	Approved date

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.00

Design rainfall intensity

Location of catchment area Brighton
Storm duration $D = 15$ min
Return period Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period $r = 0.350$
5-year return period rainfall of 60 minutes duration $M5_60\text{min} = 20.0$ mm
Increase of rainfall intensity due to global warming $p_{\text{climate}} = 40$ %
Factor Z1 (Wallingford procedure) $Z1 = 0.62$
Rainfall for 15min storm with 5 year return period $M5_15\text{min}_i = Z1 \times M5_60\text{min} \times (1 + p_{\text{climate}}) = 17.3$ mm
Factor Z2 (Wallingford procedure) $Z2 = 2.01$
Rainfall for 15min storm with 100 year return period $M100_15\text{min} = Z2 \times M5_15\text{min}_i = 34.7$ mm
Design rainfall intensity $I_{\text{max}} = M100_15\text{min} / D = 138.7$ mm/hr

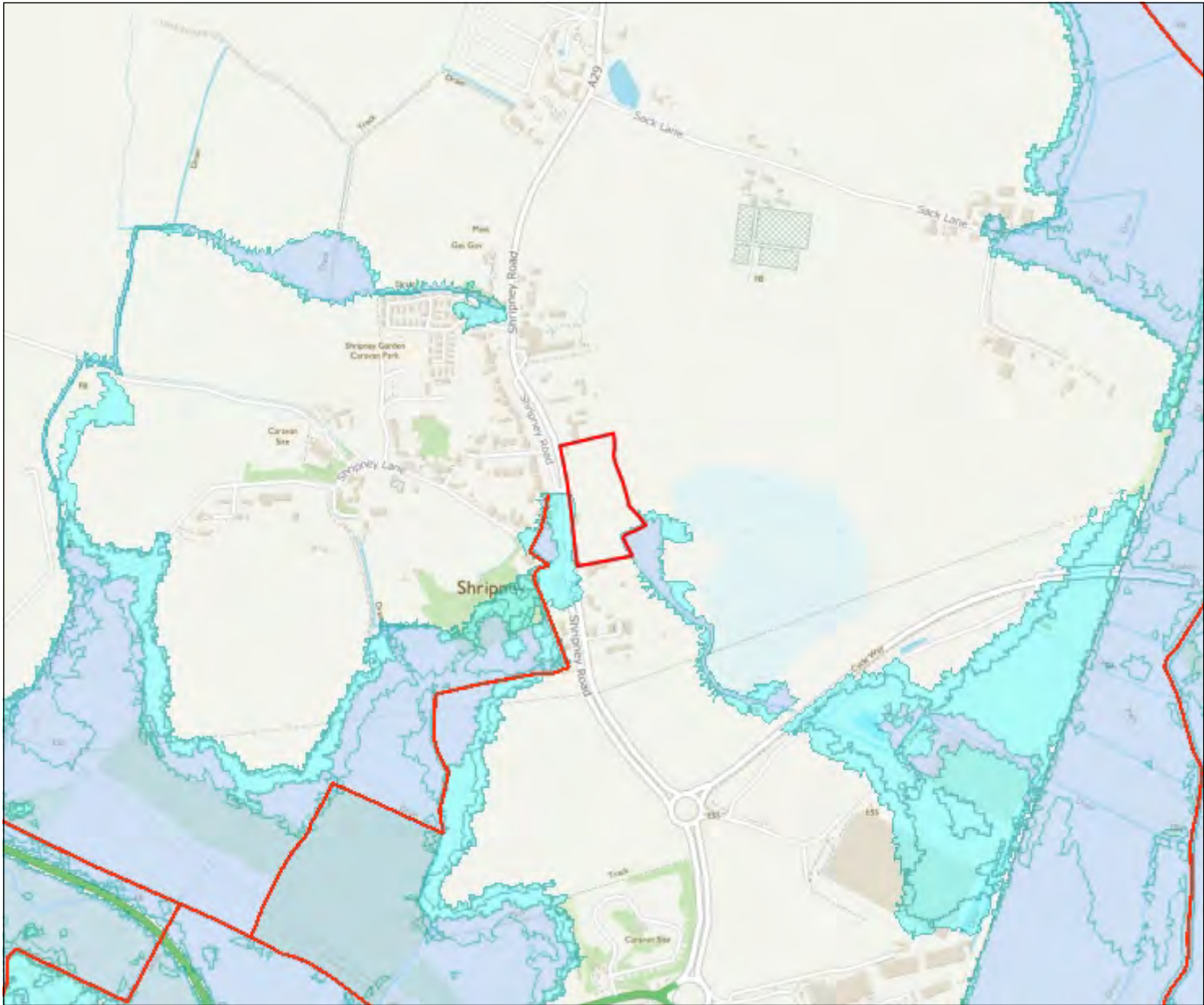
Maximum surface water runoff

Catchment area $A_{\text{catch}} = 21000$ m²
Percentage of area that is impermeable $p = 80$ %
Maximum surface water runoff $Q_{\text{max}} = A_{\text{catch}} \times p \times I_{\text{max}} = 647.2$ l/s

APPENDIX B

EA FLOOD MODELLING DATA

Flood Map for Planning (Rivers and Sea). Centred NGR 493891E, 102136N. Created 08/07/2019.



Scale 1: 10,000



Flood Map for Planning (Rivers & Sea)

-  Sealed Main Rivers
-  Defences
-  Flood Storage Areas
-  Areas benefiting from flood defences
-  Flood Zone 3
-  Flood Zone 2

Flood Map Areas (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Product 4 Flood Risk Data Requested by: Ramboll

Site: Land East of Shripney Road, Bognor Regis, NGR 493891E, 102136N

Table 1: Water Levels: Fluvial Defended

Node Ref	NGR		Modelled Flood Levels in Metres AOD					
			Defended Annual Exceedance Probability					
	Eastings	Northings	5%	1%	1% +CC (35%)	1% +CC (45%)	1% +CC (105%)	0.1%
1	493850	102137	-	-	2.25	2.25	2.44	2.38
2	493944	102084	-	-	-	-	2.19	-
3	493892	102183	-	-	-	-	-	-

Table 2: Water Levels: Tidal Undefended

Node Ref	NGR		Modelled Flood Levels in Metres AOD			
			Undefended Annual Exceedance Probability			
	Eastings	Northings	0.5%	0.5% (2070)	0.5% (2115)	0.1%
1	493850	102137	-	2.62	3.60	-
2	493944	102084	-	2.66	3.60	-
3	493892	102183	-	2.62	3.60	-

Table 3: Water Levels: Tidal Defended

Node Ref	NGR		Modelled Flood Levels in Metres AOD			
			Defended Annual Exceedance Probability			
	Eastings	Northings	0.5%	0.5% (2070)	0.5% (2115)	0.1%
1	493850	102137	-	-	-	-
2	493944	102084	-	-	-	-
3	493892	102183	-	-	-	-

Table 4: Water Depths: Fluvial Defended

Node Ref	NGR		Modelled Flood Depths in Metres					
			Defended Annual Exceedance Probability					
	Eastings	Northings	5%	1%	1% +CC (35%)	1% +CC (45%)	1% +CC (105%)	0.1%
1	493850	102137	-	-	0.39	0.39	0.56	0.52

Office Address: Guildbourne House, Chatsworth Road, Worthing BN11 1LD.
 Customer services line: 03708 506 506. Email: enquiries@environment-agency.gov.uk
www.gov.uk/government/organisations/environment-agency

2	493944	102084	-	-	-	-	0.30	-
3	493892	102183	-	-	-	-	-	-

Table 5: Water Depths: Tidal Undefended

	NGR		Modelled Flood Depths in Metres			
			Undefended Annual Exceedance Probability			
Node Ref	Eastings	Northings	0.5%	0.5% (2070)	0.5% (2115)	0.1%
1	493850	102137	-	0.67	1.66	-
2	493944	102084	-	0.51	1.46	-
3	493892	102183	-	0.00	0.92	-

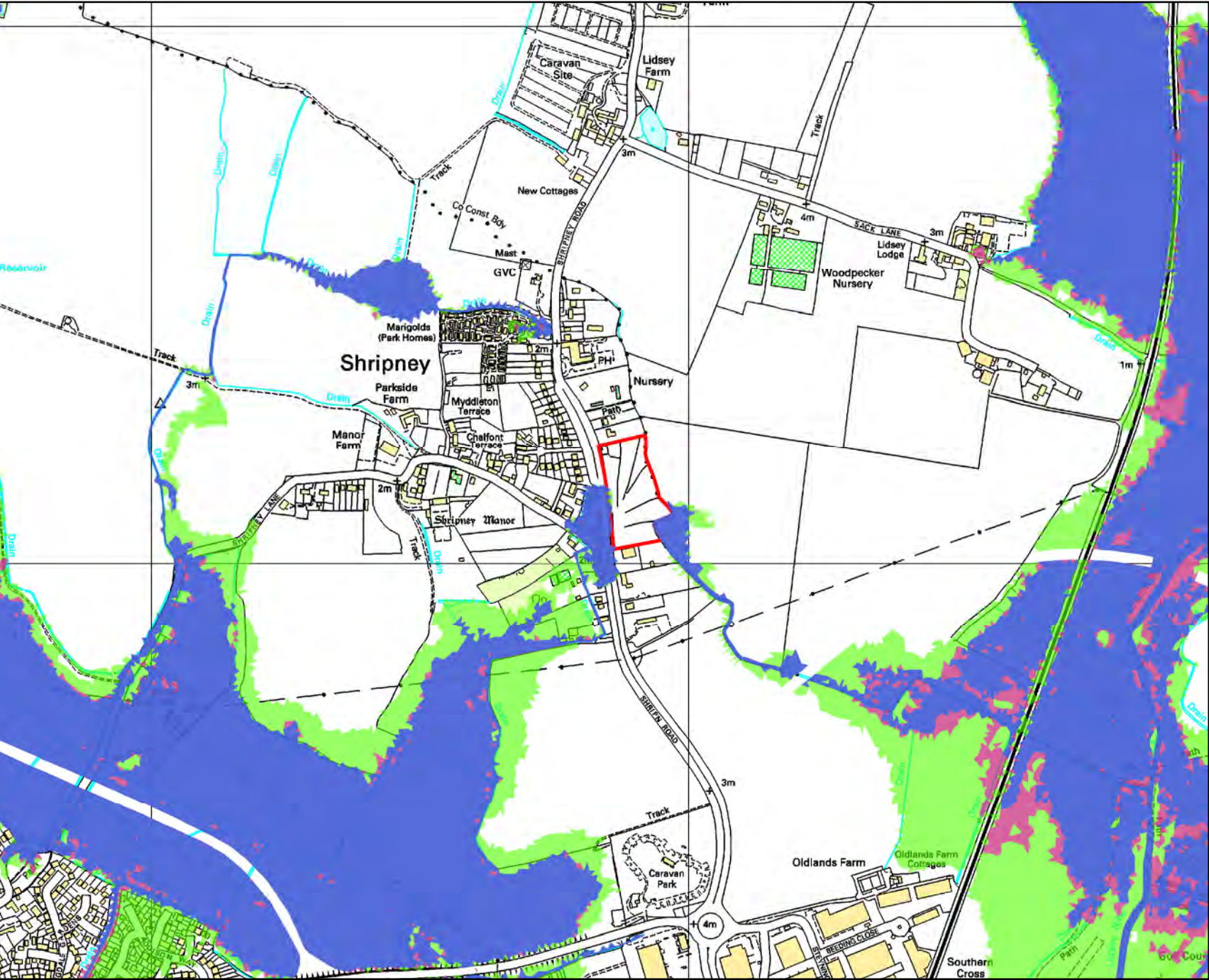
Table 6: Water Depths: Tidal Defended

	NGR		Modelled Flood Depths in Metres			
			Defended Annual Exceedance Probability			
Node Ref	Eastings	Northings	0.5%	0.5% (2070)	0.5% (2115)	0.1%
1	493850	102137	-	-	-	-
2	493944	102084	-	-	-	-
3	493892	102183	-	-	-	-

All levels taken from: Aldingbourne Flood Risk Mapping Study, completed by JBA in 2015 and the Arun to East Head Model, completed by JBA in 2016.

Produced on: 08/07/2019

There is no additional information or health warnings for these levels/depths or the model from which they have been produced.





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Legend

- 1% AEP Plus Climate Change (35%) (Defended Fluvial)
- 1% AEP Plus Climate Change (45%) (Defended Fluvial)
- 1% AEP Plus Climate Change (105%) (Defended Fluvial)
- Site Boundary

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

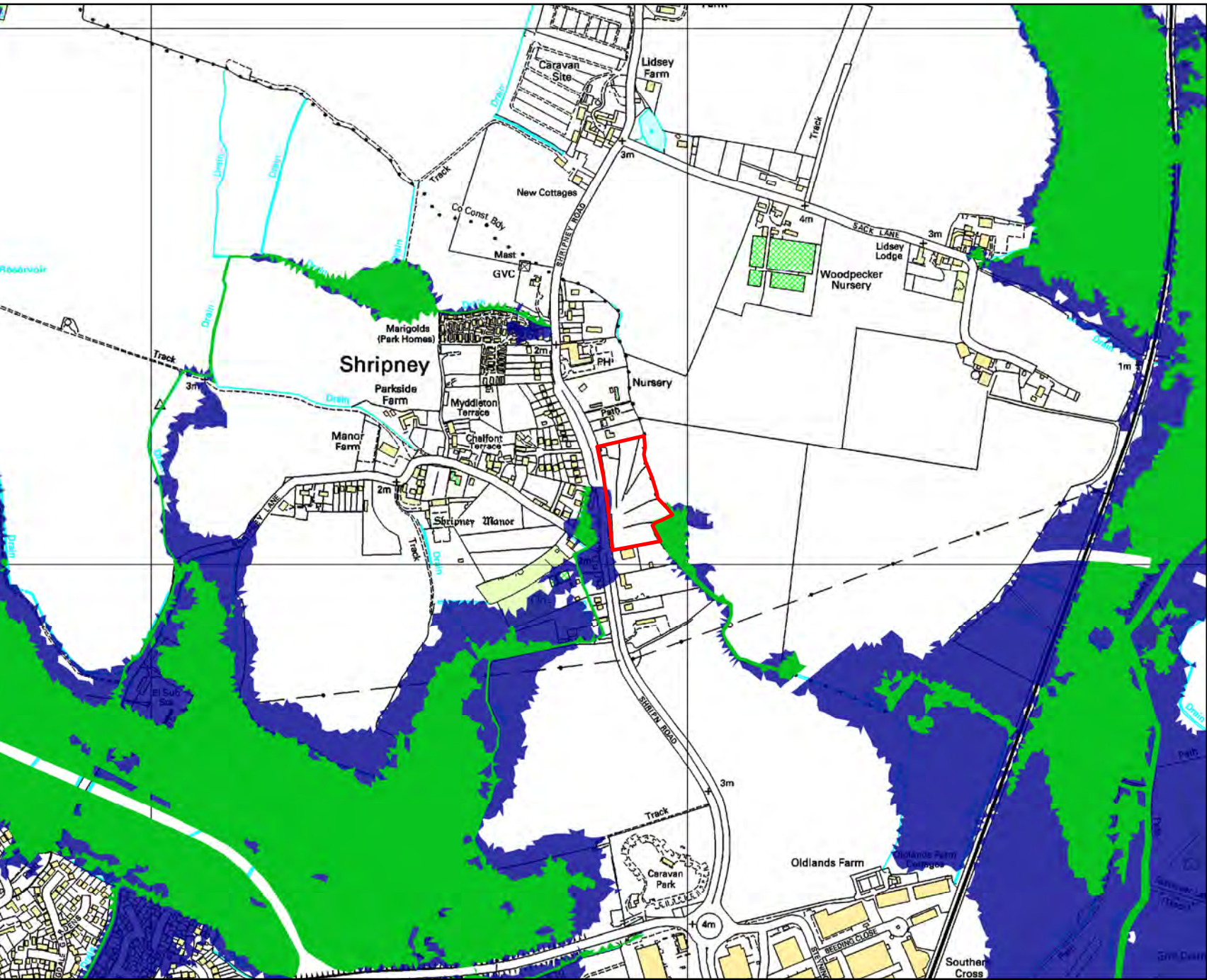
Climate Change (CC) for fluvial models is based on an increase in river flows of 35, 45 & 105% for undefended scenarios.

Defended scenarios only show the superseded 20% increase in flows

Scale: 1:10,000

00.2250.45

Kilometers



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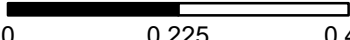


Legend

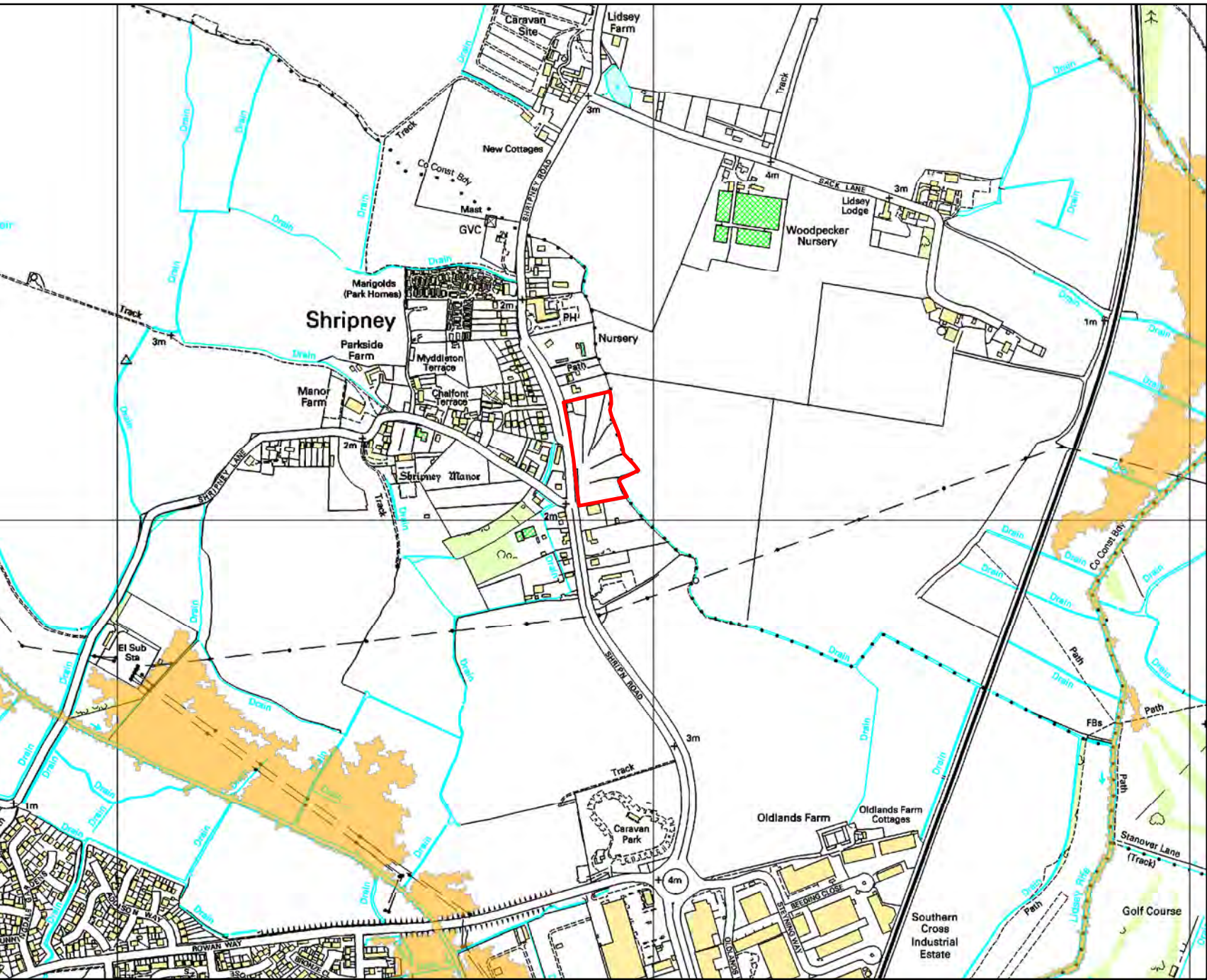
-  Site Boundary
-  1% AEP (Defended Fluvial)
-  0.1% AEP (Defended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



0 0.225 0.45
Kilometers



Environment Agency

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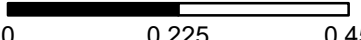


Legend

-  Site Boundary
-  0.5% AEP (Defended Tidal)
-  0.5% AEP (2070) NPPF (Defended Tidal)
-  0.5% AEP (2115) NPPF (Defended Tidal)
-  0.1% AEP (Defended Tidal)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



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Kilometers



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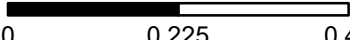
-  Site Boundary
-  1% AEP Plus Climate Change (35%) (Undefended Fluvial)
-  1% AEP Plus Climate Change (45%) (Undefended Fluvial)
-  1% AEP Plus Climate Change (105%) (Undefended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

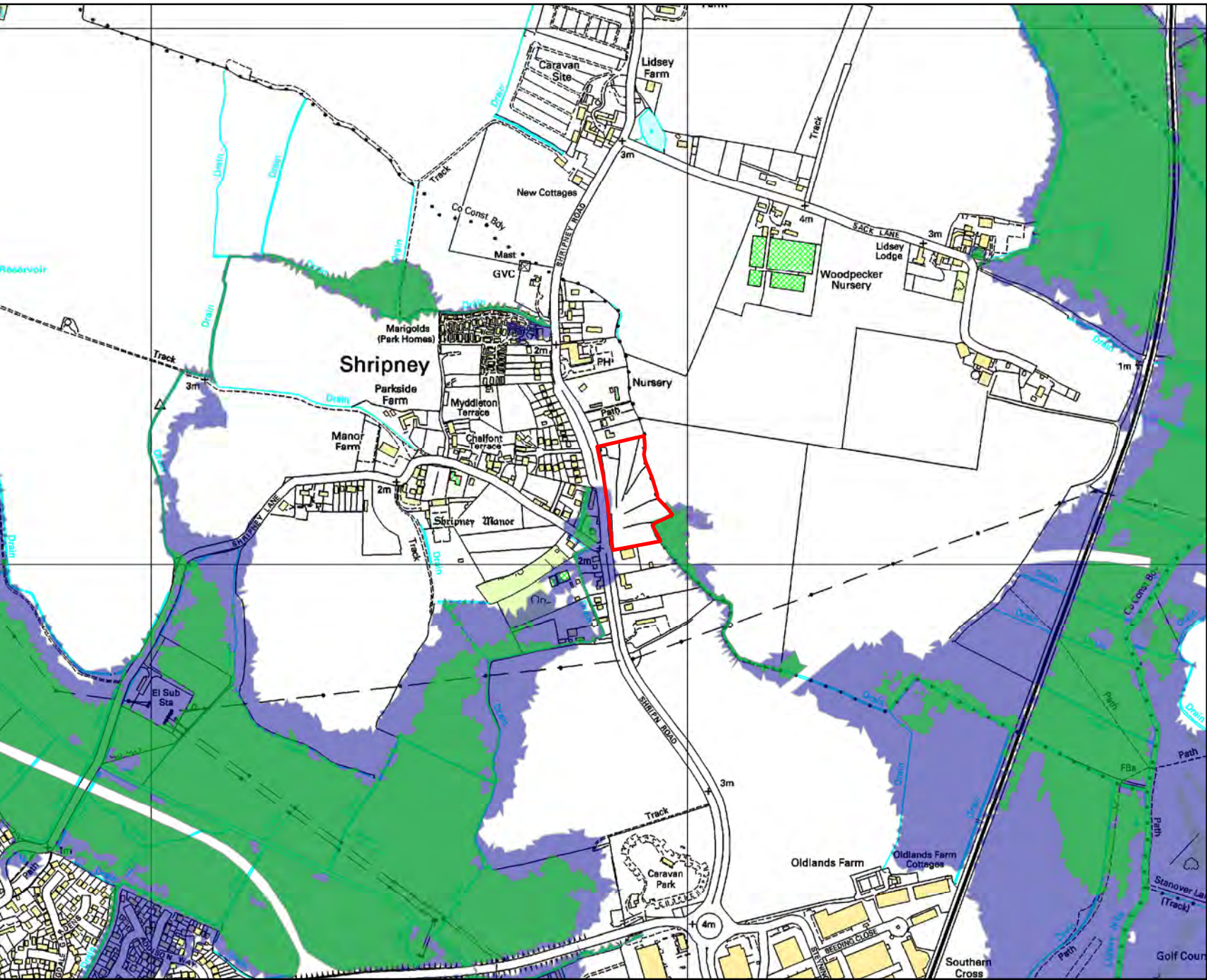
Climate Change (CC) for fluvial models is based on an increase in river flows of 35, 45 & 105% for undefended scenarios.

Defended scenarios only show the superseded 20% increase in flows

Scale: 1:10,000



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Kilometers





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Legend

Site Boundary

1% AEP (Un defended Fluvial)

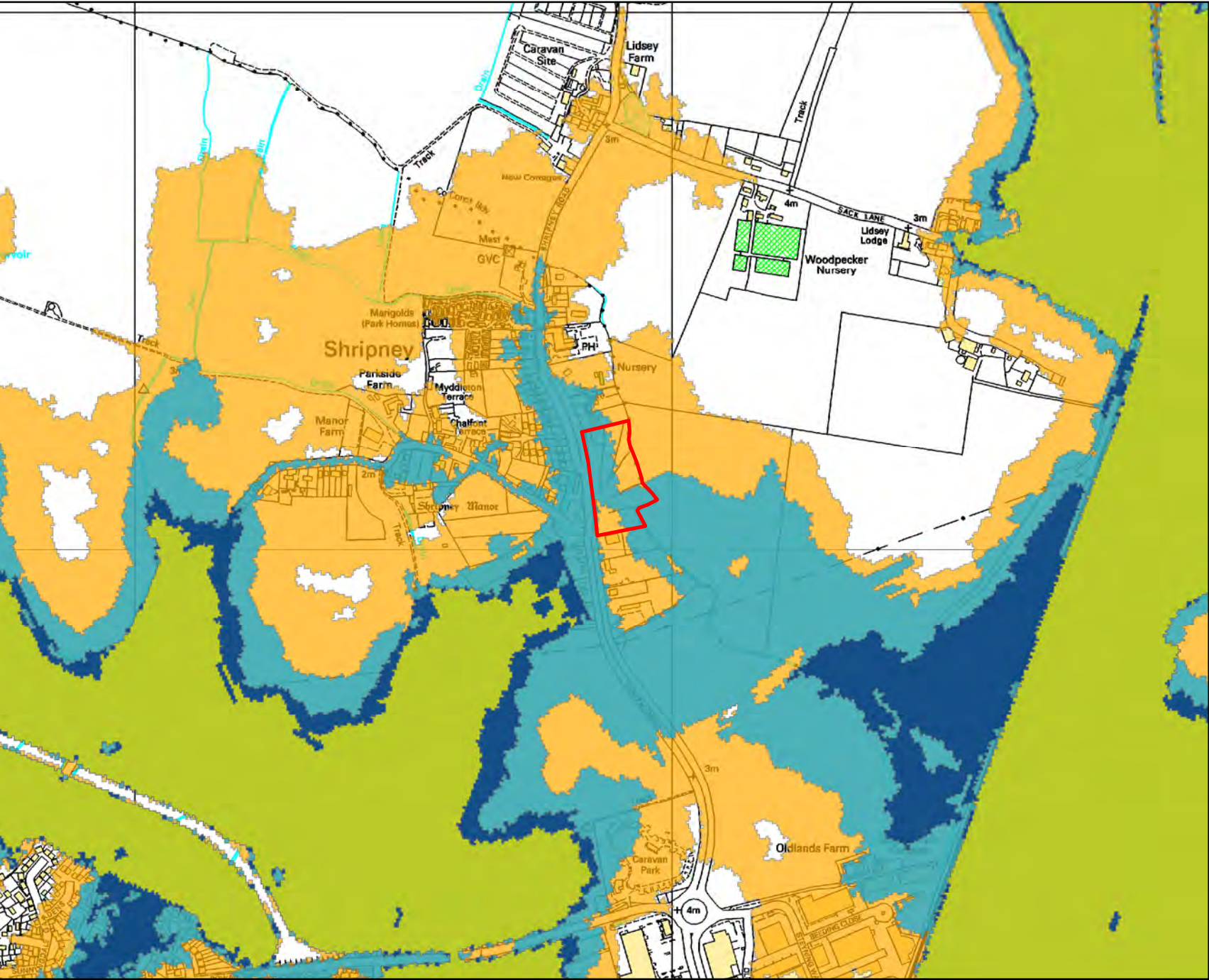
0.1% AEP (Un defended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000

00.2250.45

Kilometers





Environment Agency

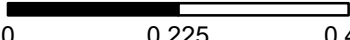


Legend

-  Site Boundary
-  0.5% AEP (Un defended Tidal)
-  0.5% AEP (2070) NPPF (Un defended Tidal)
-  0.5% AEP (2115) NPPF (Un defended Tidal)
-  0.1% AEP (Un defended Tidal)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000



0 0.225 0.45
Kilometers



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Legend

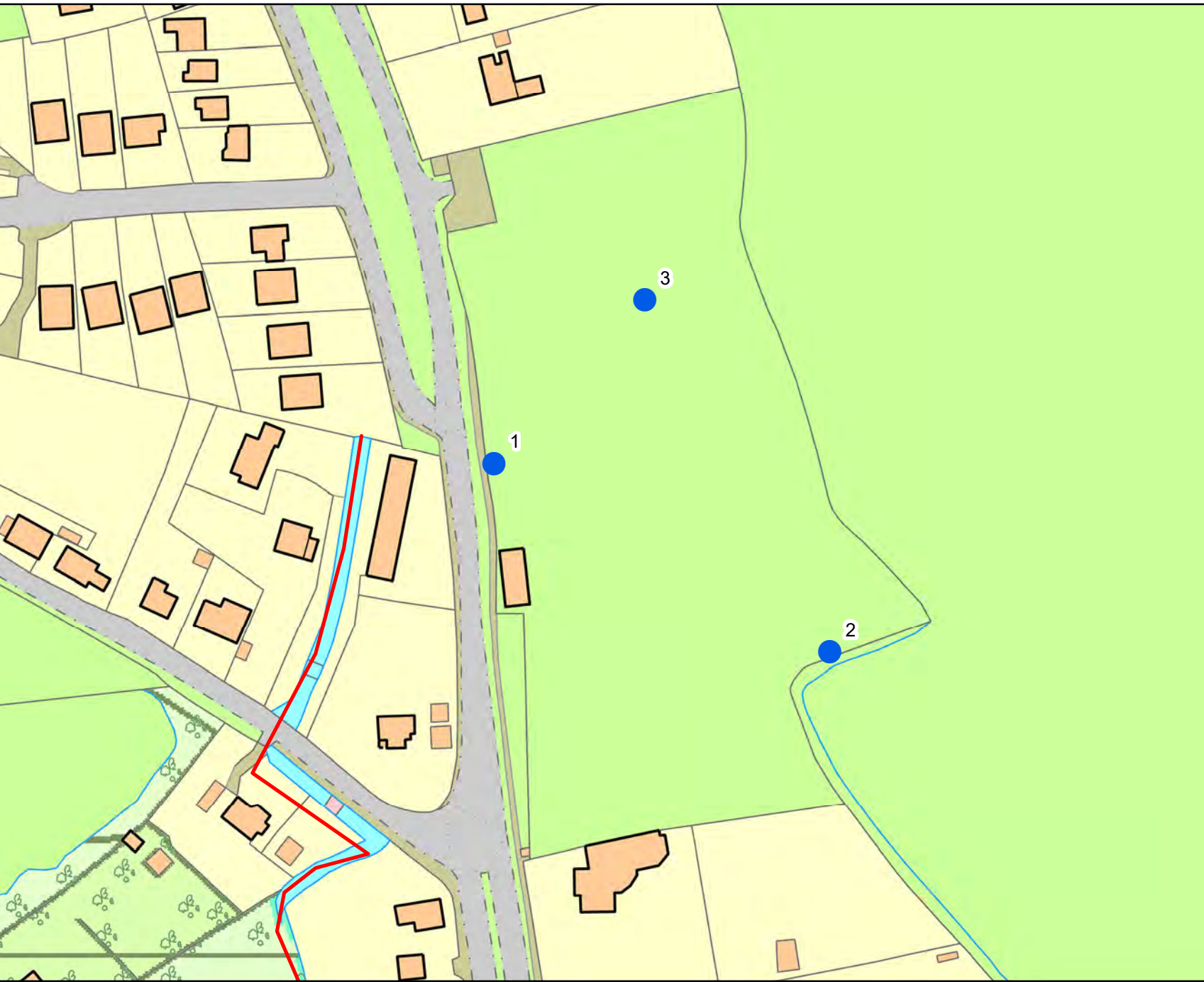
 Site Nodes

 Main River

Scale: 1:1,500

00.03250.065

Kilometers



APPENDIX C

SOUTHERN WATER SEWER RECORDS

