BRIGHT PLAN CIVILS

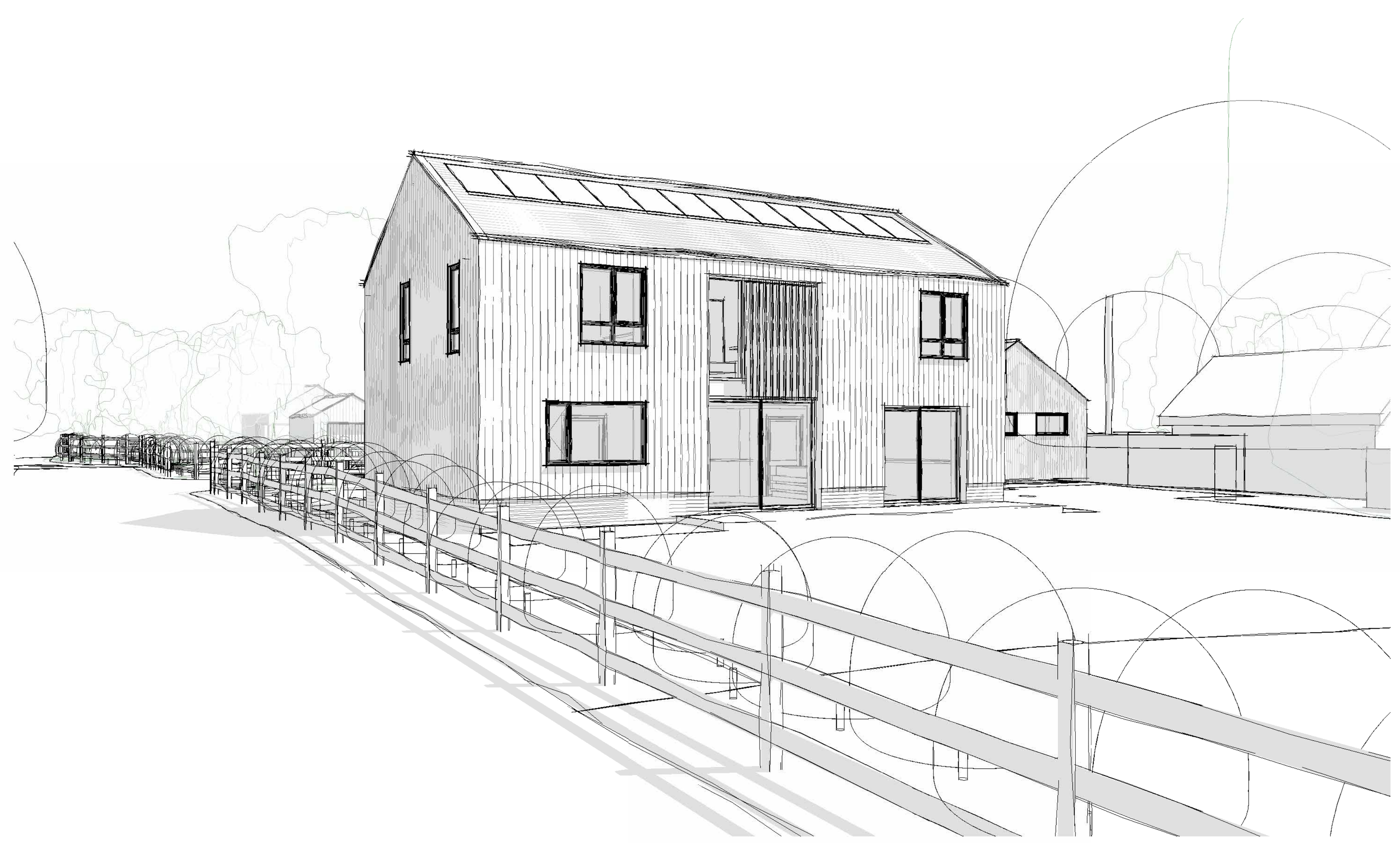
APPENDICES

BRIGHT PLAN CIVILS

Appendix A Proposed Site Layout & Existing Drainage

1. Proposed Site Layout Plan
scale 1 : 500

2. Perspective - Plot 04
scale



3. Perspective - Plot 05
scale

Area Schedule (GIFA)

Plot No	Name	Area m²	Area Sq Ft
Plot 01	Garage	36 m²	388 ft²
Plot 01	Level 00	232 m²	2492 ft²
Plot 01	Level 00 - Work	32 m²	340 ft²
Plot 01	Level 01	83 m²	893 ft²
Plot 01: 4		382 m²	4112 ft²
Plot 02	Garage	36 m²	388 ft²
Plot 02	Level 00	172 m²	1853 ft²
Plot 02	Level 00 - Work	37 m²	394 ft²
Plot 02	Level 01	97 m²	1048 ft²
Plot 02: 4		342 m²	3683 ft²
Plot 03	Garage	27 m²	291 ft²
Plot 03	Level 00	167 m²	1798 ft²
Plot 03	Level 00 - Work	37 m²	394 ft²
Plot 03	Level 01	103 m²	1106 ft²
Plot 03: 4		333 m²	3589 ft²
Plot 04	Garage	18 m²	194 ft²
Plot 04	Level 00	106 m²	1141 ft²
Plot 04	Level 00 - Work	23 m²	250 ft²
Plot 04	Level 01	83 m²	890 ft²
Plot 04: 4		230 m²	2476 ft²
Plot 05	Garage	18 m²	194 ft²
Plot 05	Level 00	83 m²	893 ft²
Plot 05	Level 00 - Work	35 m²	378 ft²
Plot 05	Level 01	83 m²	893 ft²
Plot 05: 4		219 m²	2358 ft²
Grand total: 20		1507 m²	16219 ft²

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SCALE

1 : 500 @ A1

1:1 0mm 20mm 40mm 60mm
1:100 0m 2m 4m 6m
1:200 0m 4m 8m 12m
1:500 0m 10m 20m 30m

revision		date	author	check
01	Updated Road	18.11.20	AY	SR

CLIENT

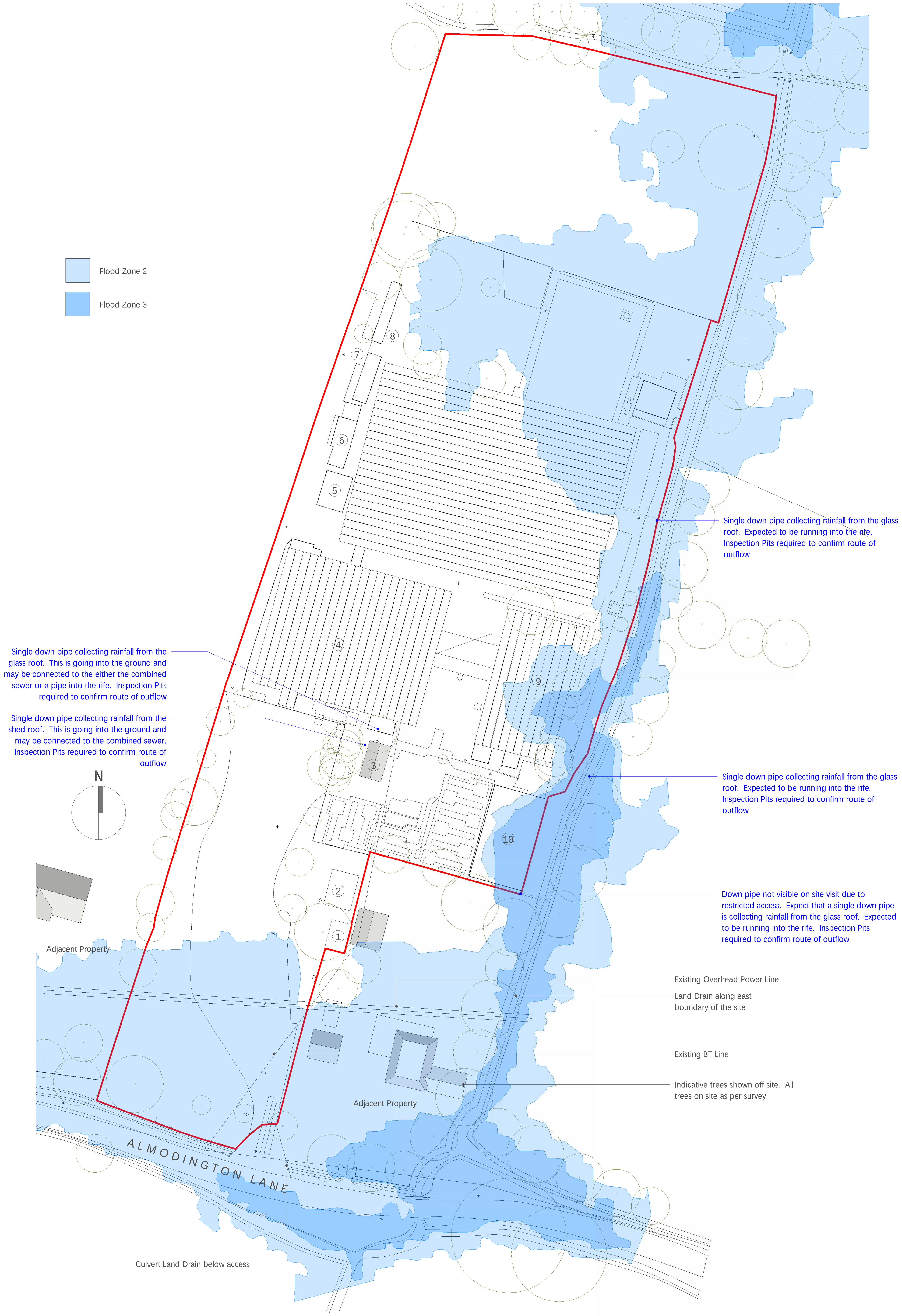
PROJECT
Earnley Meadows

DATE
September 2020

DRAWING TITLE
Proposed Site Layout Plan

DRAWING NO. 199 / 3.001

REVISION 01



1. Existing - Site Layout Plan
scale 1 : 500

Existing GIFA		
Name	Area	Area Sq Ft
Building 1	33 m²	355 SF
Building 2	14 m²	145 SF
Building 3 - Shack	38 m²	406 SF
Building 4 - Glass House	3165 m²	34069 SF
Building 5 - Stores	42 m²	455 SF
Building 6 - Stores	38 m²	408 SF
Building 7 - Stores	30 m²	319 SF
Building 8 - Stores	29 m²	309 SF
Building 9 - Glass House	496 m²	5342 SF
Building 10 - Glass House	227 m²	2444 SF
Grand total: 10	4111 m²	44252 SF

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RIBA
Chartered Practice

SCALE 1 : 500 @ A1

1:1 0mm 20mm 40mm 60mm
1:100 0m 2m 4m 6m
1:200 0m 4m 8m 12m
1:500 0m 10m 20m 30m

revision	date	author	check

CLIENT Name of Client
PROJECT Address
DATE 03/04/20
DRAWING TITLE Existing Site Layout Plan

DRAWING NO. 000 / 0.100
REVISION

Appendix B BGS Geological Records

SZ 89 NW/1

384

SZ 8102 9936

Birdham—Map N.S.G. 332.

54. *HOLT PLACE, 1 mile S.W. of church. Ht. above O.D. 23 ft.
Maps ~~72 N.E.~~, 73 N.W.

	Thickness Ft.	Depth Ft.
Brickearth	15	15
London Clay	235	250
? Lower part Reading Beds		

76.2m

—69m

Information from Mr. F. W. Ockenden, Senr. (from memory).

6" Sussex 73 NW. W

Exact site not determined.

S/Buchan
20.2.41

Information from F.W. Ockenden records at Basingstoke, May 1941:
[?1890] Kenwoods. Birdham. Bore 6in. Depth 250 ft.
F.W. Ockenden.

SCAH.

Sited by C. Reid 1885 on Field Slip 73 NW/W - Loam 15' London Clay to 250'.
Site transferred to W.R. sheet

DATA Bank

Published in
'Wells & Springs
of Sussex,'
page 60

SU 80 SW 92 8303 0009 Birdham

Block D

Surface level +6.5 m
Water struck at +4.7 m
September 1981

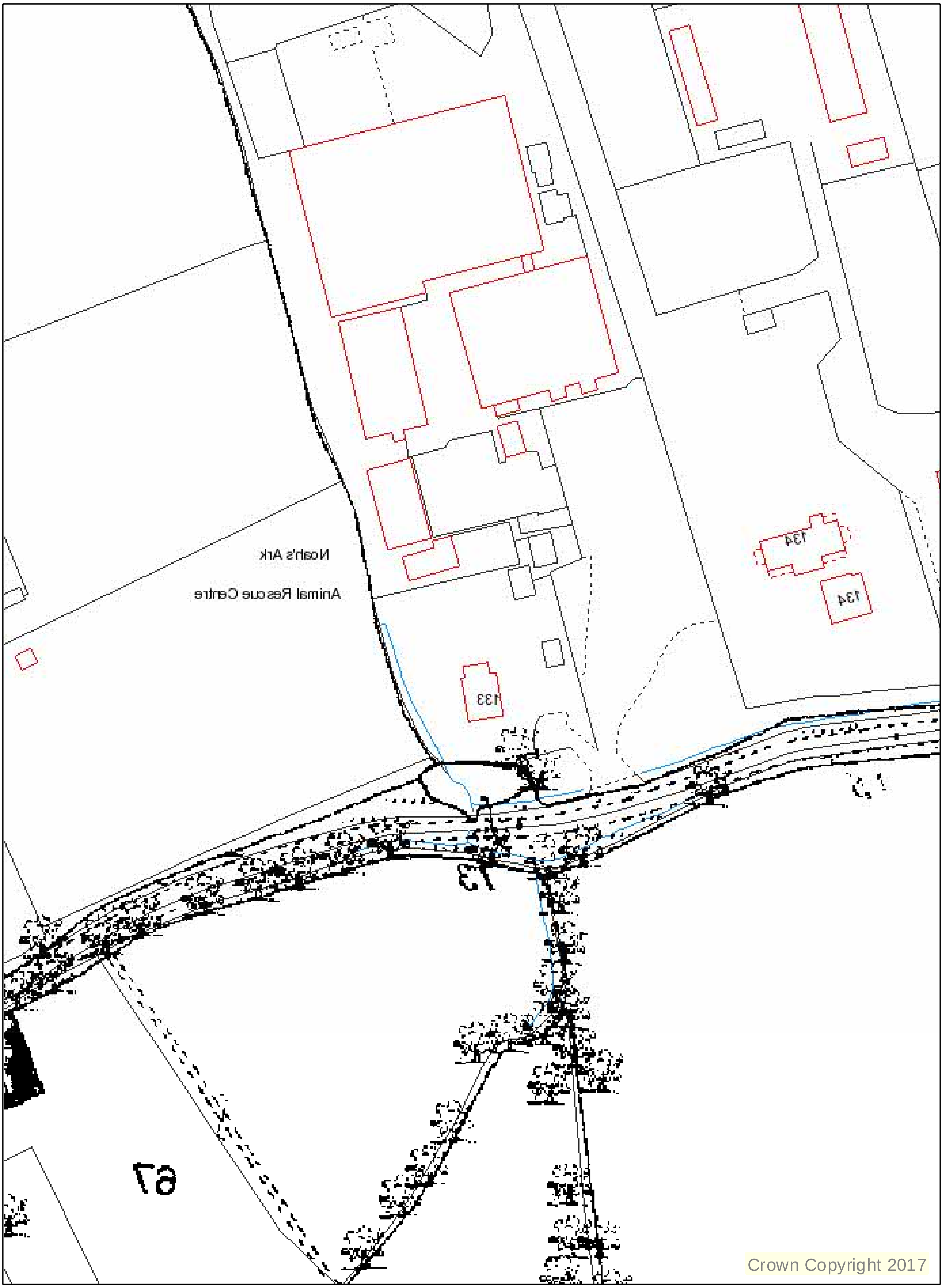
Waste 1.8 m
Bedrock 2.2 m+

LOG

Geological classification	Lithology	Thickness m	Depth m
	Soil	0.5	0.5
Brickearth	Clay, silty, brown	1.1	1.6
Raised Beach Deposits (younger)	'Very clayey' sand with flint pebbles	0.2	1.8
London Clay	Clay, brown with yellow mottling to 3.6 m, hard and grey below	2.2+	4.0

Appendix C LPA & LLFA Correspondence & SFRA Extracts

Earnley Butterfly Farm - Historic Mapping - 1895

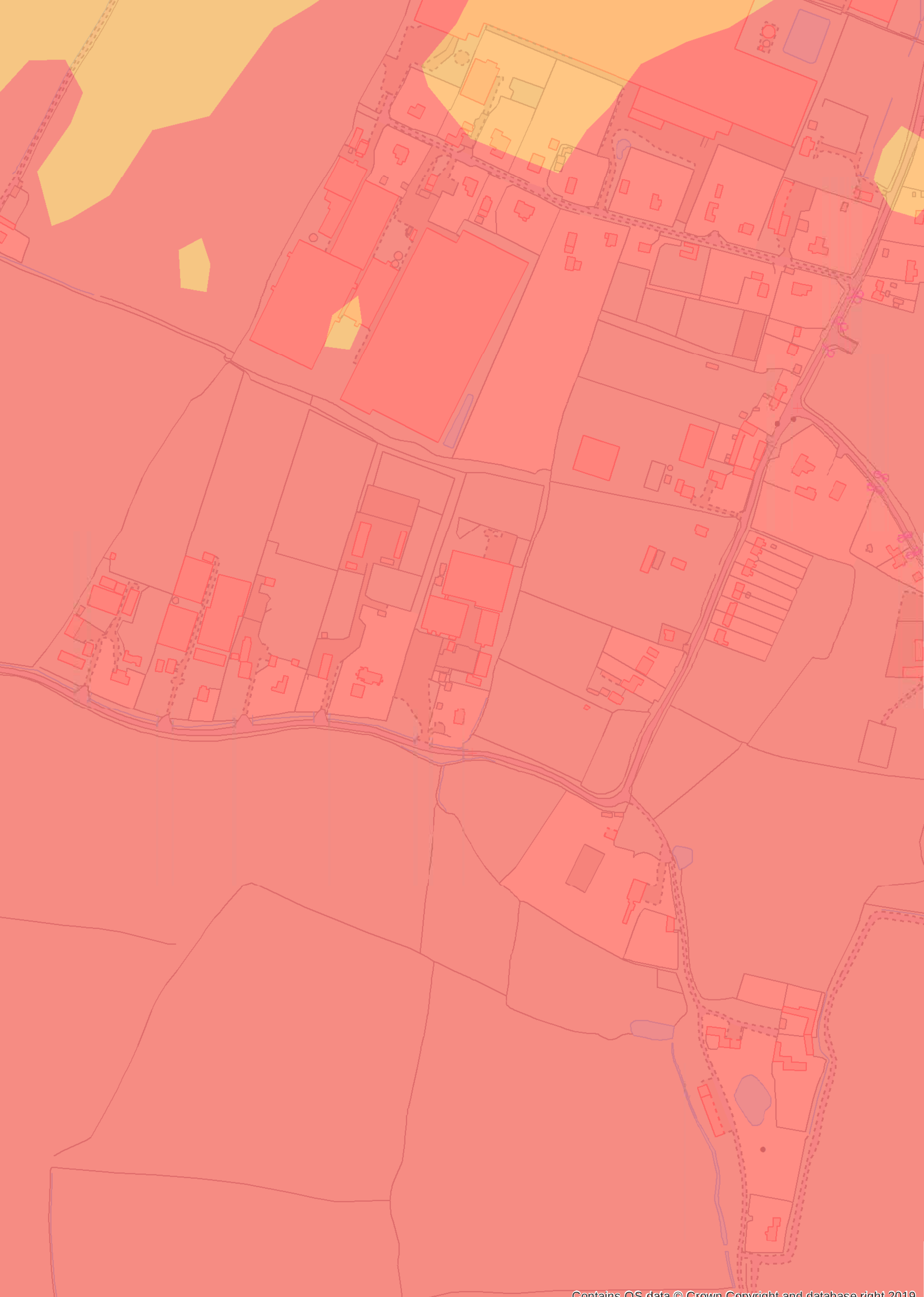


Date: April 2020

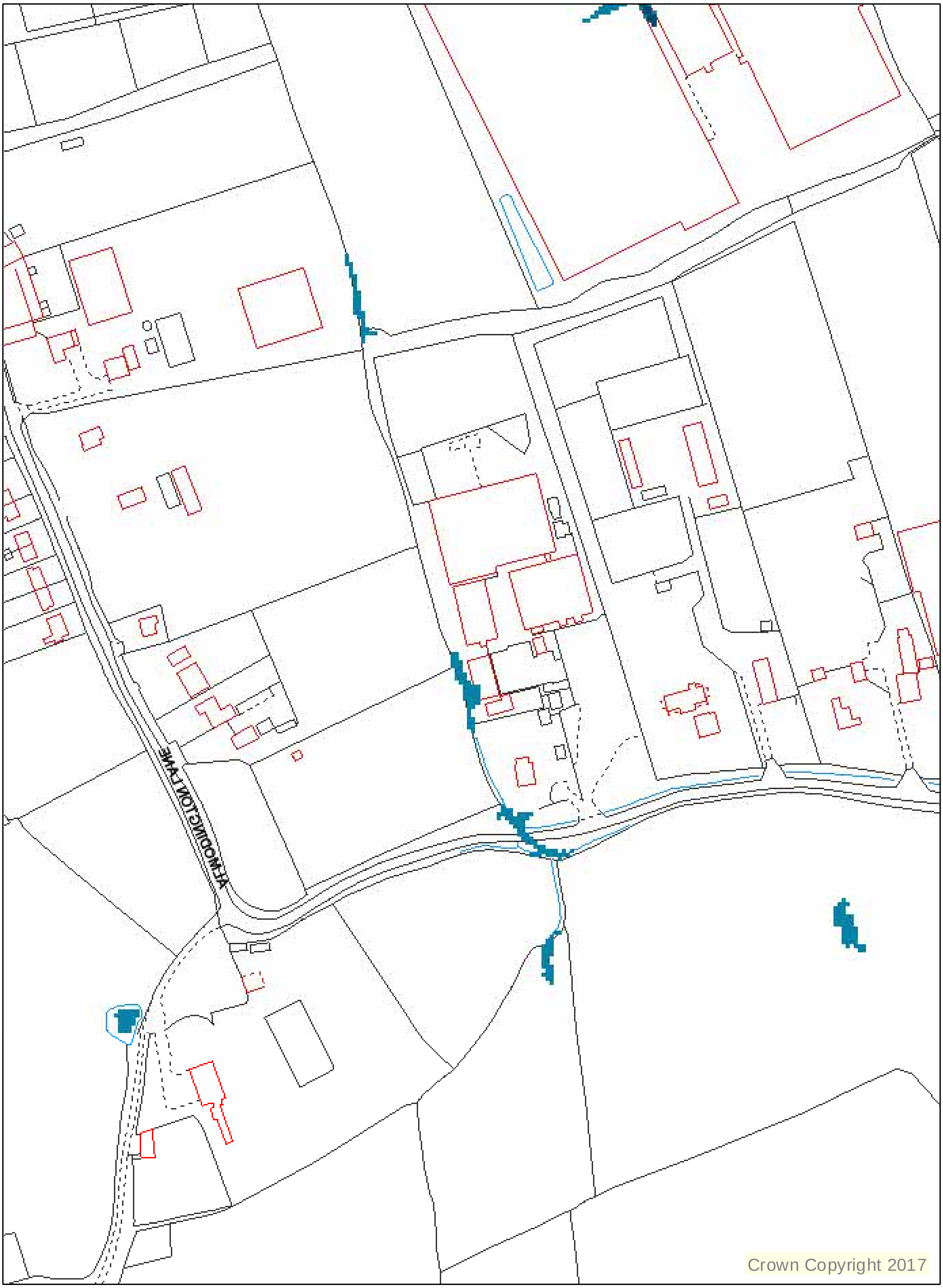
Author: K Macknay

Scale 1:1,250

Map Notes 1:1250 @ A4



Earnley Butterfly Farm - Surface Water Flood Map.



Date: April 2020

Author: K Macknay

Scale 1:2,500

Map Notes 1:2500 @ A4

Dan Lytton

From:	Dominic Henly <dhenly@chichester.gov.uk>
Sent:	01 September 2020 12:39
To:	Dan Lytton
Subject:	RE: D1879 - Earnley Meadows - Flood & Drainage Discussion
Attachments:	Earnley Meadows Brief for Dom Henly CDC.PDF; Levels and Depths Tables_P4_SSD165109_PO20 7JR.PDF; FRA Site Boundary & Node Points.pdf; H1375-1.pdf; H1375-2.pdf

Hi Dan

Thanks for your email,

The approach of locating the dwellings sequentially in areas at lowest risk (flood zone 1), reducing impermeable areas and improvements to the existing ditch network all sound positive.

Unfortunately because the site is at risk of "fluvial" flooding only the Environment Agency will be able to help with flood levels and suggest FFLs. Although like you I'm not sure I understand the variation in levels for the nodes given their close proximity, but assume you will have to design for the worst case level. Which based on the land levels, if you're able to located the houses in the current flood zone 1, this should not be too significant to exceed.

It does look from the layout like the task was to sit the houses as tight to the flood zones as possible, and instead I would have preferred to have seen the bottom two houses shifted west (away from the flood zone),

With regards to surface water drainage, like with all sites they will need to investigate the potential of shallow infiltration (winter groundwater monitoring / percolation tests to BRE365 or similar), but if that proves not to be viable then a connection to a local watercourse will be acceptable at a rate which does not exceed the existing rate. Because you are removing the old buildings / hardstanding's, if these currently connect to the watercourse (this would need to be confirmed / evidenced) then you may be able to demonstrate a significant betterment. We would also expect all of the access and parking remain permeable.

Kind regards

Dominic Henly
Senior Engineer
Environment
Chichester District Council
Ext: 34689 | Tel: 01243534689 | dhenly@chichester.gov.uk | Fax: 01243 776766
http://www.chichester.gov.uk

From: Dan Lytton [redacted]
Sent: 18 August 2020 16:43
To: Dominic Henly
Subject: D1879 - Earnley Meadows - Flood & Drainage Discussion

Hi Dom,

Our Client is looking to redevelop the Earnley Butterfly site with a low-density 4 home development, with a particular focus on sustainability, returning hardstanding areas to the environment, and enhancement of wetland. Given the difficulties in redeveloping this site in the past, they are looking at a proposal that will provide significant benefit, including in terms of flood risk and drainage, and that is where we are appointed.

the Thames CFMP and Hampshire CFMP respectively. The River Arun and Western Streams CFMP is currently awaiting imminent public release of the finalised main stage report. The boundaries of the CFMPs are shown in **Map M1** in Annex A.

Shoreline management plans (SMPs)

3.37 The long term management of coastal flood risk and erosion is set out within Shoreline management plans (SMPs). As with CFMPs, SMPs are developed by a group of key stakeholders such as the South Downs Coastal Group (SDCG) and the Environment Agency. The CDC coastline is covered by two SMPs. The Beachy Head to Selsey Bill SMP (2nd Review) and the East Solent Shoreline SMP. The extents of the SMPs are shown in **Map M1** in Annex A. The East Solent SMP cover all of the Chichester district coastline, extending from Pagham in the east to the mouth of the River Hamble in the west, and includes the natural harbours of Chichester, Langstone, Portsmouth and Pagham.

3.38 The SMPs identify policies appropriate to the long-term management of coastal flood risk. Much of the coastline has a SMP policy of 'hold the line'. This means that existing coastal defences will be maintained to offer the same level of protection in the future, as they do today. This may require the defences to be raised in line with rising sea levels as a result of climate change and the localised sinking of land in southern England. In other places, such as Atherington, the SMP policy is 'managed realignment,' which means that new development in these areas must consider a possible reduction in future standards of protection in the area. As with CFMP policies, the policies of the SMP should be considered when making land use planning decisions. The policies are shown on **Map M2** in Annex A.

Flood defences strategies

3.39 The Environment Agency, in partnership with Chichester and Arun District Council’s, are consulting on the draft Pagham to East Head Coastal Defence Strategy (May 2008).

3.40 The Environment Agency are currently reviewing their assets to develop System Asset Management Plans so that they can make informed decisions on their investments in capital works. These plans may have a bearing on decisions made by Chichester District Council in relation to the long term condition of existing flood defences in the area.

Manhood Peninsula Partnership

3.41 The Manhood Peninsula Partnership was formed in 2001 to assist in the management of the future development of the Peninsula. It has identified a number of issues for further investigation within the area. One of these is the overall view of land drainage since certain areas within the Peninsula appear to be becoming increasingly prone to drainage problems.

3.42 Consequently, Chichester District Council, on behalf of the Manhood Peninsula Partnership, has commissioned a Land Drainage Study of the Manhood Peninsula. The study is being undertaken on a phased basis.

Phase 1 was submitted in August 2003 and involved an initial assessment to gain a basic understanding of the land drainage issues. It identified any gaps in the understanding of the drainage system and, most importantly, provided a platform for further assessment;

Phase 2 involved a study into the effects of siltation in and around Pagham Harbour taking into account the effects of climate change. Also included were suggested remedial measures, the potential effect on the Lavant flood alleviation scheme and the impact on the environment;

Phase 3 is a study of the role of the ditch system in terms of transport and storage, an investigation of possible storage sites and consideration of SuDS; and

Structures

4.29 NFCDD contains a large number of structures which are not wholly for flood defence purposes. The dataset was filtered to extract only key flood defence structures which were defined as:

Flapped outfalls.

Pumped outfalls.

Pumping stations.

Summary of key flood defences

4.30 The defences are shown in **Maps D2** to **D4** in Annex A. **Maps D2** shows the type of flood defence. **Map D3** shows the source of flood protection and **Map D4** shows the estimated standard of protection.

4.31 Due to the volume and variety of defence data, the mapped data has been simplified. GIS layers provided within the SFRA must be reviewed to obtain all of the defence information when considering the condition and standard of protection offered by flood defences at specific locations.

4.32 It is important that users of the SFRA recognise issues with data quality and consistency of the source NFCDD datasets. The most current and correct information should be used. NFCDD is a live database, which is continually updated by the Environment Agency. Future updates of NFCDD should rectify any omissions and errors in the current dataset.

Sea flood defences

4.33 The coastline of Chichester District extends from the mouth of the River Ems in the west, to Pagham Harbour in the East. In some instances land has been reclaimed and developed, making it more vulnerable to overtopping or breaching of defence structures.

4.34 The coastal fringe includes a number of important tourist areas such as Selsey and Wittering. The coastal defences serve to protect people and property as well as commercial and recreational interests including Pagham Harbour and Chichester Harbour.

4.35 Historically sea defences in Chichester District were built on a piecemeal basis as coastal towns grew, however many of these defences fell into disrepair during WWII. It was not until the Coast Protection Act 1949 that many coastal defence systems improved.

4.36 The area is mainly protected by timber, concrete and shingle defences. Prior to the 1950s some areas of the peninsula were eroding at a rate of 8m per year, however defences have been built since which provide protection to the area. There are large shingle banks which dominate Pagham Beach, Pagham Harbour and Church Norton.

4.37 The shoreline immediately west of Selsey Bill is protected only by the beach and erosion is ongoing due to exposure to waves and strong tidal currents. Erosion is also occurring along the low cliff where there are unconsolidated sands and gravels.

4.38 The shingle banks between Selsey and Bracklesham have breached previously during extreme events. Apparently this happened in 1910 when Selsey temporarily became an island. North of East Wittering the shoreline is mainly protected by a groyne shingle beach, with sections of breastwork revetment. Several groyne compartments are severely depleted.

4.39 In some locations flood protection is afforded by other means; such as the region of Wittering, which is protected by the sand spit at East Head. At a number of locations there are concrete seawalls or rock revetments. Generally, the shingle beach provides the principal coastal defence. The defence system is supported by annual beach replenishment works.

4.40 Table 4.5 contains a summary of defences along the Chichester District coastline.

Table 4.5 Defences to prevent flooding from the sea

Coastal reach	Structure(s) / FRM activity	Estimated level of protection	Maintainer	Comments
Chichester Harbour	Embankment Seawall Groynes Gabions Embankments	-	Various (EA, LA and Riparian)	
West Wittering - Bracklesham	Groyne stabilised beach	-		
Bracklesham Bay	Beach recharge	-		
Bracklesham – Selsey Bill	Sea wall Groyne stabilised beach Breakwater			
Pagham Harbour	Embankment, wharf, quaysides	Variable	Various (EA, LA, Riparian)	

LA – Local Authority Environment Agency – Environment Agency SPA – Shoreham Port Authority

River flood defences

4.41 The key flood defences in Chichester District are summarised in Table 4.6 and include:

Raised barriers such as walls or embankments.

Online storage areas which act to reduce flood peaks.

Diversion of flows from high risk areas, or increasing channel capacity to carry greater flow through high risk areas (e.g. widening, deepening and straightening of channels).

Other structures that modify the natural flow of rivers, including weirs, sluices, culverts and bridge crossings and bank protection works.

4.42 There are no significant sections of raised embankment or river wall along any of the Chichester SFRA watercourses (River Lavant, Bosham Stream, River Ems, Pagham Rifes and the Rifes of Manhood Peninsula). However there is a disused sluice gate on the Bosham Stream.

4.43 The River Lavant is highly modified, with the first modifications believed to have occurred in Roman times when the river was diverted through Chichester to provide a source of water for the town. Following the floods of 1994 and 2000, the river was modified again through the introduction of the River Lavant Flood Relief Scheme. This scheme consists of a by-pass channel to divert high flows away from the culverted watercourse through Chichester town centre. A proportion of river flow is diverted and discharged to a lake at Chalk Farm pit before entering a series of man-made and natural channels on the course to its outlet at Pagham Harbour.

4.44 Through consultation with the Environment Agency it has been agreed to assume that the scheme is not a flood defence but a channel improvement. Thus the flood zones (undefended) outline will be the same as the actual (defended) outline.

6.11 **Map M3** in Annex A shows the extent of the broadscale CFMP models that were provided by the Environment Agency for use in the SFRA. These models were reviewed to identify their relevance to the SFRA. Their key features are summarised in Table 6.2.

River Arun and Western Streams

6.12 The River Arun CFMP used results from seven different flood models. Some of the models were built from base datasets and others were based on existing models. All of the seven models were built using TUFLOW and used topographic data from a mixture of ground survey, LIDAR, SAR and photogrammetry. In some areas, model cross-sections were estimated and less confidence could be placed on the model results. The extents of the seven models were:

Lavant - upstream model extent near West Dene and downstream model extent was just downstream of the A27 in Chichester. Outfall via uni-directional culvert into Chichester Harbour. The model also included the Pagham and Bremere Rifes which discharged into Pagham Harbour via uni-directional culverts;

Aldingbourne - upstream extent of model on tributaries at Aldingbourne and Westergate and downstream model extent was at the English Channel in Bognor Regis;

Bosham - the upstream model extent was north of the A27 in West Ashling and the downstream extent was in Bosham;

Ems - the upstream extent of the model on the Ems was upstream of the A27 in Westbourne and the downstream model extent was the estuary in Emsworth;

Wittering - the upstream extent of modelling on the Wittering was at Holme Farm, east of West Wittering and the downstream extent of the model was at the English Channel in East Wittering;

Selsey - the upstream extents of the model were on the tributaries near Somerly, Aldington and Highleigh, south of the A246. The downstream extent of the model was where the Rife entered the English Channel, west of Selsey; and

River Arun and Western Rother - the upstream extent of the model on the eastern branches of the River Arun was at Horsham and on the western branch was at Chiddingfold on the A283. The River Rother was modelled from Chithurst (west of Midhurst) to the confluence with the River Arun. The downstream extent of the model on the River Arun was where the river entered the English Channel near Littlehampton.

6.13 All seven watercourses and thus models were connected to harbours or to the English Channel. For this reason the downstream tidal boundary was an important factor in determining flood risk. The tidal boundaries were reviewed for the purposes of the SFRA. The downstream of most of the models were flapped and represented by a uni-directional culvert element. The models included the impact of flood defences.

6.14 Climate change was investigated in two future scenarios. A 20 per cent increase in river flows and 300mm on sea level was used for a 50 year time horizon and a 30 per cent increase in river flow and 600mm on sea level was used for a 100 year time horizon. These scenarios were not consistent with the latest Government predictions on climate change and were updated in this commission.

CFMP tidal boundaries

6.15 Most of the downstream boundaries used in the CFMP models were taken from existing models provided by the Environment Agency. For this reason, the downstream boundary conditions were assumed appropriate for use in the CFMPs. As the SFRA must consider the source and certainty of datasets, it was important to review the downstream boundary conditions to make sure that they were "fit for purpose".

6.16 Where watercourse outlets are flapped, sea levels only have a minor influence on flooding, in the form of tide-locking. Where the watercourse is open to the sea, the impact of sea and tide levels is much greater.

6.17 At Pagham Harbour the peak water level was typically 2.85mAOD and the river flood event resulted in a peak in the order of 4.2mAOD. The Chichester Harbour outfall boundary condition was based on a predicted tide with a maximum water level of 2.4mAOD. The highest astronomical tide (HAT) for Chichester was 2.51mAOD and the mean high water spring (MHWS) was 2.05mAOD, which showed that the boundary condition was quite conservative. Although the boundary was reasonable it did not reflect any hydraulic processes within Chichester Harbour.

6.18 The downstream boundary of the Aldingbourne Rife is a flapped outfall (uni-directional culvert) and an outfall pump. A sinusoidal tide was used as the downstream boundary condition with a peak level of 3.12mAOD. Mean high water spring was 2.65mAOD, highest astronomical tide was 3.31mAOD, and the 1 in 1 year water level was estimated to be 3.2mAOD (JBA), which showed the downstream boundary condition to be conservative for a river flood model.

6.19 At Bosham, where the rifes meet Chichester Harbour, two out of the three outfalls contained uni-directional culverts. The applied boundary condition was a predicted tide (for Chichester Harbour) with a maximum water level of 2.4mAOD. Highest astronomical tide for Chichester was 2.51mAOD and the mean high water spring was 2.05mAOD, which showed that the boundary condition was reasonably conservative. Again none of the hydraulic properties of Chichester Harbour were represented in the model.

6.20 For the Ems model again the applied boundary condition was a predicted tide (for Chichester Harbour) with a maximum water level of 2.4mAOD which was reasonably conservative, however did not account for the hydraulic properties of Chichester Harbour. The boundary condition was applied directly to the 2D domain, which is likely to have produced more accurate results.

6.21 The downstream boundary for the Wittering model included a uni-directional culvert and a weir at 4.71mAOD. The same tidal boundary was used for this model as for the River Arun (observed tide with a peak of 3.0mAOD). This tidal boundary required a review for the purposes of the SFRA.

6.22 The downstream extent of the Selsey model was the outfall to the English Channel. Part of the model also drained into Pagham Harbour through a uni-directional culvert. The downstream boundary into the English Channel also consisted of a uni-directional culvert. The same tidal boundary was used for this model as for the River Arun and a constant (0mAOD) water level was applied to Pagham harbour. This boundary required a review to more accurately reflect the impact of tide-locking.

6.23 Table 6.3 summarises the downstream boundary conditions of existing CFMP models and whether a review was undertaken.

generated by south-westerly winds in the Channel. Waves in Pagham Harbour are generated locally and are only significant at higher water levels (ESSMP).

7.13 Table 7.4 details extreme water levels that have been produced by a number of different studies and summarised in the Manhood Peninsula Study.

Table 7.4 Extreme water levels from Manhood Peninsula study

Return period (years)	Chichester Harbour (mAOD)	Bracklesham (mAOD)	Medmerry (mAOD)	Selsey Bill (mAOD)	Bognor Regis (mAOD)
1	2.86	2.95	2.98	3.07	3.27
2	2.89	2.98	3.02	3.11	3.31
5	3.08	3.17	3.21	3.30	3.50
10	3.16	3.25	3.29	3.38	3.58
20	3.36	3.45	3.49	3.59	3.79
50	3.46	3.56	3.59	3.69	3.89
100	3.67	3.77	3.81	3.91	4.11
200	3.83	3.93	3.97	4.07	4.27
500	4.03	4.14	4.18	4.28	4.48
1000	4.23	4.34	4.38	4.48	4.67

Chichester and Pagham Harbours

7.14 Harbours are different to the open coast as they are dominated by high energy processes acting over long lengths of frontage. For this reason flooding must be assessed differently and water levels are different from those recorded at open sea.

7.15 Chichester Harbour is not a heavily developed harbour. The shoreline is defined by seawalls, revetments and embankments, plus a number of lengths of natural coastline, largely within Bosham and Chichester channels. Many of these defences are in need of maintenance or upgrading to provide a reasonable standard of service for the future, particularly in view of rising sea levels.

7.16 Areas of particular concern include the east shore of Hayling Island, the shoreline around the Military of Defence (MoD) establishment at Thorney Island, the Mill Pond at Emsworth and the west shore of the Chidham Peninsula.

7.17 The defences along the east shore of Hayling Island are subject to breaching which causes widespread flooding of agricultural land, holiday and recreation developments, residential areas and main roads. There is particular concern in regards to breaching at Tourner Bay and North Hayling frontage. The Tourner Bay frontage has been protected by a bank of building rubble, but this is not a sustainable defence.

7.18 Works have been undertaken along Langstone – Emsworth frontage to prevent minor erosion and flooding, including protection of Conigar Point where breaching has occurred. Emsworth has been identified as a risk area due to overtopping.

7.19 The MoD has complete design proposals for improvements to the revetments along Thornley Island. Along Marker Point the MoD has agreed to allow the existing defences to deteriorate naturally

7.20 The Environment Agency have undertaken major works along the Prinsted-Nutbourne frontage, which involves armouring the existing bank with rock to ensure that there is no future damage.

7.21 The west shore of Chidham Peninsula is suffering erosion of flood embankments and breaches are likely if maintenance is not undertaken.

Flood event records	West Sussex Fire Brigade, WSCC Highways Depots and Southern Water Services Plc	Records of historic flooding including groundwater events.
Plans, Studies and Reports		
Catchment Flood Management Plan Data	Environment Agency	Variety of data including geology, soil, landuse information.
Groundwater vulnerability layer	Environment Agency	
Groundwater Emergence Zones	Defra, 2004	Maps of potential groundwater flooding areas based on historic events and recorded groundwater levels

Historic flood events

9.21 Records of groundwater flooding prior to 1994 are sparse. An analysis of historic flood event information notes few occurrences during the period 1960 to 1990 across the study area.

9.22 Groundwater flooding across Sussex was recorded during 1974, notably across the Lavant catchment below the chalk outcrop. Significant groundwater flooding was observed during 1993/94, 2000/01 and 2002/03.

9.23 The extensive groundwater flooding that occurred during the winter of 2000/01 followed a period of exceptionally high rainfall. In England and Wales the rainfall for the period starting in September 2000 was 166% of the long-term average (Marsh and Dale 2002). The south-east recorded 183% of the long-term average. Estimated return periods for some aquifers in the south-east of England were in excess of 200 years (0.5 per cent AEP).

9.24 Across Sussex the most extensive areas of flooding occurred in the upper reaches of Chalk catchments, in areas of localised low topography, and in the absence of drift cover. In these areas ephemeral spring heads migrated to the top part of the valley systems.

Topography, geology and groundwater flooding

9.25 1.7 million properties have been identified as being at groundwater flood risk in England. In Sussex 83,481 properties are at risk from groundwater flooding (Defra, 2004). Of these properties 79,974 were located outside of the Environment Agency 1 in 100-year indicative (fluvial) flood outline.

9.26 The underlying geology of the area largely determines the characteristics of the Coastal Plain, the Chalk Downs and the hills of the Weald. Large areas of low-lying land are at risk of flooding, especially on the Coastal Plain. The study area is underlain by quick weathering sedimentary rock, dominated by Chalk and Sandstone. The distribution of soil types coincides fairly closely with the geology of the catchment, which together determine the likelihood of groundwater flooding being experienced.

9.27 Much of West Sussex is underlain by Chalk. The chalk strata of the South Downs are overlain by generally shallow and well-drained chalk or lime dominated topsoils that are often very shallow and can sustain very little vegetation. Rain can easily infiltrate this geology through large fissures into the underlying chalk aquifers and is released slowly through springs further downstream.

9.28 A characteristic of the South Downs is the spring line along the escarpment. Rain soaks through the shallow soils of the Downs into the chalk and will eventually emerge at the base of the scarp slope as springs.

9.29 However, groundwater flooding is not limited to the spring line. Significant flooding has also arisen in the areas downstream of major aquifers in the surrounding floodplains. Springs sustain baseflow and low flows throughout the county.

9.30 Soils on the Manhood Peninsula are seasonally waterlogged and clay-rich. The River Ems and Bosham Stream in the west of the peninsula run through this relatively impermeable coastal plain, however they have a high winter baseflow component as the headwaters are fed by chalk springs in the south of the South Downs. Prolonged wet winter periods lead to high groundwater levels that result in saturated ground conditions and extensive surface water in the upper catchments. This leads to an immediate response to additional rainfall and high flow velocities due to the steep stream gradients at the foot of the Downs. Groundwater processes are an important contributor to flooding in these areas.

9.31 Large areas of the district have relatively impermeable soils, the parent material of which is the dominant bedrock of the Weald, Sandstone. This bedrock weathers quickly in geological terms, leaving clay-rich soils, which generate a large amount of runoff quickly. Steep gradients in the High Weald intensify runoff velocities and volumes, leading to a higher density of streams on the Weald Clay. Poor surface drainage in these areas results in a scarcity of alluvial deposits.

9.32 The Sussex Rifes, which drain the flat coastal plain, respond rapidly to rainfall due to the waterlogged clay soils in the area. Flood velocities are relatively slow however due to shallow gradients. The watercourses in these areas are therefore runoff dominated. The likelihood of groundwater flooding in these regions is relatively low.

Methods for assessing flood risk

Identifying groundwater flood risk

9.33 No single government Agency is responsible for monitoring or responding to groundwater flood events. Defra’s Making Space for Water Strategy (MSW) aims to provide greater clarity for the public and professional bodies impacted by and involved in the management of flooding respectively. MSW recognises the need for an integrated understanding of flooding from all sources including groundwater.

9.34 As a consequence Defra have instigated a series of investigations into groundwater flooding (HA4a Flooding from Other Sources, October 2006; and HA5 Groundwater Flooding Records Collation, Monitoring and Risk Assessment, March 2006).

9.35 The research projects aim to:

HA4 - Assess the feasibility of mapping flood risk from different types of flooding (including groundwater), together with the practicalities of implementing flood modelling methods considered for the significant types of flooding (including groundwater flooding).

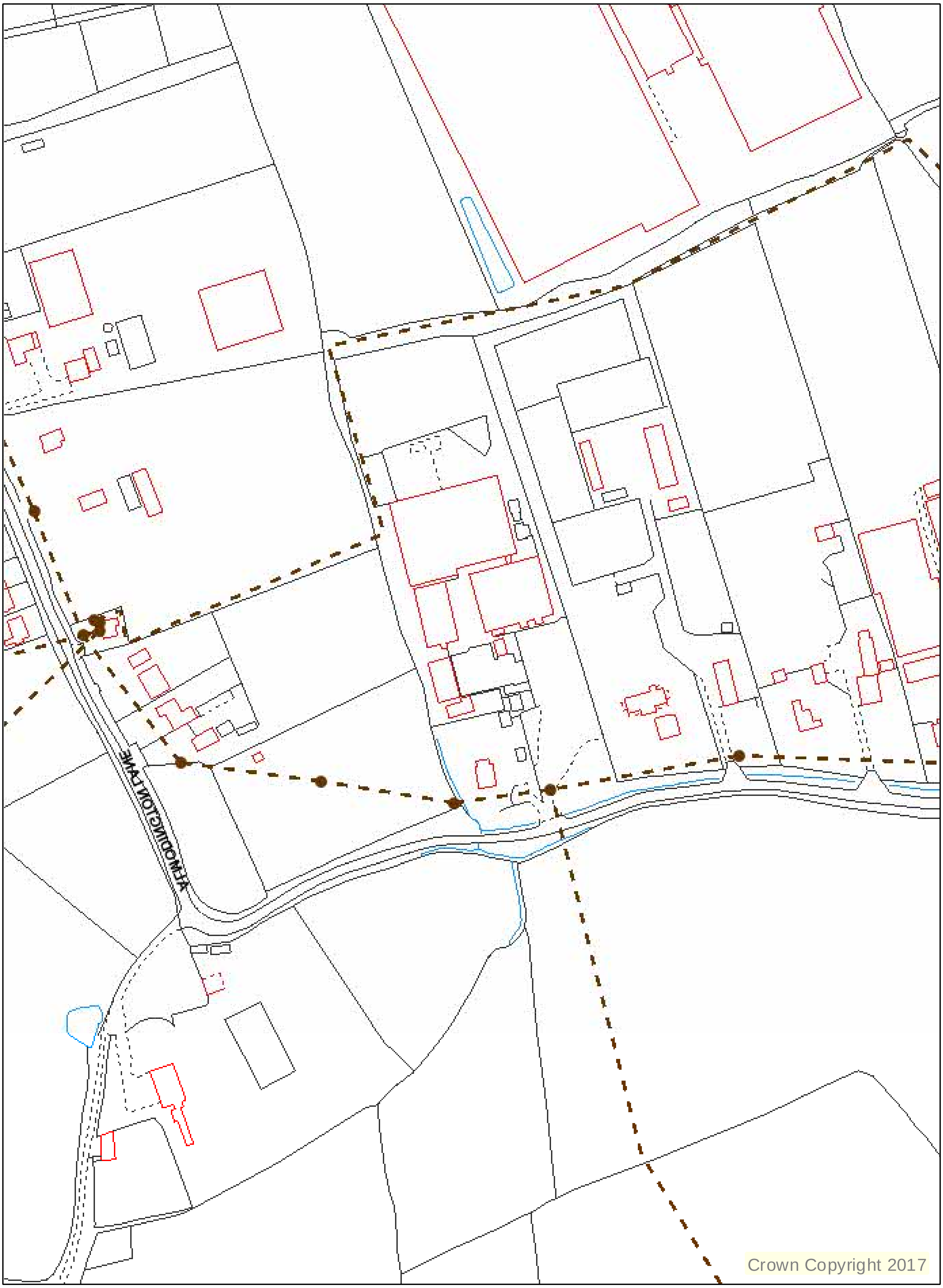
HA5 - Make recommendations for effective collation and monitoring of groundwater flooding information and identify organisational and funding arrangements required to implement this.

9.36 The research projects have identified:

HA4 - The greatest barrier to producing accurate flood risk maps of other sources of flooding is the availability of data for ground-truthing in consistent and useable formats, and that the modelling methods that would be required to capture all the observed processes are complex and may not be realistic in the immediate future.

Appendix D Southern Water Public Sewer Records

Earnley Butterfly Farm - Southern Water Sewers.



Date: April 2020

Author: K Macknay

Scale 1:2,500

Map Notes 1:2500 @ A4

Appendix E Environment Agency Product 4 Response

Ryan Hofman
Cornerstone Consulting Engineers

Our ref: SSD165109
Date: 13/03/2020

Dear Ryan Hofman ,

Enquiry Regarding Product 4 for Flood Risk Assessment for Earnley Gardens, 133 Almodington Lane, Chichester, PO20 7JR.

Thank you for your enquiry which was received on 02 March 2020.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004. The information is attached.

The information on Flood Zones in the area relating to this address is as follows:

The site is in an area located within Flood Zone 1, 2 & 3 as shown on our Flood Map for Planning (Rivers and Sea).

Note - This information relates to the area that the above named property is in and is not specific to the property itself as it is influenced by factors such as the height of door steps, air bricks or the height of surrounding walls. We do not have access to this information and is not currently used in our flood modelling.

Flood Zone definitions can be found at www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones

Flood Defences
There are no formal raised flood defences in the vicinity of the site.

Model Information
The model used was the JFLOW Almodington which was completed by JBA Consulting in 2012.

Flood History
We hold no record of previous flooding events affecting this site.

Please note our records are not comprehensive and may not include all events. I recommend contacting the Lead Local Flood Authority, **West Sussex County Council** or the Local Authority, **Chichester District Council** for a more comprehensive flood history check.

FRA advisory text

Product 4 Flood Risk Data Requested by: Cornerstone

Site: Earnley Gardens, 133 Almodington Lane, Chichester, PO20 7JR

Table 1: Water Levels: Fluvial Undefended

	NGR		Modelled Flood Levels in Metres AOD Undefended Annual Exceedance Probability	
Node Ref	**Eastings**	**Northings**	**1%**	**0.1%**
1	482307	97386	-	4.82
2	482365	97411	5.24	5.37
3	482331	97462	-	-
4	482375	97526	-	4.98

Table 2: Water Depths: Fluvial Undefended

	NGR		Modelled Flood Depths in Metres Undefended Annual Exceedance Probability	
Node Ref	**Eastings**	**Northings**	**1%**	**0.1%**
1	482307	97386	-	0.14
2	482365	97411	0.36	0.49
3	482331	97462	-	-
4	482375	97526	-	0.16

All levels taken from: JFLOW Improvements (2012)

Produced on: 27/01/2020

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

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

FRA Site Boundary & Node Points. Centred PO20 7JR. Created 13/03/2020.

Environment Agency

Legend

Site_Nodes

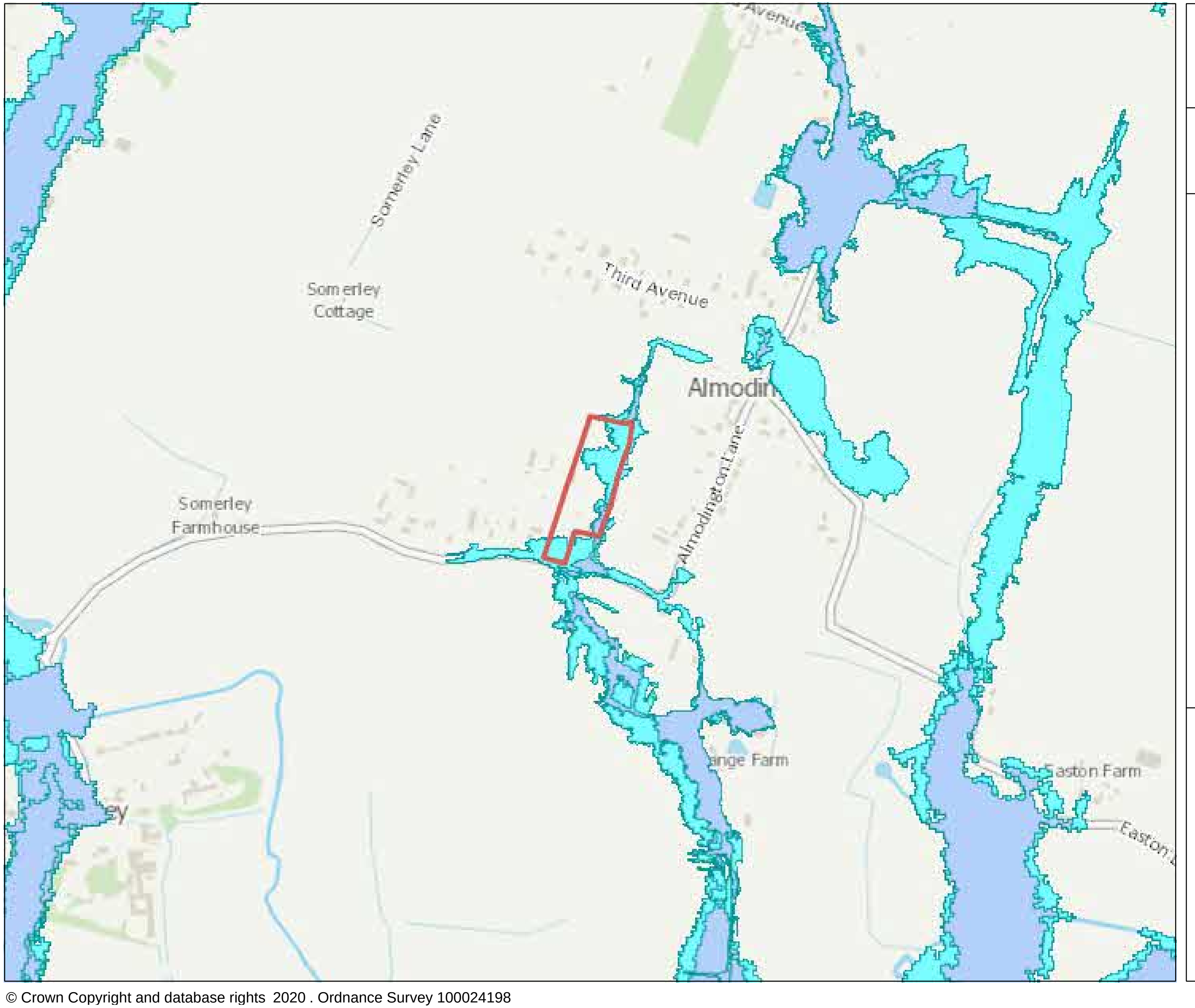
Site_Boundary

Scale: 1:2,000

0 0.045 0.09

Kilometers

Flood Map for Planning (Rivers and Sea). Centred PO20 7JR. Created 13/03/2020.



Environment Agency

1: 10,000

0 Metres 250

N W E S

Flood Map for Planning (Rivers & Sea)

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

Flood Map Areas (assuming no defences)

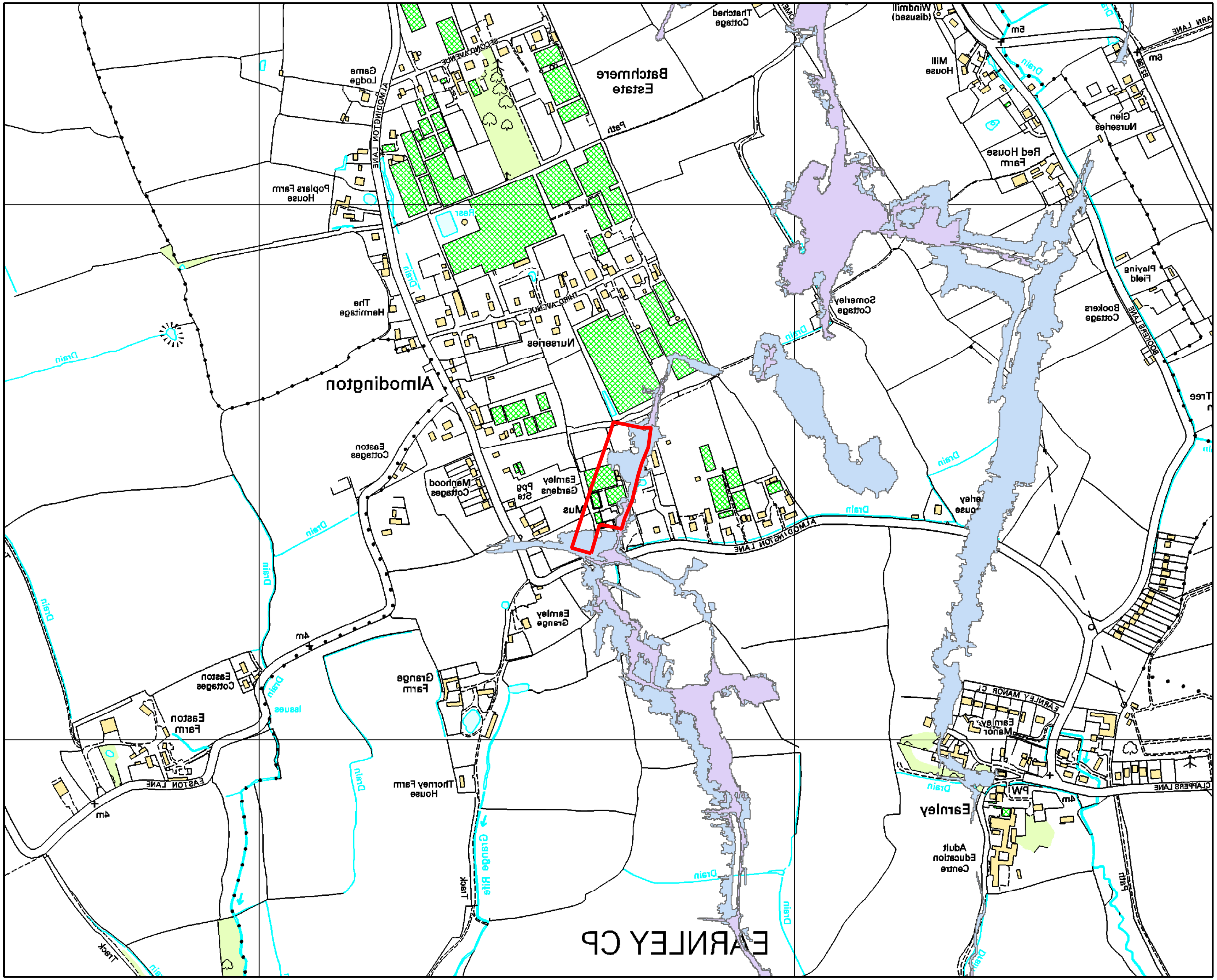
Flood Zone 3 shows the area that could be affected by flooding:

- 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 occuring each year.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Modelled Flood Outlines (Undefended Fluvial). Centred PO20 7JR. Created 13/03/2020.



Environment Agency

Legend

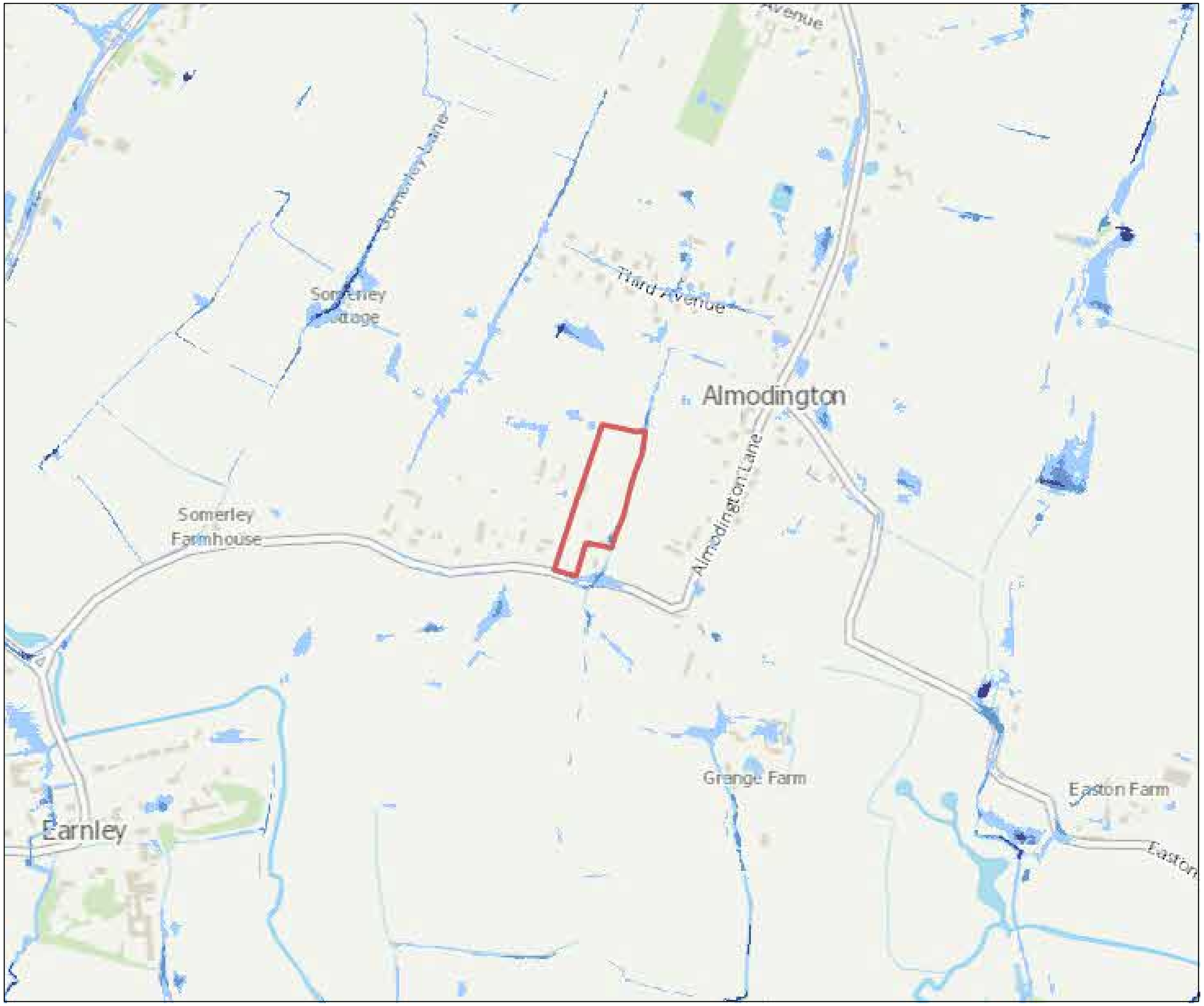
- Site_Boundary
- 0.1% AEP (Undefended Fluvial)
- 1% AEP (Undefended Fluvial)

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

Risk of flooding from Surface Water. Centred PO20 7JR. Created **13**/**03**/2020.



Environment Agency

1: 10,000

0 Metres 250

N E S W

Likelihood of flooding from Surface Water

- High (>=3.3%)
- Medium (3.3% - 1%)
- Low (1% - 01%)
- Very Low

Likelihood of flooding from Surface Water

High:	Greater than or equal to 3.3% (1 in 30) chance in any given year
Medium:	Less than 3.3% (1 in 30) but greater than or equal to 1% (1 in 100) chance in any given year
Low:	Less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1,000) chance in any given year
Very Low:	Less than 0.1% (1 in 1,000) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on GOV.UK.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). E-mail: enquires@environment-agency.gov.uk