

South Street, Bridport

Churchill Retirement Living

Flood Risk Assessment



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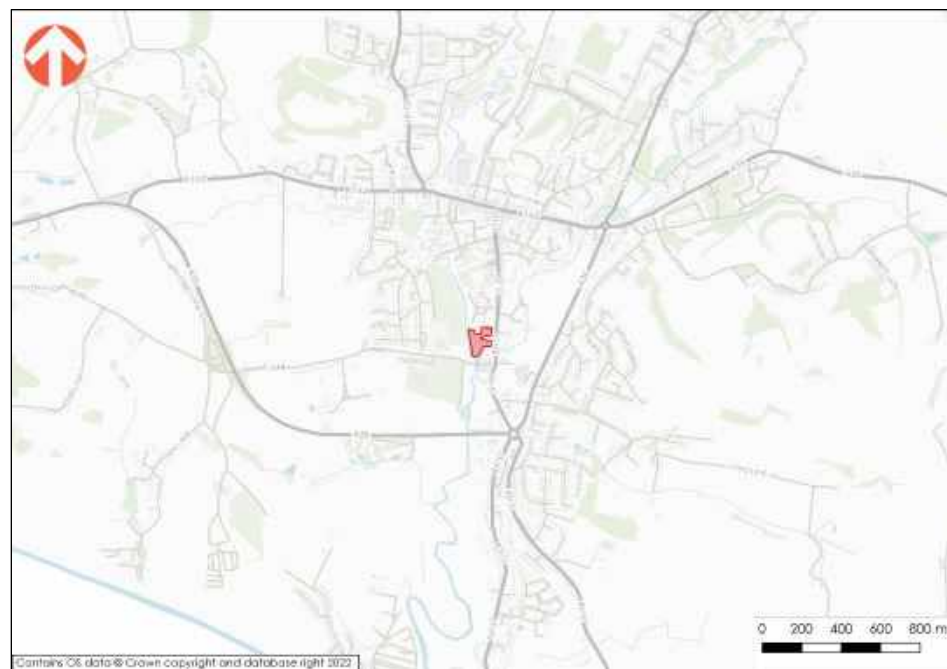
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1 Introduction

- 1.1 Awcock Ward Partnership (AWP) has been commissioned by Churchill Retirement Living to undertake a Flood Risk Assessment (FRA) in support of a detailed planning application, comprising 48 1 and 2 bedroom apartments and 25 cottages on the Hanson & Phillips builders' yard at South Street, Bridport.
- 1.2 The location of the proposed development in relation to the wider area is shown in Figure 1.1 below.

Figure 1.1 - Site Location – Wide Area



National Planning Policy Framework

- 1.3 The National Planning Policy Framework (NPPF) and the Planning Practice Guidance were most recently published by the Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government in December 2023 and February 2024 respectively.
- 1.4 The NPPF states (footnote 59) that *“A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage*

problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use."

- 1.5 The aim of a site-specific flood risk assessment is to 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"* (paragraph 170b, NPPF 2023).
- 1.6 Furthermore, the site-specific flood risk assessment must *"assess the flood risk to and from a development site ... The assessment should demonstrate to the decision-maker how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users"*, as required by the Planning Practice Guidance (*"Site-specific flood risk assessment"*, Paragraph: 020 Reference ID: 7-020-20220825, online).

Structure and limitations of this FRA

- 1.7 This site-specific FRA has been written in accordance with the guidance set by the NPPF and supplemented by the National Planning Practice Guidance, using the information that is currently available.
- 1.8 The report has been structured to describe the existing site parameters, the proposed development and to offer a surface water management plan (SWMP), indicating how surface water runoff can be managed so that it does not increase flood risk within the downstream catchment.

Reference

- 1.9 This FRA has been prepared by reference to the following documents:
- National Planning Policy Framework (December 2023);
 - National Planning Practice Guidance - Flood Risk and Coast Change(August 2022);
 - Environment Agency (EA) Flood Warning Information Service 'Flood Risk from Rivers or the Sea' and 'Flood Risk from Surface Water' (online);
 - Defra's Magic Map – Source Protection Zones (online);
 - Crossfield Consulting Desk Study Appraisal (Mar 2022);
 - CIRIA Guides 522 Sustainable Drainage Systems, 609 Surface Water Management and the Interim Code of Practice for SuDS (ICOP), 753 The SuDS Manual; and,
 - Wessex Water's (WW) Asset Records (received September 2022),
 - Environment Agency Product 4 data (Jan 2022) and
 - Environment Agency charged advice response (June 2022).

2 Existing Conditions

Context

- 2.1 The brownfield development site is located towards the south of Bridport town centre, directly west of South Street and South of Dr Roberts Close, as shown as Figure 2.1 below. The site has a National Grid Reference SY 46557 92308.

Figure 2.1 – Site Location – Local Area



Existing land uses

- 2.2 The existing site comprises of brownfield land in use as a builders yard with existing concrete/paviour surfaces, a commercial building/warehouse and existing stockpiled material and is located at the confluence of two rivers, the Brit and the Asker.
- 2.3 The site is surrounded by the following land uses:
- To the north of the site lies residential dwellings along Dr Roberts Close;
 - Land to the east of the site primarily comprises of commercial buildings and residential dwellings, fronting South Street;

- To the south-west of the site lies the River Brit, beyond which lies an existing school, sport facilities and open space; and,
- To the south-east of the site lies the River Asker with commercial properties beyond.

Topographic survey

- 2.4 A topographic survey was undertaken by D&H Surveys Ltd Dorset Land Surveying in June 2022 and shows that the site currently gains access from South Street to the east and Dr Roberts Close to the north. It confirms the site is generally level from East to West and broadly falls from North to South from an elevation of 6.6mAOD in the north to 4.8mAOD towards the south.
- 2.5 The topographic survey indicates the location of an existing boundary wall along the top of the river bank to the west, south-west and south of the site. The Environment Agency confirm that this wall forms part of the Bridport Flood Alleviation Scheme. There is an existing access through the wall which leads to the river bank at the confluence of the two rivers. This access is infilled with demountable stop-logs.
- 2.6 The product 4 data provided by the Environment Agency advises the top level of the stoplogs as 6.2mAOD, with the lowest level of the wall in the vicinity of the site being 6.19mAOD.
- 2.7 Topographic survey levels broadly agree with the EA levels, and indicate a lowest surveyed level of the top of this wall at 6.03mAOD.
- 2.8 In their charged advice response the EA have defined the requirements for stand-off and easement to the flood defence wall that forms that site boundary against the Rivers Brit and Asker. These requirements are considered in Section 3 of this report.
- 2.9 The topographic survey is included in Appendix A and EA product 4 data is included in Appendix B.

Existing Flood Risk

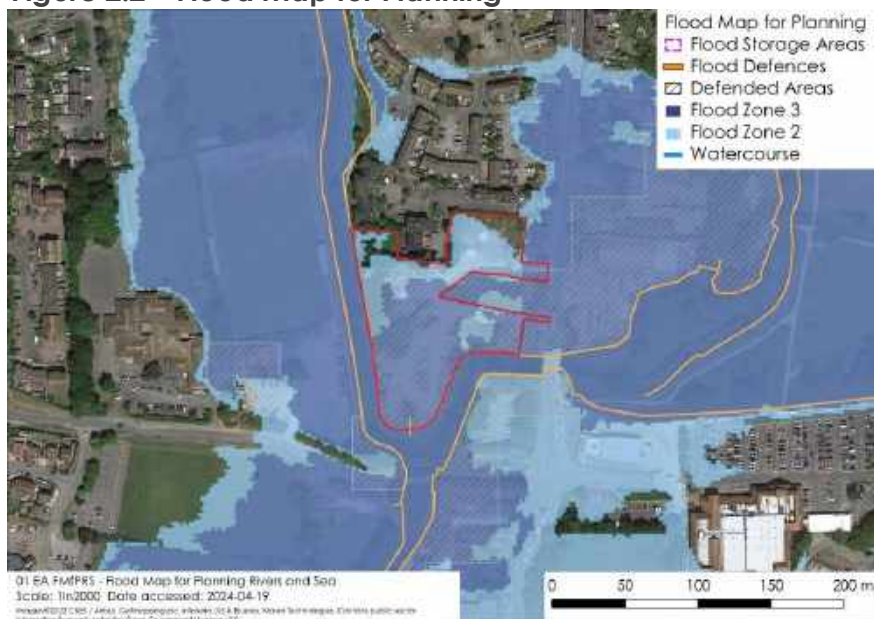
- 2.10 The Planning Practice Guidance requires planning applications for areas at risk of flooding, or sites of 1 hectare or more, to be accompanied by a site-specific flood risk assessment which assesses “flood risk”.
- 2.11 In accordance with Para. 001 of the Planning Practice Guidance, it is required that new developments consider flood risk as a ‘combination of the probability and the potential consequences of flooding from any sources... now or in the future’ including rivers and the sea, rainfall, rising groundwater, infrastructure and artificial sources.

- 2.12 Each potential source of flooding has been assessed below;

Fluvial sources (River flooding)

- 2.13 The EA's ‘Flood Warning Information Service’ provides flood risk information and mapping throughout England.
- 2.14 An extract of the ‘Flood Map for Planning’ has been reproduced as Figure 2.2 and shows that the majority of the site lies within ‘Flood Zone 2’ (0.1-1% annual probability of flooding) with a large proportion of this also included in ‘Flood Zone 3’ (1% probability of flooding). The site is shown as benefiting from flood defences and the EA product 4 data indicates that the Bridport Flood Alleviation Scheme has a 1 in100 year standard of protection.

Figure 2.2 – Flood Map for Planning



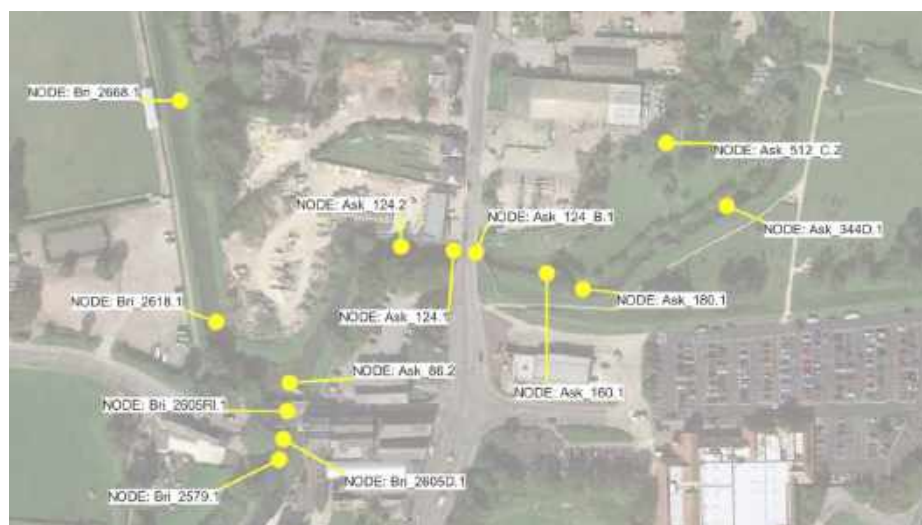
- 2.15 Figure 2.3 shows output from the defended 1in100 and 1in1000yr fluvial flood event model scenarios provided in the EA Product 4 data. It indicates the site is defended in the 1in100yr event, but continues to flood in the 1in1000yr flood scenario.

Figure 2.3 – Flood Extents in the defended 1in100 (green) and 1in1000 (purple) year fluvial flood events



- 2.16 The design flood event for the site is the 1in100 year flood event, plus climate change. The EA indicate the current allowance for climate change for fluvial flooding is 47%. Since the product 4 data climate change allowance is based on 30%, the EA have indicated that an intermediate analysis could be undertaken to determine a revised design flood level for the current 47% allowance.
- 2.17 The intermediate analysis is documented in Appendix C, and the results summarised in Table 2.1, based on flood levels data in the main river network, obtained from the EA Product 4 data (shared in Figure 2.4). The EA also provided peak levels within the site boundary from their 2D model of the flood plain and the same approach has been applied to calculate design flood levels for the 47% allowance.
- 2.18 The output of this analysis has determined an on-site site design flood level of 6.2mAOD.

Figure 2.4 Flood Level data location and node names



2.19 Table 2.1 – Summary of Intermediate Analysis

Location	1 in XXX	Defended	Un defended
Bri_2668.1	100	5.66	5.64
	100+30%CC	5.88	5.86
	100+47%CC	6.11	6.02
	1000	6.13	6.04
Bri_2618.1	100	5.43	5.41
	100+30%CC	5.71	5.66
	100+47%CC	5.87	5.81
	1000	5.99	5.88
Ask_86.2	100	5.35	5.34
	100+30%CC	5.62	5.59
	100+47%CC	5.78	5.73
	1000	5.91	5.81
Ask_124.2	100	5.49	5.47
	100+30%CC	5.76	5.71
	100+47%CC	5.87	5.87
	1000	6.06	5.92
Ask_124.1	100	5.59	5.57
	100+30%CC	5.88	5.81
	100+47%CC	5.99	5.96
	1000	6.19	5.99
Site	100	5.68	5.78
	100+30%CC	5.90	6.05
	100+47%CC	6.02	6.20
	1000	6.25	6.23

Pluvial sources (surface water flooding)

- 2.20 The EA's 'Flooding from Surface Water (Extents)' map has been reproduced as Figure 2.5 and shows the site being unimpacted by pluvial flooding.
- 2.21 In the 1in100 and 1in1000 year events, an area of isolated pooling is noted within the lozenge of land associated with the neighbouring residential properties to the east. Surface water is mapped impounded by the wall that partly surrounds the low spot on its downslope (southern and western) sides. Since the wall is retained and the surface water is not connected to wider off-site flow paths, the site is not considered to be directly impacted by surface water flooding.

Figure 2.5 – Flood Risk from Surface Water



- 2.22 The EA's mapping shows circa 150-300mm of surface water flooding can be expected in the 100 year return period flood within South Street, to the east of the site. This may impede vehicular access during flood events, however pedestrian connectivity could still be provided to South Street, south of the mapped flood extents.
- 2.23 It is important to note that the flood risk displayed across the width of South Street at the highway bridge over the River Asker on South

Street is likely an artefact in the data set with flow passing under the bridge, rather than in the highway.

Groundwater sources

The EA's Groundwater Flood Warning map for the local region identifies the site to be outside of any groundwater flood warning area. The EA check your long term flood risk website indicates the risk of flooding from groundwater is '*unlikely in this area.*'

Infrastructure (overwhelmed sewers or drainage systems)

- 2.24 There are no known on-site flood risks associated with infrastructure failure.

Artificial sources (Reservoirs, Canals & Lakes)

- 2.25 Areas at risk of flooding from reservoir failure is indicated in Figure 2.5. The site is identified as being within the maximum extent of flooding due to reservoir failure. If reservoir failure were to occur in combination with fluvial flooding events, the extent of flooding appears to be only marginally increased in very localised areas.

Figure 2.5 – Reservoir Flooding



- 2.26 It should be considered that, as the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency must

ensure that reservoirs are inspected regularly, and that essential safety work is carried out.

- 2.27 Reservoir flooding is extremely unlikely to occur and carries a significantly lower annual probability of failure than other sources of flooding.

Ground conditions

- 2.28 A desk study appraisal by Crossfield Consulting Geotechnical Environment concluded that the *“soakaways/infiltration drainage solutions will be precluded for the proposed development due to the existing ground conditions”*.
- 2.29 The desktop study recorded a groundwater level at circa 3m depth at the nearby brewery bore hole (approximately 50m from the site) close to the proposed brownfield development site, in which ground water is abstracted.
- 2.30 The Soilscape database (<http://www.landis.org.uk/soilscales/>) indicates the site is underlain by a natural wet soil, see Figure 3.4. The BGS database indicates the site is underlain by superficial deposits of variable sediment of mud, sand and gravel with some sand in places. The underlying bedrock geology is mapped as the Eype Clay Member - Siltstone and Limestone, interbedded.
- 2.31 A Phase 1 desktop study undertaken by Crossfield Consulting Ltd indicates that the area may have shallow groundwater and that the local surface and sub-surface water environment is potentially sensitive in relation to controlled waters. The local sensitivity and groundwater levels preclude infiltration as a method of surface water discharge, and an alternative basis of discharge should be considered.

Existing site drainage and drainage infrastructure

- 2.32 A CCTV survey of the site, carried out by Utilities Surveys Ltd in October 2022 indicates the site comprises existing stormwater outfalls to main river via headwalls located outside the flood defence wall, with flap valves fitted.
- 2.33 It is expected that surface water would pool in the lowest areas of the site and discharge via the existing connections. The lowest

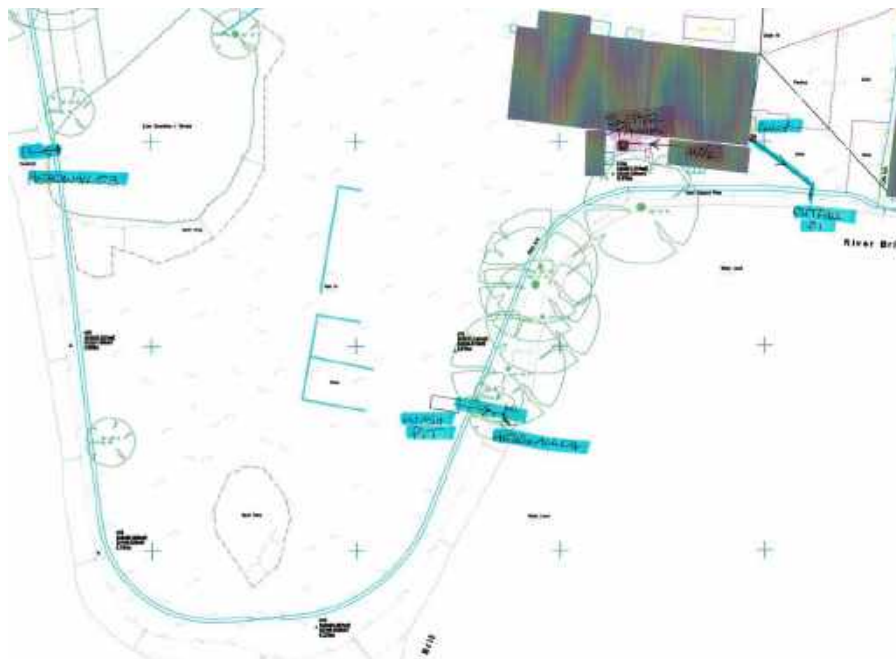
ground level on site is along the western edge of the site, local to an existing headwall.

- 2.34 Figure 2.6A and 2.6B show the outputs from the CCTV survey which is included in full, within Appendix D.

Figure 2.6A – Existing drainage (north)



Figure 2.6B – Existing drainage (south)



- 2.35 Wessex Water's (WW) existing asset records (Figure 2.7) identify a combined sewer overflow (CSO) crossing the site. Through liaison with WW it is understood that the CSO comprises an oval shape

brick sewer, with height 350mm and width 600mm. The sewer requires an easement of 4.0m to either side.

- 2.36 WW require 24 hour access to the pipe and outfall for the purposes of maintenance and repair. The proposed development should seek to respect the existing CSO and easement, to avoid any potential diversion. Two very minor areas of encroachment have been raised and agreed with WW.
- 2.37 Beyond the site boundary, there are strategic combined sewers to the east, and a foul sewer in Dr Roberts Close and local to 156 South Street.

Copies of WW's asset records can be found within Appendix E of this report and are extracted below in Figure 2.7.

Figure 2.7 – Wessex water mapping



3 Development Proposals

Introduction

- 3.1 The development proposals comprise 48 no. 1 and 2 bedroom retirement apartments and 25 cottages, together with access, parking, and landscaping and amenity space.
- 3.2 A copy of the proposed site layout can be found within Appendix F of this report.

Vulnerability

- 3.3 Dorset Council's Level 2 Strategic Flood Risk Assessment identifies the site as being within the extents of Functional Floodplain (Flood Zone 3b) however the technical note on their map acknowledges that the mapping assumes all Flood Zone 3 is shown as functional floodplain and therefore provides an overestimation. They note that functional floodplain would not ordinarily include areas of land that benefit from flood defences.
- 3.4 Figure 2.2 and Figure 2.3 indicate the site benefits from flood defences so this assessment considers that the site is not functional floodplain, and thereby remains defended Flood Zone 3a.

Consultation

- 3.5 The EA have provided guidance in meeting the requirements of the exception test for this site through their charged advice service. The advice covers the following areas discussed below;

Finished Floor Levels

- 3.6 Finished Floor Levels should be set relative to the 1 in 100 year event with a 47% allowance for climate change. Self-contained ground floor flats require a freeboard of 0.6m. For two storey dwellings a lower freeboard could be acceptable.

Climate Change

- 3.7 The 47% climate change could be estimated by taking the 'intermediate level' approach of using the existing modelled flood and flow data to construct a stage-discharge rating curve, which can be used to interpolate a flood level based on the required peak flow allowance to apply to the 'design flood' flow.

Floodplain Compensation

- 3.8 In accordance with internal EA guidance, floodplain compensation can be necessary in defended areas in some circumstances. In defended areas the need for compensation should be based on the results of a sensitivity test. The test can be assessed using the points discussed below.
- What increase in flood levels may result from development in the defended area if the defences were breached or overtopped?
 - What is the effect of this change, how much better or worse will flooding be to properties in particular?
 - Are the affects acceptable, and in reality, what mitigation measures can the developer implement to offset the impacts?
 - Compensation will be an appropriate solution if the principle of development in the area is in accordance with the NPPF.

Site Layout and Flood Alleviation Scheme

- 3.9 The EA have set out access requirements to the flood defence wall including the requirement to track an 8-wheel tipper and 22T long reach excavator up to, and beyond, the stoplogs in the south of the site. This is to be achieved by ensuring a suitable surface is available, and that a clear distance of 6m on straights and 8m at bends is achieved on the proposed route to the stoplogs.
- 3.10 The EA charged advice response is included in Appendix G, and the following sections describe how the development has addressed the EA charged advice response.

Maintenance Access

- 3.11 The site layout has been developed to provide the required minimum widths adjacent to the flood defence wall along the access route to the stoplogs in the south of the site. A 6m easement is provided in straight sections of the access and 8m is provided at bends. Within this area a hard surface suitable for access and turning is proposed.
- 3.12 A vehicular track drawing has been prepared and is included within Appendix J of this report.

Access, Egress and safe refuge

- 3.13 The site is located in Flood Zone 2 and 3, where flood depths in the 1in1000 year event will prevent safe access and egress to and from the site in extreme fluvial flood events.
- 3.14 To address residual flood risks related to access and egress in extreme events, the site must incorporate safe refuge and a Flood Warning and Emergency Plan (FWEP) to be activated during appropriate flood events.
- 3.15 The need to evacuate or seek 'safe refuge' will be based on the Floodline flood warning codes and will be set out in the site Flood Warning Emergency Plan.
- 3.16 It is anticipated that residents, visitors or staff will prioritise evacuation of the building (time permitting) or otherwise will seek safe refuge internally.
- 3.17 Where it is necessary to seek 'safe refuge', residents, visitors or staff should remain in the building, where all proposed FFL's will be set above the design flood level defined as the 1in100yr event plus 47% allowance for climate change.

Flood Warning

- 3.18 The EA operates a flood forecasting and warning service in areas at risk of flooding, known as "Floodline".
- 3.19 The service operates 24 hours a day, 365 days a year and is a free warning service that provides flood warnings directly by telephone, mobile, email, SMS text message and fax.
- 3.20 The proposed apartments must sign up for Floodline by calling 0845 988 1188 or by visiting the website: <https://www.gov.uk/sign-up-for-flood-warnings>
- 3.21 Once registered, warnings are issued using a set of four easily recognisable codes. It is important to know the anticipated lead time before a flood arrives. While flood warning codes provide approximate time ranges for anticipated floods, direct communication with Floodline, the emergency services or local flood warden is recommended and this should be promoted within a Flood Warning Emergency Plan (FWEP).

- 3.22 The FWEP will set out the proposed safe refuge protocol for the development, as detailed in the section on 'Access, egress and safe refuge'. FWEPs should include emergency contacts, details for Floodline, and will warn against entering floodwaters (unless engaging in a managed evacuation by emergency services).
- 3.23 The FWEP should advise residents to retain a 'flood kit' or 'grab bag' within the property. This might contain torches, batteries, first aid kits, blankets, non-perishable food stuffs and water.
- 3.24 It is recommended that the FWEP is conditioned and prepared and agreed with the LPA ahead of occupation.
- 3.25 The proposed mitigation measures (i.e. elevated finished floor levels, safe refuge and flood evacuation ensure the site remains safe throughout its lifetime, as required by Part (b) of the Exception Test.

Sequential Approach

- 3.26 The majority of the development is located within 'Flood Zone 2' with the southern half of the site located within defended 'Flood Zone 3a', therefore the site will need to pass both the sequential and exception tests.
- 3.27 The whole development is located within an area that benefits from defences and is defended to at least the 1 in 100yr event. In addition, the proposals have sought to place development in the areas of site at least risk of flooding in the 1in1000 year event, these being towards the north-east and along the northern aspect of the site.
- 3.28 The sequential approach has been undertaken in terms of the requirements for the delivery of a successful retirement living development which puts the end user of the development at the forefront by the proximity to a highly sustainable location and within walking distance of day-to-day services.
- 3.29 Residents would need to be 60 years old (or 55 for partners) to live within the development and the typical age of its residents in other schemes is 79. Residents are likely to have reduced mobility and walking long distances would be likely to prevent or at least dissuade use of local amenities.

- 3.30 Residents are less likely to own vehicles as set out with the Transport Statement. As such, easy access to public transport, services and facilities is essential and has a very real prospect of improving the quality of life of the likely residents and ensuring their ongoing independence and social cohesion.
- 3.31 There are no known sites available within Bridport that would suit the proposed land use and offer a reduced flood risk, especially when considering the current level of protection offered by the EA's flood defences.

Exception Test

- 3.32 The exception test looks to show that,
- (a) development that has to be in a flood risk area will provide wider sustainability benefits to the community that outweigh flood risk; and
 - (b) 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.
- 3.33 In terms of the Exception Test, this brownfield re-development would provide wider sustainability benefits to the community in providing specialist accommodation for older people in an area where there is a demonstrable need. Provision of such accommodation would also be likely to release other housing stock to the market which would assist in meeting the wider short-term housing need in the area, meeting the requirements of Part (a) of the exception test.
- 3.34 Part (b) of the exception test can be addressed by setting appropriate finished floor levels (FFLs) above the design flood level; implementing a FWEP; ensuring no loss of flood storage throughout the site, and through implementation of a suitable Surface Water Management Plan (SWMP), which limits peak rates of discharge from the site so flood risk within the downstream catchment is not increased.

Analysis to support Exception Test

- 3.35 To define FFLs and determine flood compensation requirements, levels determined from the intermediate analysis summarised in Section 2 have been used to determine water surface elevations

in the 1in100, 1in100+47%CC, and 1in1000 year flood events. The analysis is shared in Appendix H.

Cross Sections and Finished Levels

- 3.36 The water surface elevation for the 1in100yr+47%CC event in the defended and undefended scenarios have been used to determine FFLs in the vicinity of the proposed buildings, as visualised by Figure 3.1 below.

Figure 3.1 – Design flood levels at proposed buildings



- 3.37 The EA's charged advice indicates that apartments require a freeboard of 0.6m above design flood levels whereas a lower freeboard allowance could be applied to cottages with a second storey that offers safe refuge at first floor level.
- 3.38 The development proposes FFLs for the cottages are set at 6.4mAOD, and the FFL of the main apartment building is set at 6.7mAOD. These levels provide at least 0.3m and 0.6m of freeboard to the cottages and apartment buildings respectively.
- 3.39 The elevated FFLs are all indicated above the 1in1000yr defended and undefended flood levels for the site.

Flood Volume Compensation

- 3.40 The water surface elevation for the 1in100 and 1in1000 year defended and undefended scenario were used to calculate the volumes of water excluded by the proposed buildings and fill for related to ramps, stairs and gardens.
- 3.41 The site currently has both existing buildings and long-term stockpiles of material that currently occupy flood storage on the site. Therefore, a net value of the current and proposed volume of water excluded from the flood plain is used.
- 3.42 To compensate for volumes of storage lost in the floodplain, floodable sub-floor voids have been incorporated below the buildings 1,2 and 5 and their flat accesses (not ramps). An allowance of 15% of the volume beneath these areas is given over to structure and therefore not available for flood compensation.
- 3.43 Flood water will access the voids through external grills. The base of the void will be surfaced to prevent erosion or scour and to ease future maintenance.
- 3.44 A summary of the volumes obtained from this analysis are shown in Table 3.1.

3.45 Table 3.1 – Summary of flood volume compensation

	Feature	D1000	U1000	U100
Proposed Volume Lost (A)	Buildings, accesses, ramps, podia and landscaping.	2057.8	1769.3	614.8
Existing Volume Lost (B)	Stockpiles and existing buildings	617.8	534.9	186.8
Net Proposed Volume Lost (C)=(A-B)		1440.0	1234.4	428.0
Compensatory Volume Provided (D)	Voids under buildings and flat accesses (1,2 &5)	1496.7	1291.2	475.0
Volume Provided – Volume Required (D-C)		56.7	56.7	47.0

- 3.1 The analysis summarised in Table 3.1 indicates the volumes occupied by the proposed constructions on site can be fully compensated in the 1in1000 defended and 1in100 and 1in1000 undefended flood scenarios, and therefore the impact on the wider flood plain is neutral.
- 3.2 The site will be managed by Churchill Estate Management and therefore there will be an enhanced ability to ensure flood voids

beneath the proposed buildings are maintained, inspected and not re-purposed for storage or other uses. Therefore, the proposed flood compensation volumes are expected to operate as intended during the lifetime of the building.

Drainage strategy requirements

- 3.3 As required by the NPPF, the drainage strategy must demonstrate that the development will be safe throughout its lifetime, without increasing flood risk elsewhere, whilst also taking account of the impacts of climate change.
- 3.4 CIRIA C753 advises that surface water disposal should be prioritised in the following order;
1. Infiltration
 2. Discharge to surface waters
 3. Discharge to a surface water drainage system
 4. Discharge to a combined sewer
- 3.5 The existing ground conditions within the site preclude the use of soakaways. Instead, runoff will be attenuated on-site and discharges at the equivalent greenfield rates.
- 3.6 It is proposed to discharge surface water drainage to the confluence of the main rivers to the south of the site via an existing connection to the headwall in the south east of the site.
- 3.7 The proposed Surface Water Management Plan will implement surface water attenuation with a controlled pumped discharge and suitable exceedance runoff management to ensure downstream flood risk is not increased and the site remains safe throughout its lifetime.

Climate change impacts

- 3.8 The NPPF requires that the impact of climate change be considered to minimise vulnerability and provide resilience. The NPPF and Planning Practice Guidance explain that an FRA should demonstrate how flood risk will be managed across the development's lifetime, taking climate change into account.

- 3.9 The Environment Agency, as the government's expert on flood risk, released revised climate change allowances on the Hydrology Data Explorer in 2022.
- 3.10 Table 3.1 provides an extract detailing the increase in peak rainfall intensity due to climate change over the next 100 years.
- 3.11 The guidance states for peak rainfall intensity, Flood Risk Assessments should "assess both the central and upper end allowances to understand the range of impact".

Table 3.1 – Peak rainfall intensity allowances (Devon Management Catchment)

Allowance category	Total potential change anticipated for (2050 epoch)	Total potential change anticipated for (2070 epoch)
Upper end (90 th Percentile)	40%	45%
Central (50 th Percentile)	25%	25%

The on-site attenuation for this proposed development has been sized to offer flood protection for the development and its downstream catchment throughout its lifetime, with the upper end allowance of 45% being used to present a worst-case scenario.

In terms of River flows the EA have indicated that the climate change addition for fluvial flooding is 47%.

Summary

- 3.12 The proposals and analysis demonstrate that the development can be made safe from fluvial flooding for its lifetime; including the indicated allowance for climate change and the EA guidance on freeboard allowances for apartments and cottages.
- 3.13 In addition, the analysis of flood compensation volumes achievable on site indicate the development is expected to have a neutral effect on flood storage volumes on the site.
- 3.14 The development proposals have made allowance for the required clear distances and easements to enable the EA to continue to maintain the flood defence wall in perpetuity.

4 Surface Water Management Plan

Existing surface water runoff

- 4.1 The existing drainage regime represents that of brownfield site, with some surface water runoff soaking into the underlying strata where unbound surfacing might allow, and the remainder following the natural topography of the site. It is expected that discharges to the bounding rivers might occur where drainage connections to external headwalls outside the flood wall might allow, otherwise excess flow would impound within the site.
- 4.2 Causeway FLOW has been used to assess the equivalent greenfield runoff rates for the existing site using the FEH statistical methodology. Brownfield discharge rates from the site have been calculated using the Modified Rational Method.
- 4.3 A copy of the equivalent greenfield and brownfield runoff assessments have been included within Appendix I of this report, with the results summarised in Table 4.1 below;

Table 4.1 – Existing Runoff Rates 0.703ha (l/s)

Return Period	Equivalent Greenfield runoff (l/s) 0.703ha	Existing Brownfield runoff (l/s) 0.78 ha
2 years	1.8	82.4
30 years	5.0	224.8
100 years	6.6	298.8

- 4.4 To ensure the development will be safe throughout its lifetime and that it does not increase flood risk elsewhere, the drainage strategy will include appropriate mitigation measures, so that the greenfield runoff rates stated within Table 4.1 are not increased.

Surface Water Management Plan

- 4.5 To ensure the development is safe throughout its lifetime, the surface water strategy accounts for runoff in up to the 100 year return period.
- 4.6 The strategy safeguards against the upper end allowances for climate change (45%), providing betterment over undeveloped conditions, where the rate and volume of runoff would continue to increase due to climate change.

- 4.7 Runoff generated by the development is unable to discharge via infiltration due to unfavourable ground conditions, so will instead be attenuated to greenfield rates and discharged to the main river via existing on-site surface water drainage connections to the existing headwall outside the flood defence wall.
- 4.8 Runoff generated by the roofs of the proposed development will route through a new private surface water network towards below ground cellular attenuation tanks.
- 4.9 Flows from hardstanding and parking will receive treatment from areas of under-drained permeable paving, prior to discharge to the cellular attenuation tanks. The storage volume in the sub-base of the permeable paving also contributes to attenuation storage.
- 4.10 Flows will be attenuated within the site, prior to discharging via two separate surface water pumps. The first pump will engage at the 1in2 year greenfield rate, the second pump will engage in the 1in30 year return period and will 'top-up' the discharge to the 1in30 year greenfield rate. No further increase in discharge rate will occur beyond the 1in30 year return period, offering additional betterment over existing conditions, where there is no attenuation storage, no allowance for climate change and no flow controls.
- 4.11 The proposed surface water arrangements can be seen on drawings 1348-01-PDL-1001 within Appendix J of this report.

Water Quality Management

- 4.12 In line with the pollution indices set out in CIRIA SuDS Manual (C753) the scheme is required to provide 'SuDS component features' which have a 'total SuDS mitigation index' greater than or equal to the 'pollution hazard index'.
- 4.13 Table 4.2 outlines the pollution hazard indices required for the proposed land use at this site, taken from Table 26.2 of C753 as summarised below;

"Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. <300 traffic movements/day."

Table 4.2 – Pollution Hazard Indices (Ref. C753 Table 26.2)

Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Low	0.5	0.4	0.4

- 4.1 The SuDS components proposed for the site and their relevant 'mitigation indices' are identified within Table 4.3.

4.2 Table 4.3 – SuDS Mitigation Indices

SuDS Component	Total Suspended Solids	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7

- 4.3 Table 4.3 demonstrates that the 'SuDS mitigation index' for the features would be greater than the 'pollution hazard index', and therefore provides a robust level of water quality management, capable of mitigating the site's pollution hazard level.
- 4.4 Development of the site results in a net increase in green amenity space in place of its current brownfield character. Overall, the development, including its proposed drainage arrangements, results in increased amenity value and offers an increase in habitats resulting in an increase in biodiversity.

Attenuation storage volumes

- 4.5 Causeway FLOW has been used to determine the storage requirements for the development. This includes attenuation features sized to accommodate runoff in up to the 100 year return period, with allowances for climate change.
- 4.6 The attenuation requirements for this scheme do not consider Long Term Storage, owing to the existing impermeable (brownfield) nature of the site and overall reduction in drainage catchment and runoff volume.
- 4.7 The proposed development comprises a single building of apartments. Property deeds will prevent residents from implementing any works that would increase the drainage

catchment (patio or property extensions), hence no allowance has been made for urban creep.

- 4.8** The output of this exercise can be found within Appendix K of this report, with the results summarised in Table 4.4.

Table 4.4 – Attenuation Storage Volumes

Feature	100yr + 45% Vol. (m ³)
Geocellular Storage Tanks	422.4
Permeable Paving	76.9
Total	499.3

- 4.9 Drawing 1348-01-PDL-1001 identifies the surface water management plan for the scheme, with copies included in Appendix J of this report.

Exceedance events

- 4.10 During exceedance events beyond the 100 year return period storm, runoff will overflow from the aforementioned systems and away from primary access and egress routes, towards areas of open green space in the southern part of the site.
- 4.11 The lowest part of the site occurs on the western boundary local to an existing headwall. The existing discharge arrangement for overland flow in this location will be retained, or a new drainage connection for surface water that is independent of the main surface water drainage network will be provided. This connection will have a flap valve to prevent flood water flowing into the site during fluvial flood events, exceedance flows will be able to leave the site when there is a free discharge available on the outside of the flood defence wall.
- 4.12 It is not expected that exceedance flows could threaten any FFLs of the buildings under any likely exceedance scenario.

Proposed foul water strategy

- 4.13 In terms of wastewater connections, the developer is entitled to make a connection to the nearest practical point on the network

where the existing sewer is at least the same diameter as the new sewer required to provide capacity for the development.

- 4.14 Under the provisions of the Water Industry Act 1992 (as amended), the developer will need to pay the sewerage undertaker the published sewer connection charges and infrastructure charge per dwelling, and the sewerage undertaker is responsible for any network reinforcement.
- 4.15 A point of connection enquiry with Wessex Water has identified an in principle point of connection for a pumped foul discharge to the strategic 750mm diameter combined sewer in South Street.
- 4.16 The proposed foul water drainage arrangements can be seen identified on the preliminary drainage layout drawing 1348-01-PDL-1001 included within Appendix J of this report, whilst copies of our correspondence with WW are included within Appendix E.

Maintenance

- 4.17 Any private drainage will be designed in accordance with Building Regulations Part H and will become the responsibility of the appointed management company, Churchill Estates Management.
- 4.18 The operation and maintenance of the private SuDS features will be undertaken in accordance with 'CIRIA C753 – The SuDS Manual, Chapter 32 – Operation and Maintenance', and any manufacturers recommendations and guidance,
- 4.19 At the design stage a 'Drainage Maintenance Plan' should be prepared. The Plan will set out maintenance tasks, responsibilities and frequencies for the entire drainage network.
- 4.20 The proposals make the necessary allowances required by the EA for their maintenance of the flood defence wall as set out in their charged advice.

5 Mitigation, Conclusions and Recommendations

Mitigation

- 5.1 The proposed development has been assessed in line with the NPPF, to allow the planning application to be progressed and to show that the development can be undertaken in an acceptable manner from a flood risk perspective.
- 5.2 The extents of built development are located with Flood Zone 2/3 and located within an area at risk of reservoir flooding.
- 5.3 The site is not susceptible to flooding from pluvial and groundwater flooding, and not thought to at risk of flooding from drainage infrastructure or other non-reservoir artificial sources.
- 5.4 Finished floor levels have been calculated from data provided by the EA in a product 4 data request. FFLs provide a freeboard of at least 600mm for apartments and 300mm to for cottages.
- 5.5 The effects of the development on flood volume compensation have been determined and with the inclusion of flooded sub-voids the effects of the development on the wider flood plain are expected to be neutral.
- 5.6 To ensure the development is safe throughout its lifetime, the surface water strategy accounts for runoff in up to the 100 year return period.
- 5.7 The strategy also safeguards against the upper end allowances for climate change (45%), providing betterment over undeveloped conditions, where the rate and volume of runoff would continue to increase due to climate change.
- 5.8 Ground conditions precluded the use of soakaways so an attenuated discharge to the main river confluence is proposed.
- 5.9 The use of SuDS attenuation will enable storm water runoff to be stored on site and discharged to the existing main river, at rates not exceeding the 1in30yr equivalent greenfield rate, with allowances for climate change. The SuDS will also provide water quality enhancement, and the site as a whole increases biodiversity and provides amenity benefits.

- 5.10 During exceedance events runoff will be directed towards areas of open green space and the proposed attenuation features, where any surplus storage volume can be utilised. Exceedance flows would not threaten FFLs in any likely scenario and can be discharged to the watercourse via existing site connections protected with flap valves.
- 5.11 Foul flows generated by the development will benefit from a pumped connection to the existing on-site public foul network.

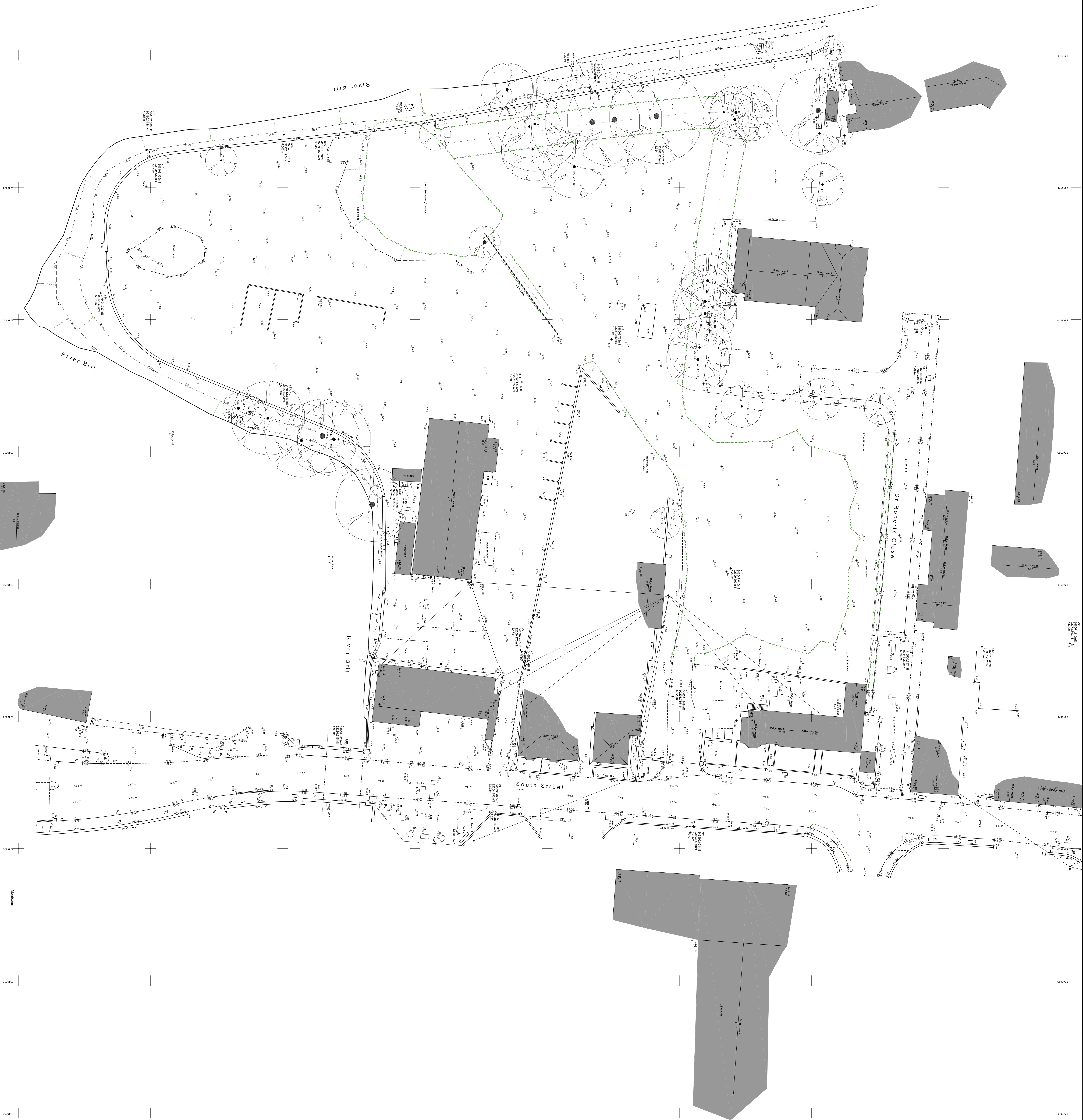
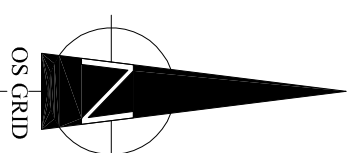
Conclusions

- 5.12 This Flood Risk Assessment has been assessed in line with the NPPF. It is concluded that the development can be undertaken in a sustainable manner, whilst also reducing the flood risk to existing properties in the downstream catchment.

Recommendations

- 5.13 As demonstrated, the development will be safe from flooding throughout its lifetime and will actively reduce flood risk to properties within the downstream path of the southern catchment. There are therefore no grounds for objections, and we trust that the Lead Local Flood Authority and Environment Agency will confirm this to the local planning authority accordingly.

Appendix A Topographic Survey

[illegible]

Appendix B EA Product 4 Data

Verity Saunders

From: Wessex Enquiries <WessexEnquiries@environment-agency.gov.uk>
Sent: 01 February 2022 11:38
To: Chris Yalden
Subject: FW: COMPLETE RE: 247049 WX: Product 4 Data Request - Land at South Street, Bridport (DT6 3NP)
Attachments: 247049 WX- Asset location map.pdf; 247049 WX- New Defended Modelled Fluvial Flood Outlines.pdf; 247049 WX- New Undefended Modelled Fluvial Flood Outlines.pdf; 247049 WX- Node Location Map.pdf; 247049 WX- Site Boundary Map.pdf; Use of Environment Agency Information for Flood Risk Assessments.pdf; 247049-WX node data.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

247049 WX

Dear Chris

Thank you for your enquiry. We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

Please note:

Our team inform that the flood depth maps requested will follow. They have to copy the depths off of the hard drive and produce the depth maps for you.

Please refer to [Open Government Licence](#) which explains the permitted use of this information.

Abstract

Name	Product 4
Description	Flood Risk Information for land at Hanson & Phillips Depot, South St, Bridport, DT6 3NP. Grid Reference: SY 46500 92280
Licence	Open Government Licence
Information Warnings	<i>The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply.</i>
Attribution	Contains Environment Agency information © Environment Agency and/or database rights. Contains Ordnance Survey data © Crown copyright 2020 Ordnance Survey 100024198.

Open data

The following Environment Agency published datasets are now available on the weblink below as part of the Government's 'Open Data' project and are available for you to download free of charge.

Environment Agency published datasets: <https://data.gov.uk/data/search?publisher=environment-agency&unpublished=false>

You will need to search and select the name of the following datasets to take you directly to the weblink to enable you to download the data:

- Flood Map for Planning (Rivers and the Sea) – Flood Zones 2 and 3
- Flood Map for Planning (Rives and Sea) – Areas Benefiting from Defences
- Flood Map for Planning (Rivers and Sea) Spatial Flood Defences
- Flood Map for Planning (Rivers and Sea) Flood Storage Areas

- Recorded Flood Outlines
- Historic Flood Map
- Risk of Flooding from Surface Water Extent for:
 - 3 percent annual chance
 - 1 percent annual chance
 - 0.5 percent annual chance

You can also access the **current** Flood Map for Planning here: <https://flood-map-for-planning.service.gov.uk/> **Please note: The Flood Map for Planning for this area will be updated in the next month.**

You can also access the Risk of Flooding from Surface Water maps and Risk of Flooding from Reservoirs information here: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>

Recorded Historic Flood Events

Historic records indicate that there was flooding in the area in 1929 (unconfirmed source), 1955 (unconfirmed source), 1979 (fluvial), 1998 (fluvial), 2003 (fluvial) 2007 (surface water, drainage) and 2012 (local drainage, foul drainage, fluvial, surface water, unconfirmed source)

We also hold records of high river levels on the River Brit in 2004 and 2008.

Please note: we cannot guarantee that this is an exhaustive list of all past flood events in this location. All reasonable care has been taken to ensure that the historical flood event data is as accurate as possible. The Environment Agency will update it's records if new evidence emerges.

Please contact the Lead Local Flood Authority – Dorset Council to see if they can provide any further information about local flood issues in the area, such as from surface water runoff and groundwater flooding.

Modelled Fluvial Water Levels

The attached map contains a set of modelled (within the river channel) fluvial flood level node locations/unique identifiers, for the River Brit and the River Asker. The modelled data is taken from the Bridport Model Enhancement 2020 model. A sheet is also attached providing the associated flood levels, flood flows if available and NGRs relating to each of these nodes.

Please note: Modelled water levels and flows are in channel values only. There may be a variation in water levels and flows across the flood plain in the 2D domain.

2D Modelled Flood Plain Water Levels

Please see below for maximum 2D level information for your site for a range of return periods. This information is taken from the Bridport Model Enhancement 2020 model.

Maximum 2D modelled water levels for the investigation area:

Undefended:

Undefended Levels

1% AEP (100yr) undefended: **5.78 mAOD**

1% AEP (100yr) with 30% increase in flow - undefended: **6.05 mAOD**

0.1% AEP (1000yr) undefended: **6.23 mAOD**

Defended:

Defended Levels

1% AEP (100yr) defended: **5.68 mAOD**

1% AEP (100yr) with 30% increase in flow - defended: **5.90 mAOD**

0.1% AEP (1000yr) defended: **6.25 mAOD**

N.B. Levels and depths have been extracted based upon the site boundary plan provided. Please see the attached site boundary map which outlines the shapefile drawn to calculate the 2D levels.

For more information on climate change allowances please see the guidance on the Gov.UK website here: [Flood risk assessments: climate change allowances - GOV.UK](#). Please be aware that we will soon be updating the peak river flow climate change allowances given in this link.

New Fluvial Model Flood Outlines

We have also supplied you with a map showing the new 1% and 0.1% AEP fluvial flood outlines for Bridport for both the Undefended and Defended Scenarios.

The new undefended outlines and Areas Benefitting from Defences will be published in the Flood Map for Planning (Rivers & Sea) this month.

Environmental Permit for Flood Risk Activities

In addition to any other permission(s) that you may have already obtained e.g. planning permission, you may need an environmental permit for flood risk activities (formerly known as Flood Defence Consent prior to 06 April 2016) if you want to do work:

- in, under, over or near a main river (including where the river is in a culvert)
- on or near a flood defence on a main river
- in the flood plain of a main river
- on or near a sea defence

For further information and to check whether a permit is required please visit: <https://www.gov.uk/guidance/flood-risk-activities-environmental-permits>.

For any further advice, please email Blandford.frap@environment-agency.gov.uk.

Flood Asset Information

The area benefits from the Bridport Flood Alleviation Scheme, designed to the 1:100 year standard. The stoplogs are for access to the watercourse and are kept in-situ. The crest level data below is from topographic survey so has an accuracy of +/-5mm. We have no specific concerns regarding the condition of any of the assets present.

Asset ID	Upstream crest level (mAOD)	Downstream crest level (mAOD)	Condition Grade	Info
57497	6.64	6.2	3 - fair	EA Floodwall
122173	6.19	6.19	3 - fair	EA Floodwall
53	6.24	6.23	2 - good	EA Sheet Piling
135151	6.23	6.23	3 - fair	EA Floodwall
328120	6.2	6.2	2 - good	EA stoplogs

Please note that flood defences can increase water levels elsewhere eg through channels being restricted by defences, or because defences prevent flood water flowing back into the river channel.

Planning

If you have questions regarding the planning nature of your enquiry, or require advice on floor levels, please contact our Sustainable Places team on SWX.SP@environment-agency.gov.uk. Please be aware that we now charge for planning advice when consulted on pre-application enquiries. This new approach provides advice to developers in two ways. Firstly there is the provision of 'free' advice available to everyone where we give a preliminary opinion on a proposed development. This sets out the environmental constraints together with any issues this raises for us. Should you wish us to review in detail any of these issues then we can do this through a chargeable scheme aimed at recovering our costs.

Strategic Flood Risk Assessment (SFRA)

Please contact Dorset Council for an update on their Strategic Flood Risk Assessment in your area of interest.

Further Information

We advise that you also contact the Flood Risk Management Department at **Dorset Council** as they may be able to provide further advice with regard to localised flooding and drainage issues.

Further details about the Environment Agency information supplied can be found on our website:

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

We hope you find this information helpful and it is provided subject to the attached notice 'Use of Environment Agency Information for Flood Risk Assessments', which we strongly recommend you read.

Regards

Corinne

Corinne Moyse

Environment Agency, Wessex Enquiries, Customer & Engagement Team

02030 250 376 - Wessex Enquiries

Working from home: [REDACTED]

From: Chris Yalden [REDACTED]

Sent: 05 January 2022 16:10

To: Wessex Enquiries <WessexEnquiries@environment-agency.gov.uk>

Subject: 247049 WX: Product 4 Data Request - Land at South Street, Bridport (DT6 3NP)

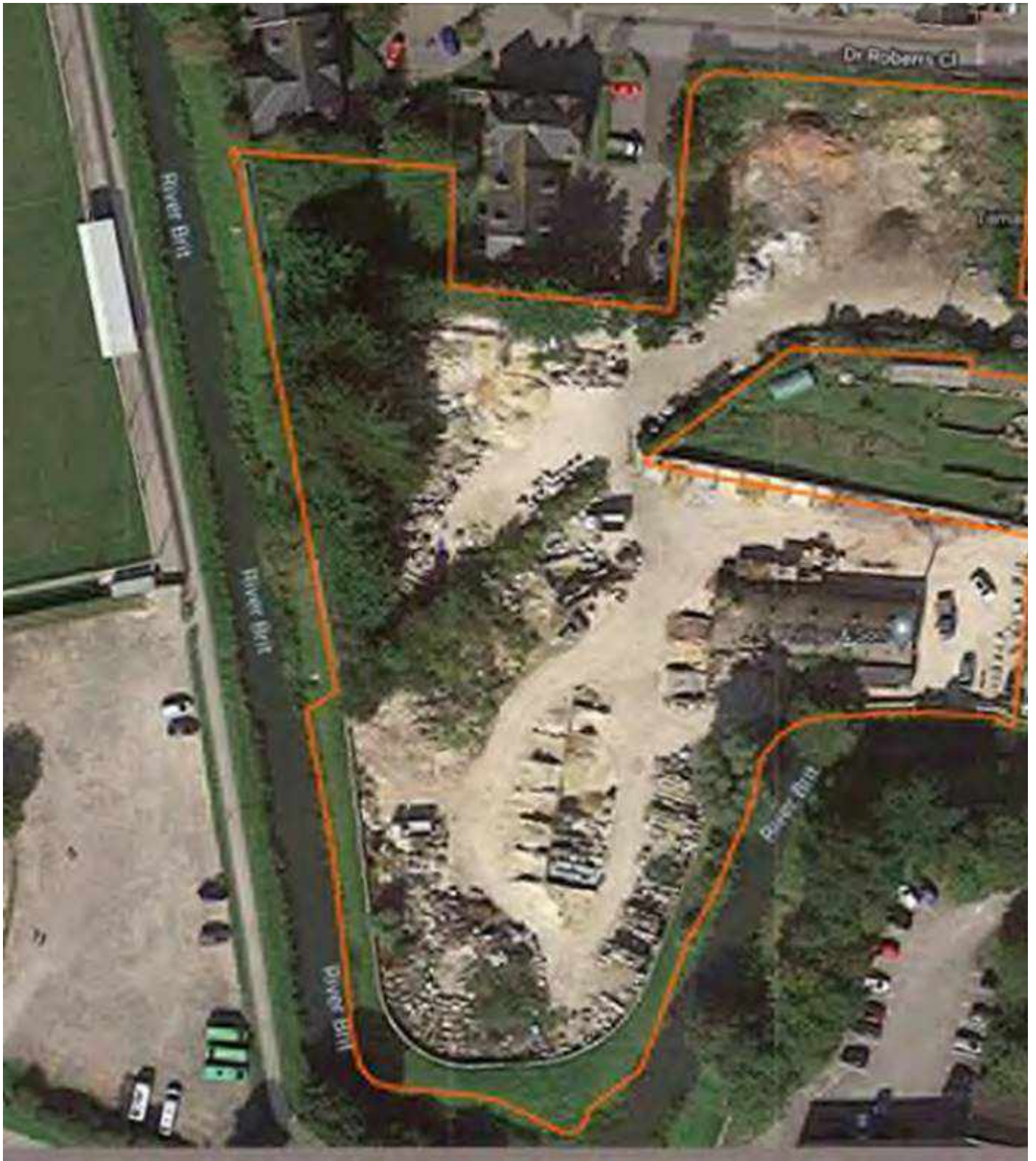
Dear Recipient,

Please can you provide copies of your Product 4 flood information for below site location at South Street, Bridport (DT6 3NP).

We trust the Product 4 information would typically include any node and flood level information for the nearby River Brit, together with flood depth grid maps.

We would also like to receive separate copies of the fluvial and tidal flood maps and where available, please include both defended and undefended scenarios and any additional maps which include climate change allowances.

Please let me know if you require any further information to assist in this enquiry, otherwise we look forward to hearing from you in due course.



Best Regards,

Chris Yalden
 Technical Director
 IEng, MICE



Ada House, Pynes Hill, Exeter EX2 5TU

Mobile: [REDACTED]
email: chris.yalden@awpexeter.com
web: www.awpexeter.com

AWP is a regional engineering consultancy providing development planning and infrastructure services to developers and house builders across the south west.

From: Laura Baker <Laura.Baker@planningissues.co.uk>
Sent: 04 January 2022 12:04
To: Chris Yalden <Chris.Yalden@awpexeter.com>
Subject: CRL Potential site - Bridport

Hi Chris.

We have a site that we are looking at in Bridport. It's a peculiar shape and is bound on 2 sides by a River and is in Flood Zones 2 and 3, but the bank also has flood defences.

Due to its strange shape the developable space is quite limited so we would likely be looking at cottages in the northern half with the apartment block to the south.

There are also a number of heritage constraints which limits storey heights. It would be really helpful if you could give us some guidance on what you think the FFL would need to be and if there is any benefit from the flood defence... ie can we have apartments on the ground floor?

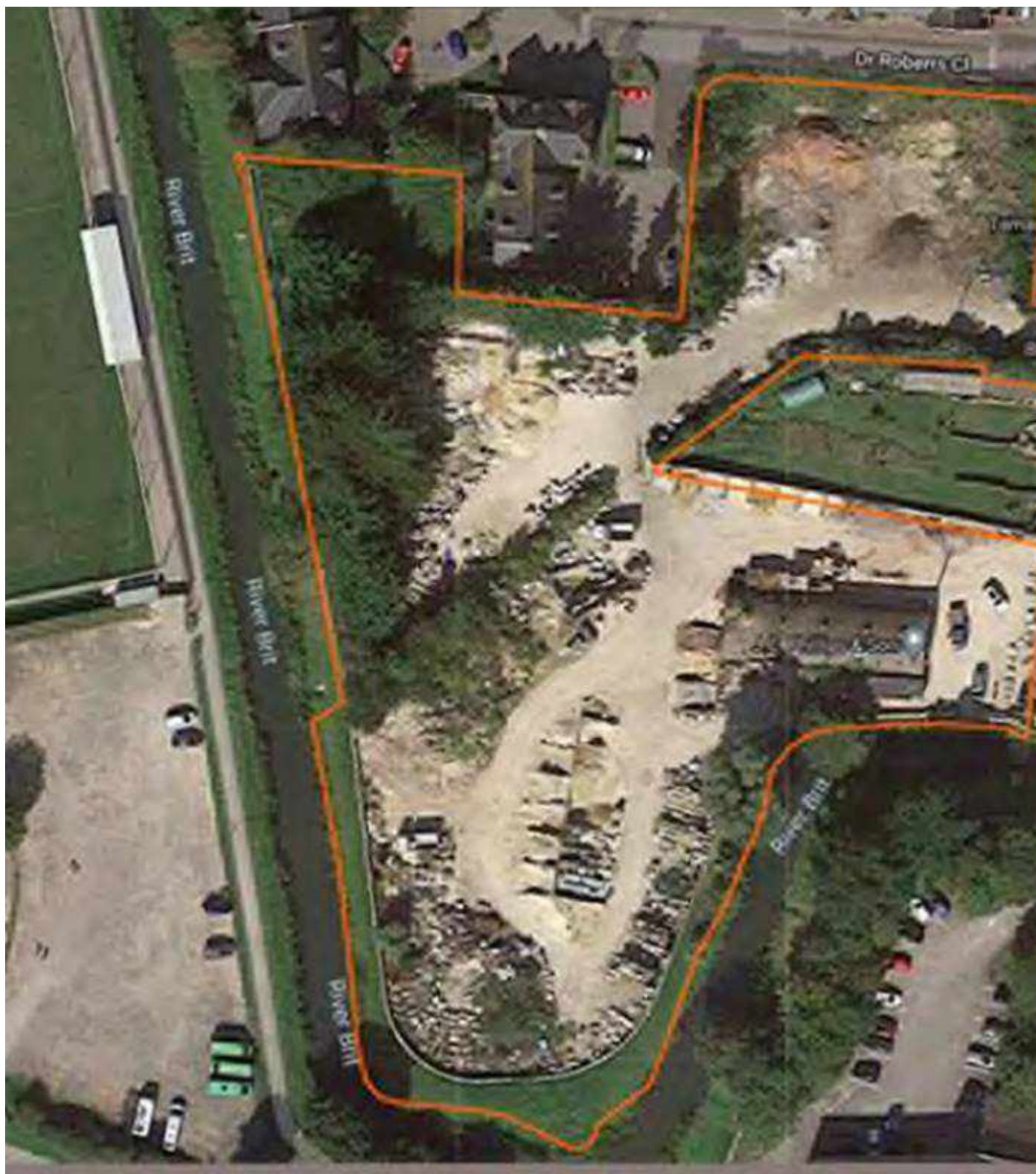
The site address is: Hanson & Phillips Depot, South St, Bridport, DT6 3NP

I'd be really grateful if you could assist.

Kind regards

Laura –

Site Plan below:



Laura Baker - MRTPI
Associate Director

Planning Issues Ltd
Churchill House
Parkside
Ringwood
BH24 3SG
Tel: 01425 462140
Mob: [REDACTED]
www.planningissues.co.uk



Churchill House, Parkside, Ringwood, Hampshire, BH24 3SG. Tel: 01425 462100 Fax: 01425 462101

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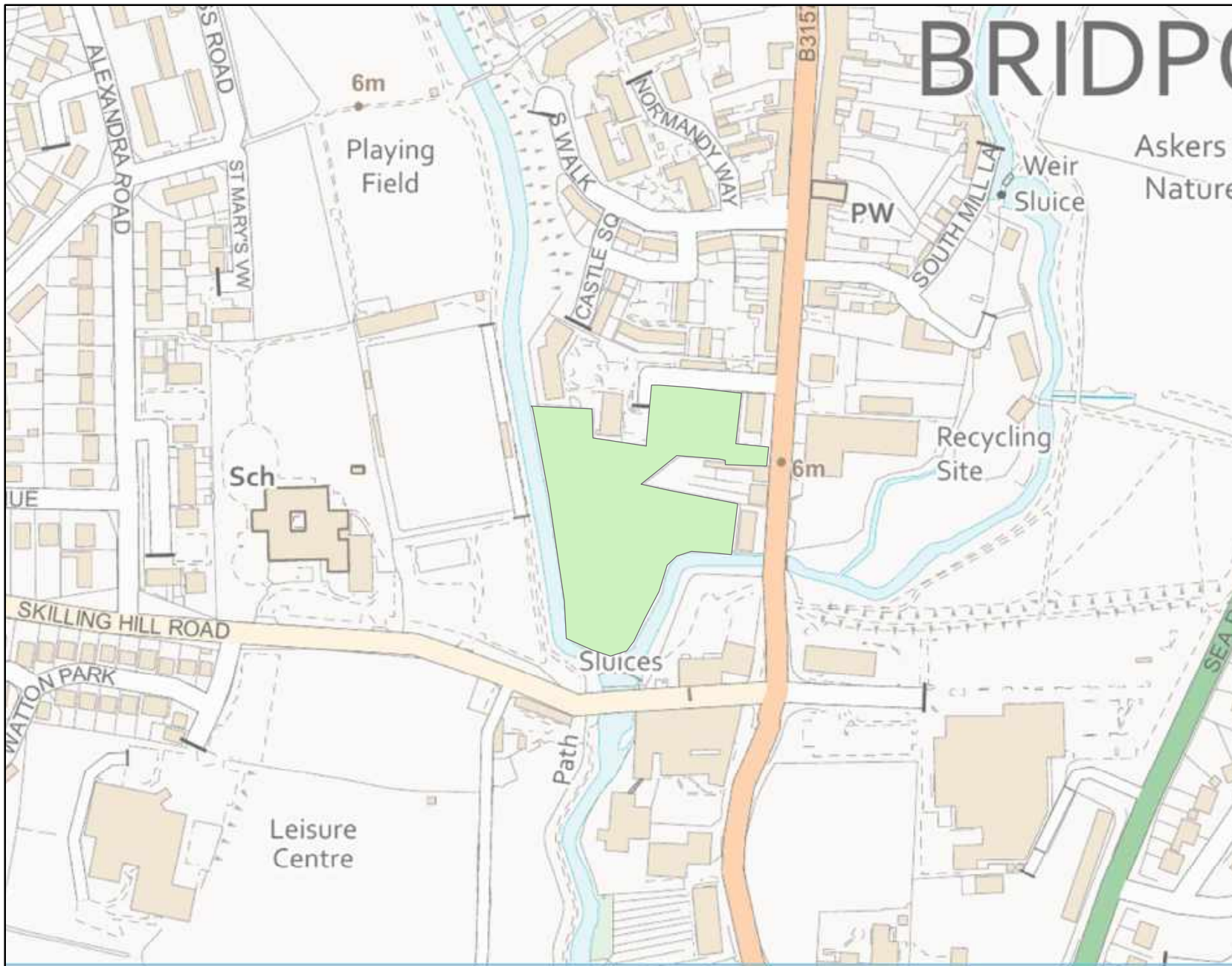
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247049 WX- Map to Show the Site Boundary Used to Calculate the 2D Levels- Created 28.01.2022



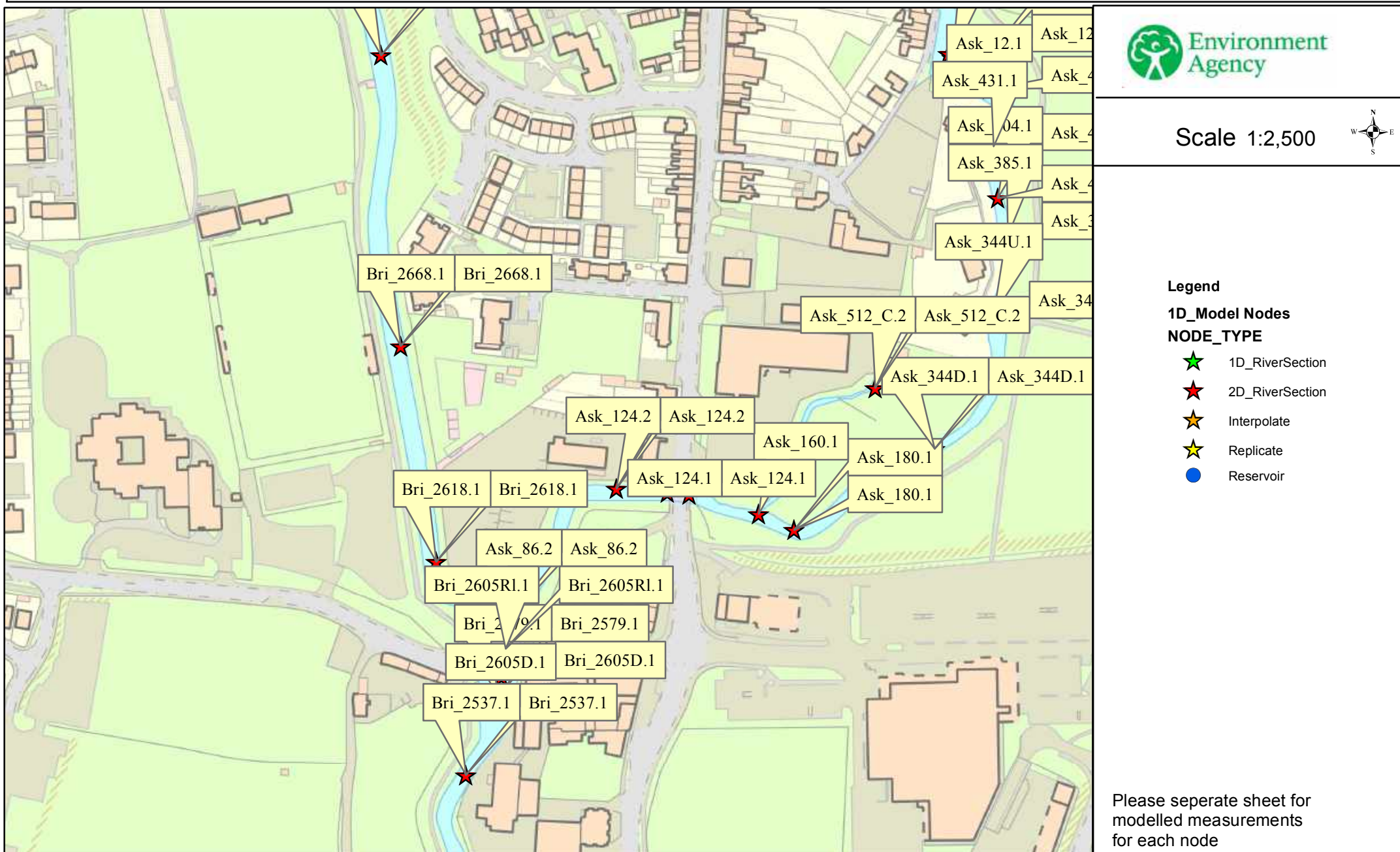
Scale 1:3,300



Legend

 Site_Boundary

247049 WX- Map to Show Model Node Locations- Bridport, DT6 3NP- Created 26.01.2022



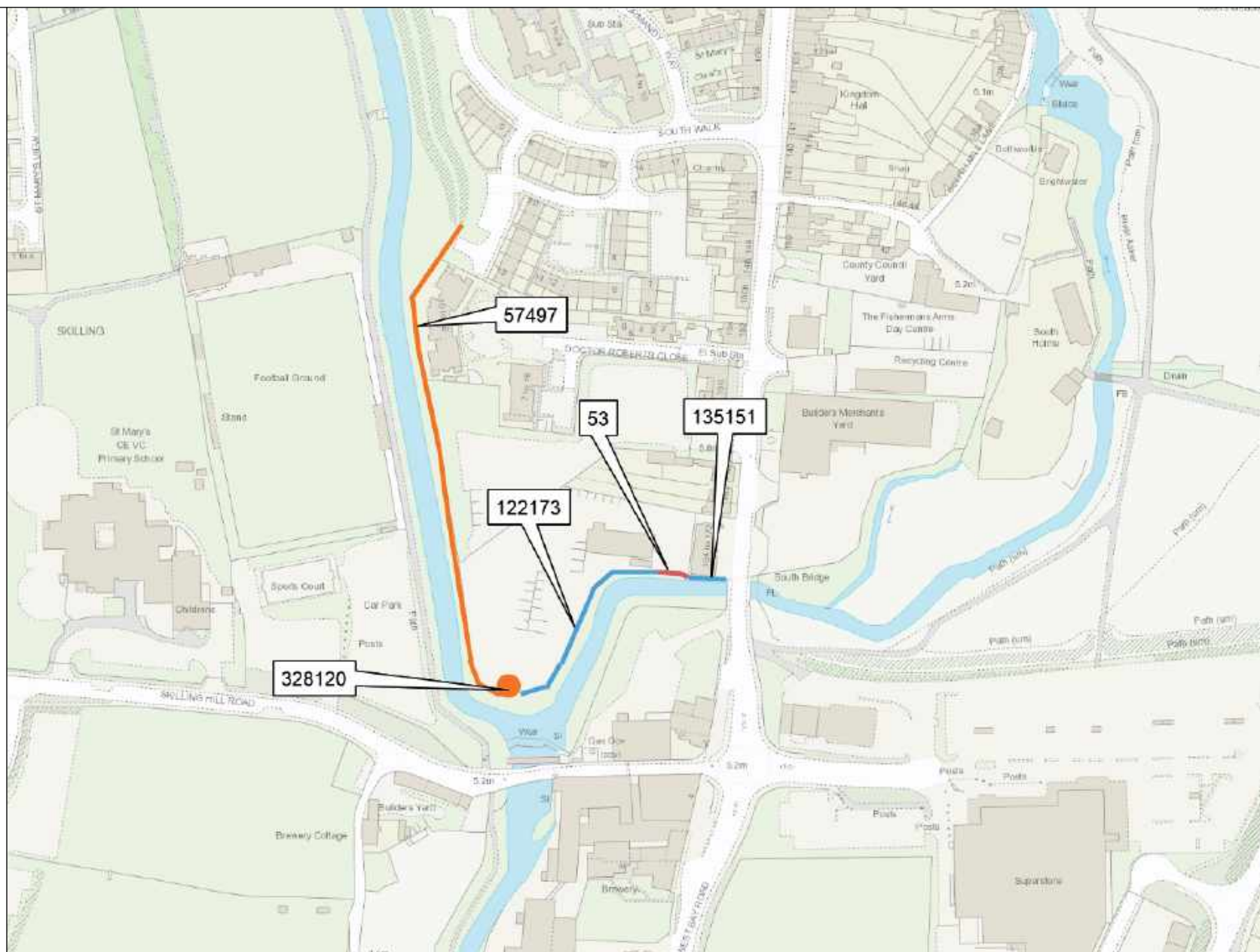
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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Title

Legend

Please see page 2 for asset
symbology



1: 2,500

0 62
Metres



Point Structures

-  Borehole
-  Central Pier
-  Control Gate
-  Debris Screen
-  Draw Off Tower
-  Fish or Eel Barrier
-  Fish Pass
-  Inspection Chamber
-  Outfall
-  Ramp
-  Security Screen
-  Slipway
-  Steps
-  Stilling Basin
-  Vortex Flow Control

Linear Structures

-  Debris Boom
-  In Channel Stoplogs
-  Pier
-  Weir
-  Other type or not defined

Defences

-  Embankment
-  Wall
-  Flood Gate
-  Demountable Defence
-  Bridge Abutment
-  Engineered High Ground
-  Natural High Ground
-  Cliff
-  Promenade
-  Quay
-  Beach
-  Barrier Beach
-  Dunes
-  Spillway

Channels

-  Open Channel
-  Complex Culvert
-  Simple Culvert

Instruments

-  CCTV Camera System
-  Flood Warning System
-  Gauge Board
-  Instrumentation
-  Piezometer
-  Rain Gauge
-  Telemetry System
-  Other type or not defined

Buildings and Compounds

-  Control Building
-  Gauging Station Building
-  Pump House
-  Storage Location
-  Other type or not defined

Channel Crossings

-  Bridge
-  Utility Services Crossing
-  Other type or not defined

Beach Structures

-  Breakwater
-  Groyne

Land

-  Water Storage Area
-  Other type or not defined

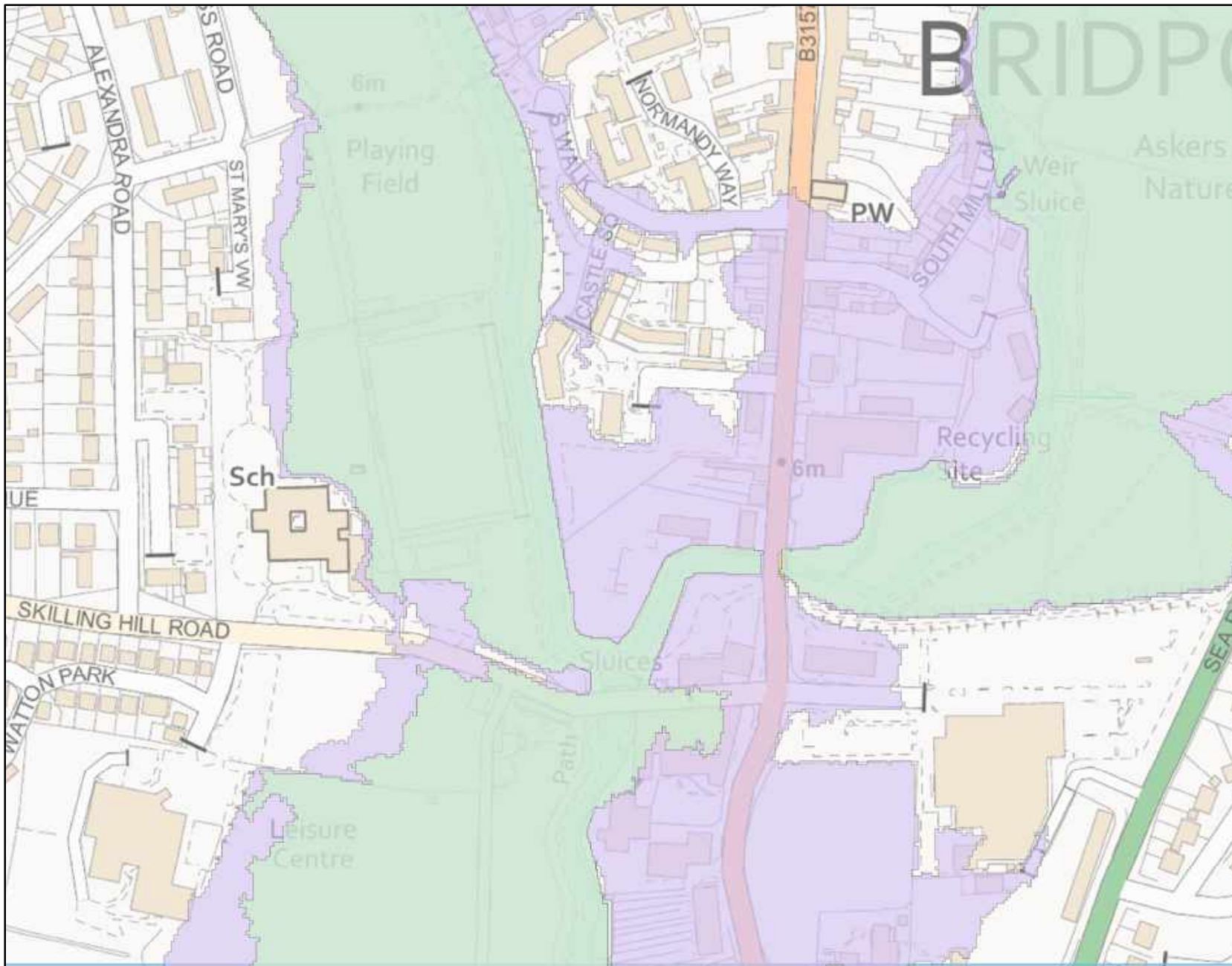
Point Aids to Navigation

-  Beacon
-  Buoy
-  Dolphin
-  Navigation Signage
-  Other type or not defined

Linear Aids to Navigation

-  Navigation Boom
-  Other type or not defined

247049 WX- Map Showing New Fluvial Modelled Flood Outlines 1% AEP and 0.1% AEP
Defended. From Bridport Model Enhancement 2020- Created 28.01.2022



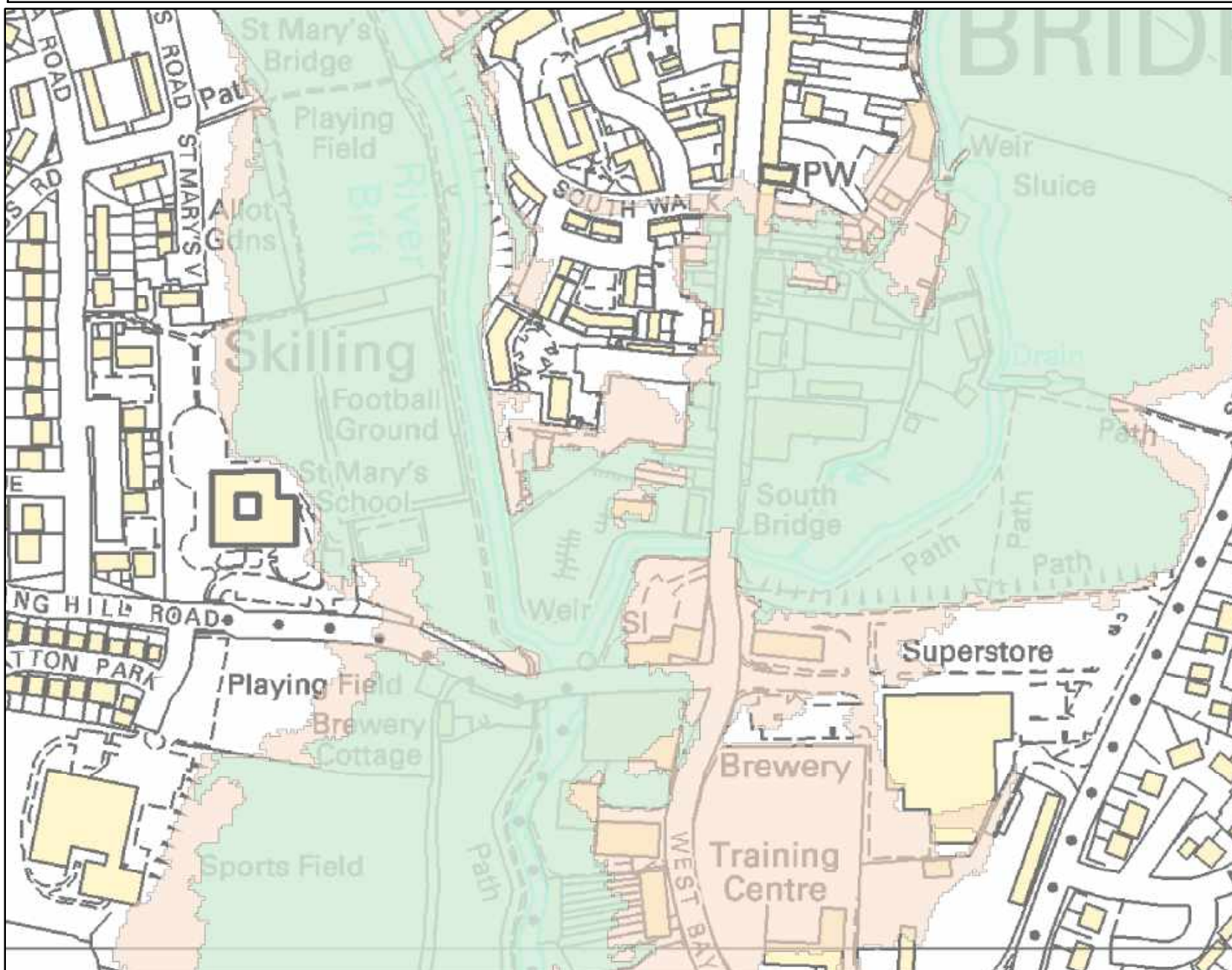
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Legend

-  Brit_DEF_SUM_Q0100_975_d_g001_Max_outline_region
-  Brit_DEF_SUM_Q1000_975_d_g001_Max_outline_region

247049 WX- Map Showing New Fluvial Modelled Flood Outlines 1% AEP and 0.1% AEP
 Undefended. From Bridport Model Enhancement 2020- Created 26.01.2022



Scale 1:3,300



Legend

- Brit_UND_SUM_Q0100_975_d_g001_Max_outline_region
- Brit_UND_SUM_Q1000_975_d_g001_Max_outline_region

We will be updating the
 Environment Agency
 Flood Map for Planning
 (Rivers & Sea)
 with these outlines this year

247049-WX selected nodes data extract

TITLE **Bridport Model Enhancement 2020**
MODEL DATE **22/03/2020**
SOFTWARE **ESTRY-TUFLOW**

SCENARIO **Defended**

NODE	Ask_124.1	Ask_124.2	Ask_124_B.1	Ask_160.1	Ask_180.1	Ask_344D.1	Ask_512_C.2	Ask_86.2	Bri_2579.1	Bri_2605D.1	Bri_2605RI.1	Bri_2618.1	Bri_2668.1	Bri_2927.1
WATERCOURSE	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al
2YR Level	4.27	4.18	4.28	4.38	4.43	4.66	4.38	4.06	3.94	3.94	3.95	4.13	4.45	4.78
2YR Flow	15.64	15.63	15.64	15.64	15.35	15.33	0.48	36.68	36.74	31.86	31.88	21.63	21.62	21.56
5YR Level	4.67	4.58	4.67	4.78	4.84	5.06	4.78	4.47	4.38	4.39	4.40	4.53	4.86	5.19
5YR Flow	21.70	21.69	21.71	21.71	21.43	21.29	0.48	51.44	51.66	46.19	46.20	30.26	30.25	29.89
10YR Level	4.90	4.81	4.91	5.02	5.08	5.27	5.02	4.70	4.61	4.62	4.63	4.77	5.09	5.41
10YR Flow	26.91	26.89	26.91	26.91	25.80	23.94	0.74	61.07	61.35	55.76	55.76	36.32	36.20	34.62
20YR Level	5.16	5.07	5.18	5.29	5.32	5.43	5.30	4.97	4.87	4.87	4.90	5.03	5.34	5.64
20YR Flow	32.03	32.02	32.03	31.99	27.12	24.78	2.48	74.39	73.57	67.59	67.59	43.20	41.90	39.58
20YR 20%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
20YR 20%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
25YR Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
25YR Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
30YR Level	5.28	5.19	5.32	5.43	5.44	5.52	5.44	5.08	4.96	4.97	5.00	5.15	5.43	5.73
30YR Flow	35.31	35.43	35.31	34.59	27.38	24.90	3.54	80.76	80.08	74.26	74.34	46.84	43.43	42.14
50YR Level	5.42	5.32	5.49	5.59	5.60	5.66	5.61	5.20	5.06	5.07	5.11	5.27	5.53	5.81
50YR Flow	40.05	40.04	40.05	37.55	27.67	25.12	4.66	90.58	88.33	83.59	84.10	52.16	45.05	43.85
75YR Level	5.52	5.42	5.62	5.72	5.72	5.76	5.73	5.29	5.12	5.14	5.19	5.36	5.60	5.87
75YR Flow	43.94	43.92	43.94	40.32	27.84	25.27	5.26	99.20	94.62	91.33	92.27	56.82	46.03	44.37
100YR Level	5.59	5.49	5.72	5.81	5.81	5.85	5.82	5.35	5.17	5.18	5.24	5.43	5.66	5.91
100YR Flow	46.68	46.67	46.69	41.98	27.93	25.33	5.59	105.72	99.22	97.16	98.44	60.48	46.79	44.66
100YR 20%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
100YR 20%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
100YR 30%CC Level	5.88	5.76	6.11	6.19	6.19	6.21	6.19	5.62	5.32	5.34	5.46	5.71	5.88	6.08
100YR 30%CC Flow	57.70	57.70	57.71	49.66	28.09	25.43	6.48	133.83	118.16	121.57	124.23	75.26	49.52	45.65
100YR 40%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
100YR 40%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
100YR 85%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
100YR 85%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
200YR Level	5.75	5.64	5.93	6.01	6.01	6.03	6.02	5.50	5.26	5.27	5.36	5.58	5.78	6.00
200YR Flow	52.26	52.26	52.26	45.76	28.23	25.54	6.04	120.82	109.59	110.63	112.64	67.92	48.31	45.17
200YR 20%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
200YR 20%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
500YR Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
500YR Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
1000YR Level	6.19	6.06	6.56	6.62	6.62	6.63	6.63	5.91	5.49	5.51	5.70	5.99	6.13	6.29
1000YR Flow	74.01	73.99	74.27	62.05	26.73	24.53	8.08	163.72	135.65	143.11	145.90	90.38	50.61	46.78
1000YR 20%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
1000YR 20%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
TIDE 200YR	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000
TIDE 1000YR	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000	-9999.99000000
Eastings	346580	346554	346591	346626	346644	346715	346685	346499	346494	346496	346498	346463	346445	346435
Northings	92238	92240	92237	92227	92219	92260	92291	92173	92135	92145	92159	92203	92312	92459

247049-WX selected nodes data extract

SCENARIO

Undefended

NODE	Ask_124.1	Ask_124.2	Ask_124_B.1	Ask_160.1	Ask_180.1	Ask_344D.1	Ask_512_C.2	Ask_86.2	Bri_2579.1	Bri_2605D.1	Bri_2605RI.1	Bri_2618.1	Bri_2668.1	Bri_2927.1
WATERCOURSE	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al	Brit, Wey et al
2YR Level	4.27	4.18	4.28	4.37	4.43	4.65	4.37	4.06	3.94	3.95	3.95	4.13	4.45	4.78
2YR Flow	15.54	15.52	15.54	15.54	15.25	15.23	0.48	36.48	36.59	31.75	31.76	21.65	21.64	21.59
5YR Level	4.65	4.57	4.66	4.76	4.83	5.05	4.77	4.46	4.37	4.38	4.38	4.52	4.84	5.18
5YR Flow	21.60	21.57	21.60	21.60	21.33	21.31	0.48	51.01	51.15	45.70	45.70	30.08	30.06	29.74
10YR Level	4.90	4.81	4.91	5.02	5.08	5.27	5.02	4.70	4.61	4.62	4.63	4.76	5.09	5.40
10YR Flow	26.88	26.86	26.88	26.88	25.53	23.89	1.04	61.08	61.37	55.78	55.78	36.02	35.89	34.34
20YR Level	5.15	5.06	5.17	5.28	5.30	5.41	5.30	4.96	4.85	4.86	4.89	5.02	5.33	5.63
20YR Flow	31.72	31.71	31.72	31.68	26.82	24.66	3.50	73.35	72.99	67.05	67.04	42.78	41.62	39.23
20YR 20%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
20YR 20%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
25YR Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
25YR Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
30YR Level	5.27	5.18	5.31	5.42	5.43	5.51	5.44	5.07	4.96	4.97	5.00	5.14	5.42	5.72
30YR Flow	34.79	34.83	34.80	34.08	27.05	24.78	4.45	80.65	79.74	74.03	74.10	46.42	43.20	41.89
50YR Level	5.41	5.31	5.48	5.57	5.58	5.63	5.59	5.19	5.05	5.06	5.10	5.26	5.52	5.81
50YR Flow	39.50	39.52	39.51	36.18	27.29	24.97	5.11	89.76	87.49	82.88	83.32	51.20	44.83	43.73
75YR Level	5.51	5.40	5.60	5.69	5.70	5.74	5.71	5.28	5.11	5.12	5.17	5.35	5.59	5.86
75YR Flow	43.31	43.43	43.34	37.69	27.46	25.09	5.32	98.14	93.55	90.38	91.24	55.07	45.86	44.31
100YR Level	5.57	5.47	5.69	5.77	5.77	5.81	5.78	5.34	5.15	5.17	5.22	5.41	5.64	5.90
100YR Flow	45.64	46.16	45.66	38.49	27.53	25.13	5.39	104.17	97.58	95.64	96.82	57.50	46.56	44.56
100YR 20%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
100YR 20%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
100YR 30%CC Level	5.81	5.71	5.99	6.04	6.04	6.06	6.05	5.59	5.31	5.33	5.43	5.66	5.86	6.08
100YR 30%CC Flow	52.27	54.25	51.90	40.81	27.64	25.15	5.98	129.30	116.09	117.85	119.79	69.57	49.84	46.24
100YR 40%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
100YR 40%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
100YR 85%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
100YR 85%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
200YR Level	5.72	5.62	5.89	5.95	5.95	5.98	5.96	5.48	5.25	5.26	5.35	5.56	5.77	6.00
200YR Flow	50.65	52.36	50.43	40.36	27.75	25.27	5.53	119.22	108.57	108.91	110.65	64.38	48.32	45.13
200YR 20%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
200YR 20%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
500YR Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
500YR Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
1000YR Level	5.99	5.92	6.18	6.22	6.22	6.24	6.23	5.81	5.44	5.46	5.62	5.88	6.04	6.24
1000YR Flow	56.00	59.11	55.22	42.22	27.90	25.30	7.79	151.31	132.63	137.13	138.92	79.62	51.75	49.41
1000YR 20%CC Level	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
1000YR 20%CC Flow	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD	NMD
TIDE 200YR	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000
TIDE 1000YR	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000	-9999.9900000
Eastings	346580	346554	346591	346626	346644	346715	346685	346499	346494	346496	346498	346463	346445	346435
Northings	92238	92240	92237	92227	92219	92260	92291	92173	92135	92145	92159	92203	92312	92459

Level of confidence	Moderate	The model was produced to assess our flood risk management assets and the results are fit for this purpose. We have MODERATE confidence in its input data, and subsequently its results. The reason that we have MODERATE confidence in the model and its results is because the model requires verification against a known flood event. You will need to contact our Partnership and Strategic Overview Team to discuss whether the flood levels from this model are suitable for your FRA or whether they require you to carry out further work to update the modelling.
NMD	No Modelled Data	
UNITS	LEVELS:	mAOD
	FLOW:	cumecs

Appendix C Intermediate Analysis

South Street Bridport

Intermediate Modelling Report.

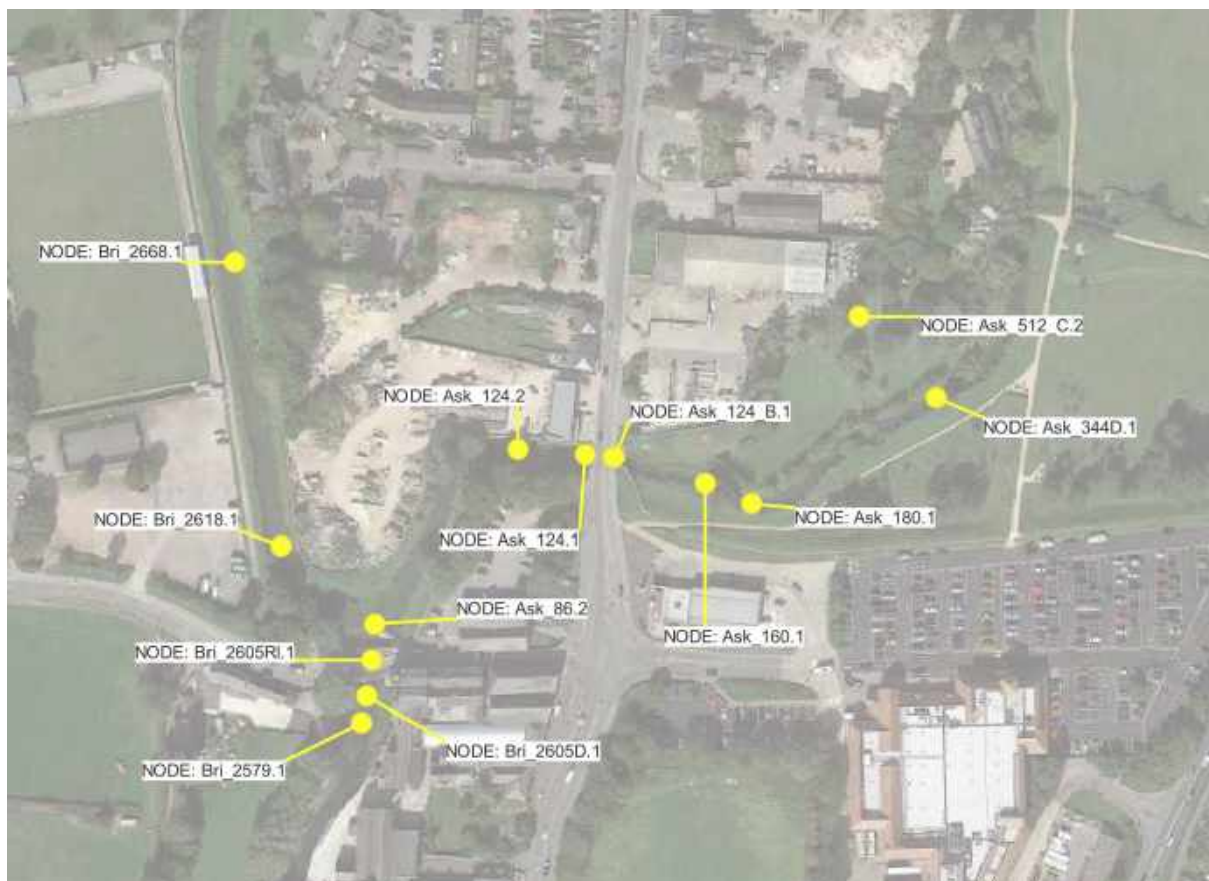
Methodology and Output

This report details the method, analysis and output of an intermediate modelling approach. The purpose of the analysis is to determine a revised Q100+47%CC stage value from flow and stage data provided from hydrodynamic model outputs received as part of a product 4 data request.

Developing Flow/Stage relationships

Data points from the product 4 information request were considered at the 13 nodes provided and mapped in the Figure 1.

Figure 1 – Node points and labels considered



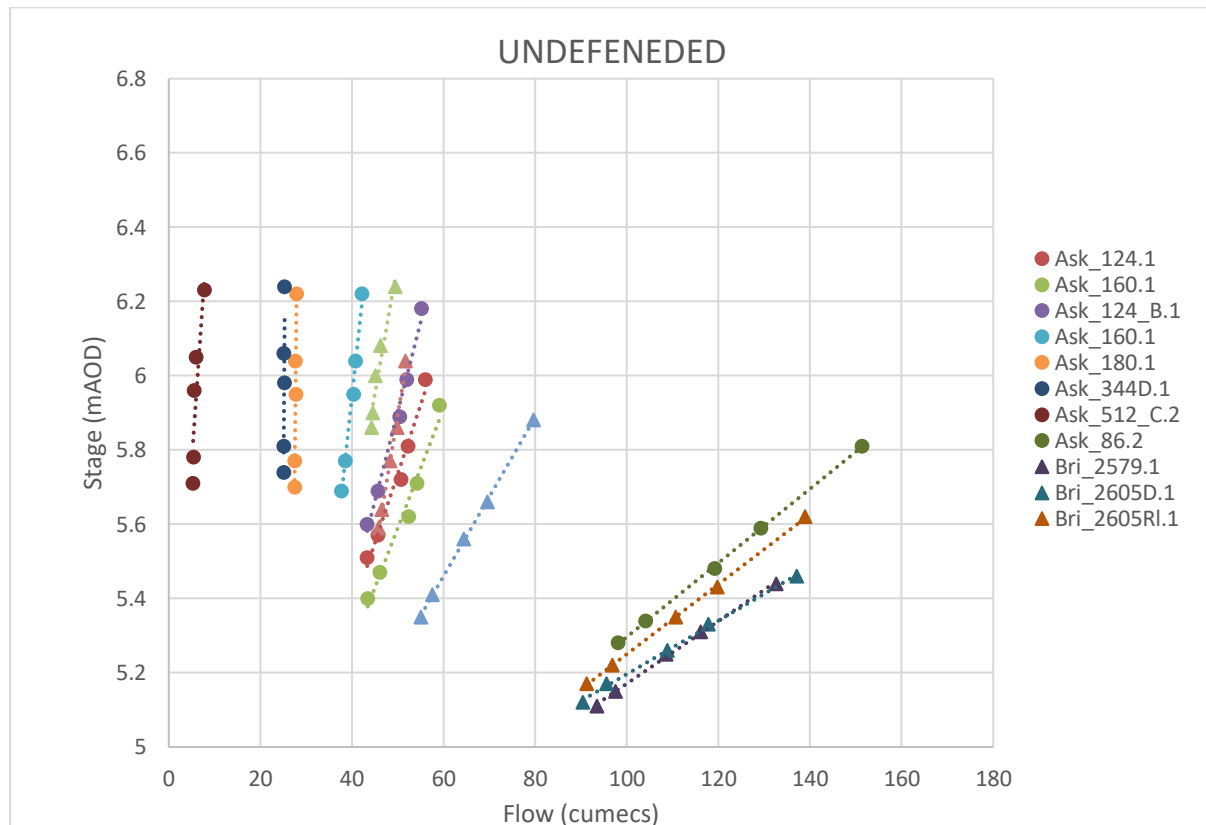
The product 4 data included two scenarios, defended and undefended, at the following flow rates (cumecs) with accompanying stage (mAOD); Q2, Q5, Q10, Q20, Q30, Q50, Q75, Q100, Q100+30%CC, Q200, Q1000.

A flow/stage curve was plotted using the Q75, Q100, Q100+30%CC, Q200, Q1000 data points and the data fitted to a linear relationship of the form,

$$\text{Stage(mAOD)} = \text{Flow (cumec)} \times \text{slope} + \text{intercept} \quad (y=mx+c)$$

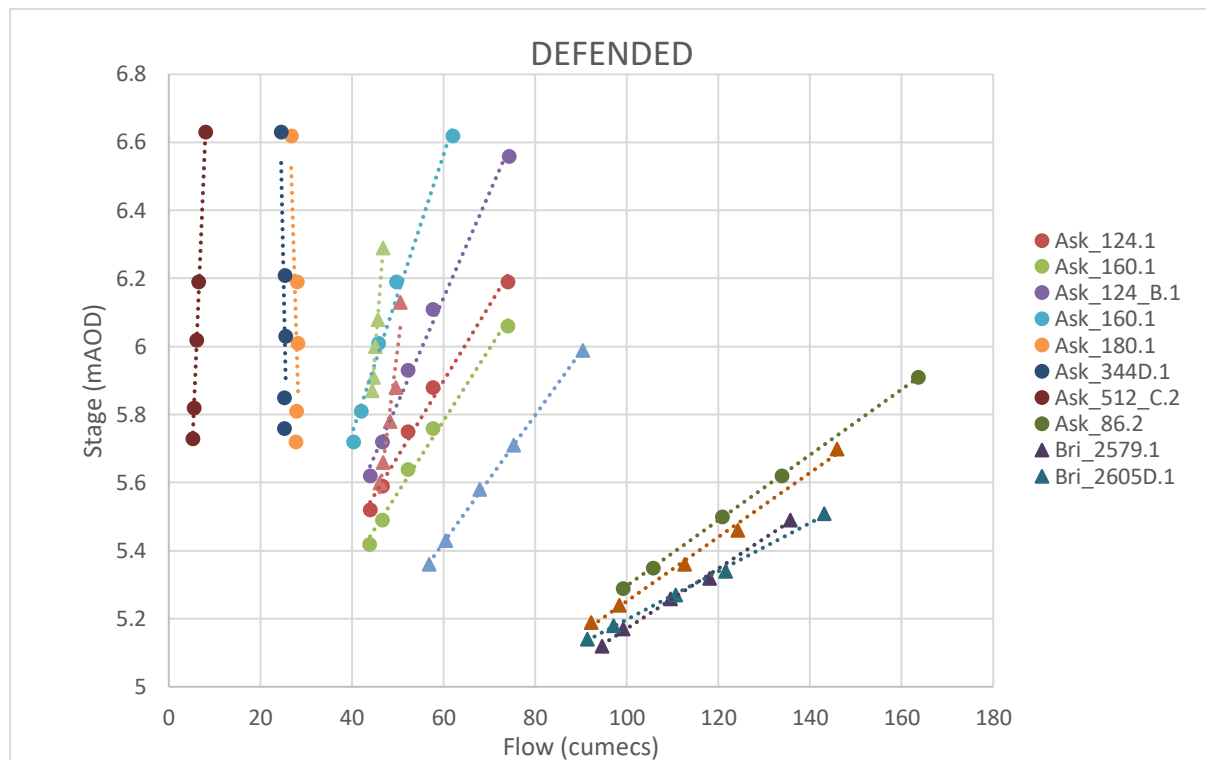
Excel was used to calculate the constants (slope (m) and y-intercept (c)) from the data points.

Figure 2 – Un defended scenario linear relationships between flow and stage



As a guide for linearity R^2 values for each line were checked. In the defended scenario data associated with nodes Ask_180.1 and Ask_344D.1 gave R^2 values of 0.5405 and 0.5530 respectively, most likely due to the near vertical relationship at these points, meaning there is increased uncertainty related to the relationship between flow and stage at these nodes. All other nodes gave an R^2 values in excess of 0.98 indicating a high degree of fit to a linear model over the data range used.

In the undefended scenario nodes Ask_180.1, Ask_344D.1 and Ask_5.12_C.2 all gave R^2 values of 0.8618, 0.6581 and 0.7781 and have near vertical linear relationships between flow and stage and therefore increased uncertainty related to the relationship between flow and stage. All other nodes gave an R^2 values in excess of 0.93 indicating a high degree of fit to a linear model over the data range used.

Figure 3 – Defended scenario linear relationships between flow and stage.**Calculating Q100+47% flow**

The purpose of this modelling was to interpolate a revised Q100+47%CC stage level.

Three approaches were taken to determine the flow rate associated with Q100+47%CC event.

Approach 1

In this approach Q100+47% flow was calculated by multiplying the product 4 reported Q100 flow by 1.47.

$$Q100 \times 1.47 = Q100 + 47\%$$

Approach 2

In this approach the Q100+30% flow was divided by 1.3 to report a derived Q100 flow and then this derived Q100 flow was multiplied by 1.47.

$$\left(\frac{(Q100 + 30\%)}{1.3} \right) \times 1.47 = Q100 + 47\%$$

Approach 3

In this approach, the difference between the Q100 and Q100+30%, (the result of adding 30% to flows) is scaled to 47% and added to the product 4 report Q100 flow.

$$\left(\left(\frac{(Q100 + 30\%) - Q100}{0.3} \right) \times 0.47 \right) + Q100$$

Values for Q100+47% flow were calculated for all three approaches at each node in the defended and undefended scenarios, and the stage calculated according to the linear relationships developed from the product 4 data. Tabulated data is appended in the defended and undefended scenarios.

Output verification

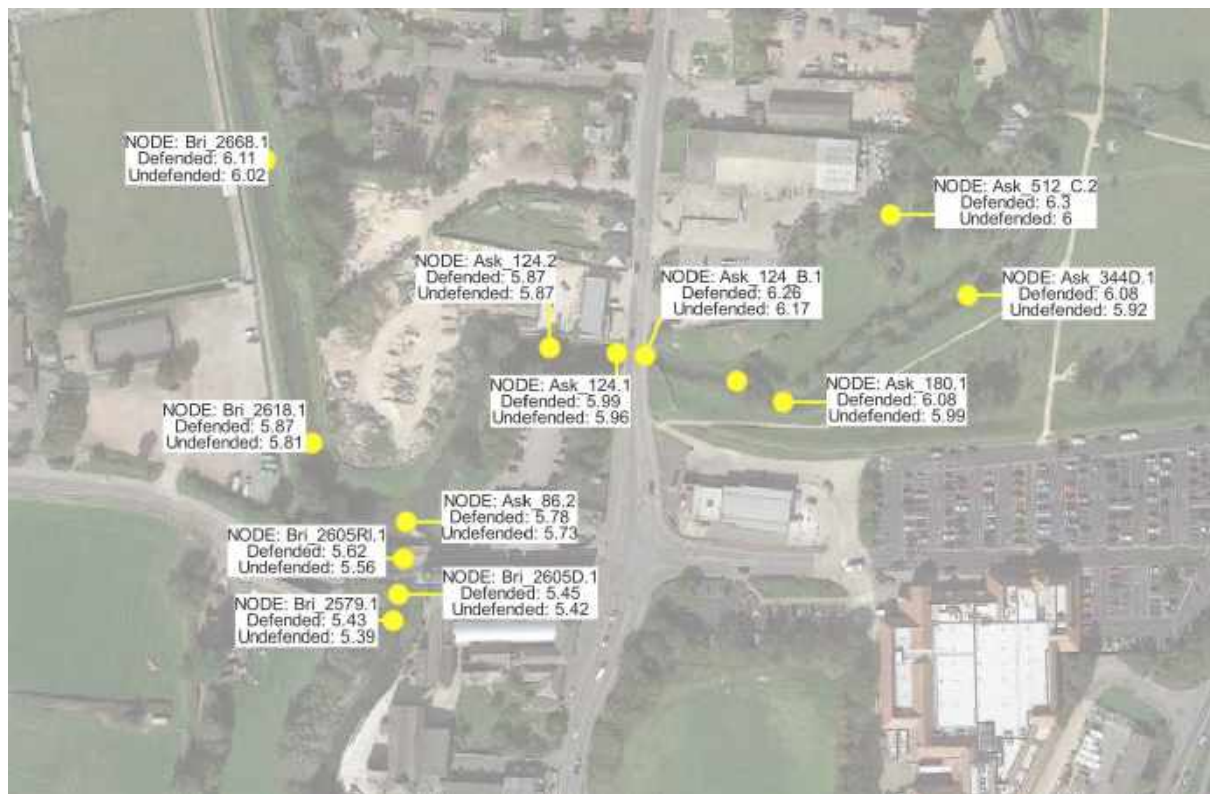
The stage values for each approach have been conditionally formatted to indicate if the calculated stage is extrapolated beyond the range of the product 4 data. Red cells in the appended tabulated data indicates that the value for stage is above the Q1000 stage level at the node.

In general, across all the data, approach 1 lead to increased incidence of extrapolation beyond the extents of the product 4 data and to levels at some nodes that were uncharacteristic of the stages reported in the product 4 data.

Approach 3 did not lead to extrapolation beyond the product 4 data extents and furthermore across the nodes in the two scenarios gave the most consistent set of data points when compared to existing product 4 data. Given the indicated application of a 0.6m freeboard in this case approach 3 is considered to be the most appropriate method to apply to calculate the stage at Q100+47%CC.

Summary Output

Figure 4 indicates the Q100+47% stages calculated using Approach 3 in the defended and undefended scenarios.

Figure 4 – Summary of approach 3 stages at Q100+47%CC

Flood Storage Compensation Calculation Report



DEFENDED															
NODE	A	Ask_124.1	Ask_124.2	Ask_124_B.1	Ask_160.1	Ask_180.1	Ask_344D.1	Ask_512_C.2	Ask_86.2	Bri_2579.1	Bri_2605D.1	Bri_2605RI.1	Bri_2618.1	Bri_2668.1	Bri_2927.1
2YR	Flow	15.64	15.63	15.64	15.64	15.35	15.33	0.48	36.68	36.74	31.86	31.88	21.63	21.62	21.56
5YR	Flow	21.7	21.69	21.71	21.71	21.43	21.29	0.48	51.44	51.66	46.19	46.2	30.26	30.25	29.89
10YR	Flow	26.91	26.89	26.91	26.91	25.8	23.94	0.74	61.07	61.35	55.76	55.76	36.32	36.2	34.62
20YR	Flow	32.03	32.02	32.03	31.99	27.12	24.78	2.48	74.39	73.57	67.59	67.59	43.2	41.9	39.58
30YR	Flow	35.31	35.43	35.31	34.59	27.38	24.9	3.54	80.76	80.08	74.26	74.34	46.84	43.43	42.14
50YR	Flow	40.05	40.04	40.05	37.55	27.67	25.12	4.66	90.58	88.33	83.59	84.1	52.16	45.05	43.85
75YR	Flow	43.94	43.92	43.94	40.32	27.84	25.27	5.26	99.2	94.62	91.33	92.27	56.82	46.03	44.37
100YR	Flow	46.68	46.67	46.69	41.98	27.93	25.33	5.59	105.72	99.22	97.16	98.44	60.48	46.79	44.66
100YR30%CC	Flow	57.7	57.7	57.71	49.66	28.09	25.43	6.48	133.83	118.16	121.57	124.23	75.26	49.52	45.65
200YR	Flow	52.26	52.26	52.26	45.76	28.23	25.54	6.04	120.82	109.59	110.63	112.64	67.92	48.31	45.17
1000YR	Flow	74.01	73.99	74.27	62.05	26.73	24.53	8.08	163.72	135.65	143.11	145.9	90.38	50.61	46.78
2YR	Level	4.27	4.18	4.28	4.38	4.43	4.66	4.38	4.06	3.94	3.94	3.95	4.13	4.45	4.78
5YR	Level	4.67	4.58	4.67	4.78	4.84	5.06	4.78	4.47	4.38	4.39	4.4	4.53	4.86	5.19
10YR	Level	4.9	4.81	4.91	5.02	5.08	5.27	5.02	4.7	4.61	4.62	4.63	4.77	5.09	5.41
20YR	Level	5.16	5.07	5.18	5.29	5.32	5.43	5.3	4.97	4.87	4.87	4.9	5.03	5.34	5.64
30YR	Level	5.28	5.19	5.32	5.43	5.44	5.52	5.44	5.08	4.96	4.97	5	5.15	5.43	5.73
50YR	Level	5.42	5.32	5.49	5.59	5.6	5.66	5.61	5.2	5.06	5.07	5.11	5.27	5.53	5.81
75YR	Level	5.52	5.42	5.62	5.72	5.72	5.76	5.73	5.29	5.12	5.14	5.19	5.36	5.6	5.87
100YR	Level	5.59	5.49	5.72	5.81	5.81	5.85	5.82	5.35	5.17	5.18	5.24	5.43	5.66	5.91
100YR30%CC	Level	5.88	5.76	6.11	6.19	6.19	6.21	6.19	5.62	5.32	5.34	5.46	5.71	5.88	6.08
200YR	Level	5.75	5.64	5.93	6.01	6.01	6.03	6.02	5.5	5.26	5.27	5.36	5.58	5.78	6
1000YR	Level	6.19	6.06	6.56	6.62	6.62	6.63	6.63	5.91	5.49	5.51	5.7	5.99	6.13	6.29
M		0.0222	0.0211	0.0308	0.0410	0.9341	1.2139	0.3220	0.0096	0.0088	0.0071	0.0094	0.0187	0.1072	0.1755
C		4.5666	4.5128	4.2929	4.1041	-20.2422	-24.8616	4.0526	4.3353	4.2874	4.4888	4.3076	4.2986	0.6363	-1.9227
R ²		0.9907	0.9919	0.9936	0.9887	0.5405	0.5530	0.9901	0.9999	0.9975	0.9978	0.9945	0.9996	0.9370	0.9987
CC allowance		1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
App1: 100yr+C Flow		68.6	68.6	68.6	61.7	41.1	37.2	8.2	155.4	145.9	142.8	144.7	88.9	68.8	65.7
App1: 100+CC Stage		6.09	5.96	6.41	6.63	18.11	20.34	6.70	5.83	5.58	5.50	5.67	5.97	8.01	9.60
App2: 100yr+C Flow		65.2	65.2	65.3	56.2	31.8	28.8	7.3	151.3	133.6	137.5	140.5	85.1	56.0	51.6
App2: 100yr+C Stage		6.02	5.89	6.31	6.41	9.43	10.04	6.41	5.79	5.47	5.46	5.63	5.89	6.64	7.13
App3: 100yr+C Flow		63.9	64.0	64.0	54.0	28.2	25.5	7.0	149.8	128.9	135.4	138.8	83.6	51.1	46.2
App3: 100yr+C Stage		5.99	5.87	6.26	6.32	6.08	6.08	6.30	5.78	5.43	5.45	5.62	5.87	6.11	6.19
Eastings	Z	346580	346554	346591	346626	346644	346715	346685	346499	346494	346496	346498	346463	346445	346435
Northings	Z	92238	92240	92237	92227	92219	92260	92291	92173	92135	92145	92159	92203	92312	92459



UNDEFENEDED															
NODE	A	Ask_124.1	Ask_124.2	Ask_124_B.1	Ask_160.1	Ask_180.1	Ask_344D.1	Ask_512_C.2	Ask_86.2	Bri_2579.1	Bri_2605D.1	Bri_2605RI.1	Bri_2618.1	Bri_2668.1	Bri_2927.1
2YR	Flow	15.54	15.52	15.54	15.54	15.25	15.23	0.48	36.48	36.59	31.75	31.76	21.65	21.64	21.59
5YR	Flow	21.6	21.57	21.6	21.6	21.33	21.31	0.48	51.01	51.15	45.7	45.7	30.08	30.06	29.74
10YR	Flow	26.88	26.86	26.88	26.88	25.53	23.89	1.04	61.08	61.37	55.78	55.78	36.02	35.89	34.34
20YR	Flow	31.72	31.71	31.72	31.68	26.82	24.66	3.5	73.35	72.99	67.05	67.04	42.78	41.62	39.23
30YR	Flow	34.79	34.83	34.8	34.08	27.05	24.78	4.45	80.65	79.74	74.03	74.1	46.42	43.2	41.89
50YR	Flow	39.5	39.52	39.51	36.18	27.29	24.97	5.11	89.76	87.49	82.88	83.32	51.2	44.83	43.73
75YR	Flow	43.31	43.43	43.34	37.69	27.46	25.09	5.32	98.14	93.55	90.38	91.24	55.07	45.86	44.31
100YR	Flow	45.64	46.16	45.66	38.49	27.53	25.13	5.39	104.17	97.58	95.64	96.82	57.5	46.56	44.56
100YR30%CC	Flow	52.27	54.25	51.9	40.81	27.64	25.15	5.98	129.3	116.09	117.85	119.79	69.57	49.84	46.24
200YR	Flow	50.65	52.36	50.43	40.36	27.75	25.27	5.53	119.22	108.57	108.91	110.65	64.38	48.32	45.13
1000YR	Flow	56	59.11	55.22	42.22	27.9	25.3	7.79	151.31	132.63	137.13	138.92	79.62	51.75	49.41
2YR	Level	4.27	4.18	4.28	4.37	4.43	4.65	4.37	4.06	3.94	3.95	3.95	4.13	4.45	4.78
5YR	Level	4.65	4.57	4.66	4.76	4.83	5.05	4.77	4.46	4.37	4.38	4.38	4.52	4.84	5.18
10YR	Level	4.9	4.81	4.91	5.02	5.08	5.27	5.02	4.7	4.61	4.62	4.63	4.76	5.09	5.4
20YR	Level	5.15	5.06	5.17	5.28	5.3	5.41	5.3	4.96	4.85	4.86	4.89	5.02	5.33	5.63
30YR	Level	5.27	5.18	5.31	5.42	5.43	5.51	5.44	5.07	4.96	4.97	5	5.14	5.42	5.72
50YR	Level	5.41	5.31	5.48	5.57	5.58	5.63	5.59	5.19	5.05	5.06	5.1	5.26	5.52	5.81
75YR	Level	5.51	5.4	5.6	5.69	5.7	5.74	5.71	5.28	5.11	5.12	5.17	5.35	5.59	5.86
100YR	Level	5.57	5.47	5.69	5.77	5.77	5.81	5.78	5.34	5.15	5.17	5.22	5.41	5.64	5.9
100YR30%CC	Level	5.81	5.71	5.99	6.04	6.04	6.06	6.05	5.59	5.31	5.33	5.43	5.66	5.86	6.08
200YR	Level	5.72	5.62	5.89	5.95	5.95	5.98	5.96	5.48	5.25	5.26	5.35	5.56	5.77	6
1000YR	Level	5.99	5.92	6.18	6.22	6.22	6.24	6.23	5.81	5.44	5.46	5.62	5.88	6.04	6.24
M		0.04	0.03	0.05	0.12	1.11	1.77	0.18	0.01	0.01	0.01	0.01	0.02	0.07	0.07
C		3.88	3.98	3.49	1.32	-24.69	-38.50	4.87	4.30	4.33	4.48	4.31	4.18	2.16	2.78
R ²		0.9783	0.9750	0.9901	0.9899	0.8618	0.6581	0.7781	0.9996	0.9980	0.9984	0.9995	0.9995	0.9942	0.9351
CC allowance		1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
App1: 100yr+C Flow		67.1	67.9	67.1	56.6	40.5	36.9	7.9	153.1	143.4	140.6	142.3	84.5	68.4	65.5
App1: 100+C Stage		6.37	6.16	6.73	7.86	20.13	26.72	6.29	5.83	5.54	5.49	5.65	5.98	7.27	7.40
App2: 100yr+C Flow		59.1	61.3	58.7	46.1	31.3	28.4	6.8	146.2	131.3	133.3	135.5	78.7	56.4	52.3
App2: 100yr+C Stage		6.07	5.96	6.32	6.66	9.92	11.71	6.08	5.76	5.43	5.44	5.58	5.86	6.37	6.46
App3: 100yr+C Flow		56.0	58.8	55.4	42.1	27.7	25.2	6.3	143.5	126.6	130.4	132.8	76.4	51.7	47.2
App3: 100yr+C Stage		5.96	5.87	6.17	6.19	5.99	5.92	6.00	5.73	5.39	5.42	5.56	5.81	6.02	6.11
Eastings	Z	346580	346554	346591	346626	346644	346715	346685	346499	346494	346496	346498	346463	346445	346435
Northings	Z	92238	92240	92237	92227	92219	92260	92291	92173	92135	92145	92159	92203	92312	92459

Appendix D CCTV Surveys



CCTV SURVEYS



**HIGH PRESSURE
JETTING**



**MAN ENTRY
SURVEYS**



RELINING & REPAIRS



PILING SURVEYS



CHIMNEY SURVEYS



**5 SUFFOLK ROAD
MALDON
ESSEX
CM9 6AX**
Telephone: 07971 910371

DRAINAGE REPORT

CLIENT	CHURCHILL RETIREMENT LIVING
LOCATION	SOUTH STREET BRIDPORT DORSET DT6 3NP
DATE	09/10/2022
REF	071474

UTILITY SURVEYS LTD

5 SUFFOLK ROAD
MALDON
ESSEX
CM9 6AX

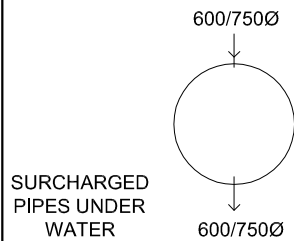
LOCATION: SOUTH STREET BRIDPORT DORSET

JOB REF: 071474

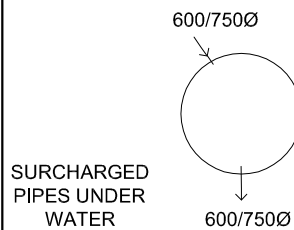
CLIENT: CHURCHILL RETIREMENT LIVING

DATE: 09/10/2022

MH No. S1
DEPTH. 2.85
COVER. SH
CONSTRUCTION. Co Ring
REMARKS. SURCHARGED
PIPES FULLY
UNDERWATER



MH No. 5211
DEPTH. 2.66
COVER. RM
CONSTRUCTION. Co Ring
REMARKS. SURCHARGED
PIPES FULLY
UNDERWATER



KEY:
C - Circular
S - Square
T - Triangular

L - Light Duty
M - Medium Duty
H - Heavy Duty

Co - Concrete
Br - Brick
R - Rectangular



MH S1



HEADWALL 01



MH 5211



MH 5211 LOCATED IN PRIVATE GARDENS



HEADWALL 02



HEADWALL 03



REDUNDANT WASH PIT



HEADWALL 04



OUTFALL 01

Drainage Investigation – Daily Record Sheet

Date Job No

Client

Site Address

Rig Manager Operative



5 Suffolk Road
Maldon
Essex
CM9 6AX

Tel: 07971910370

Remarks

MANHOLE 5211 (WESSEX WATER) LOCATED IN REAR GARDEN OF 158 SOUTH STREET 2.66M DEEP TO INVERT, SURCHARGED DEPTH OF WATER OVER 1.00M PIPES FULLY COVERED, APPROX DIAMETER OF PIPES 600MM-750MM

MANHOLE 51 IN YARD 2.85M DEEP TO INVERT, SURCHARGED DEPTH OF WATER OVER 1.10M DEEP PIPES FULLY COVERED

ASSUMED ROUTE TO HEADWALL 01 IN RIVER FLAPGATE UNDERWATER

FOUL TOILET DRAINS TO SEPTIC TANK

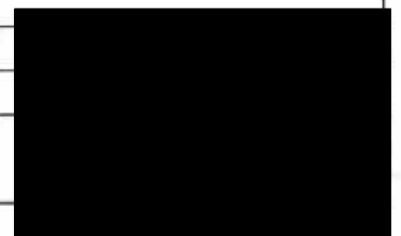
NO CURRENT FOUL OUTFALL TO PUBLIC SEWER IN ROAD.

Standing Time Meterage check ☒ Length

Reason for standing time

Remarks

Special Instructions; Site Contact –



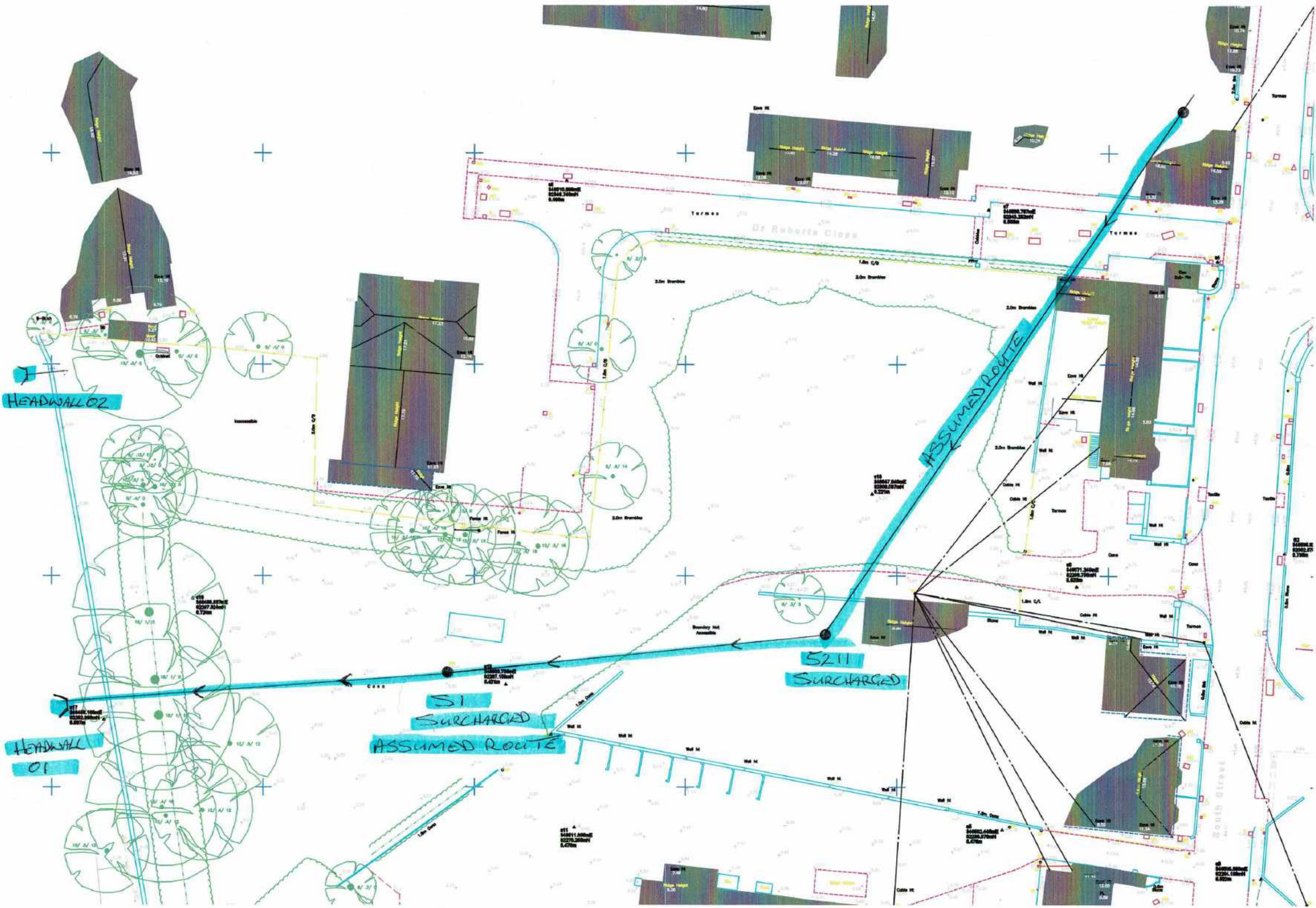
HEADWALL 02

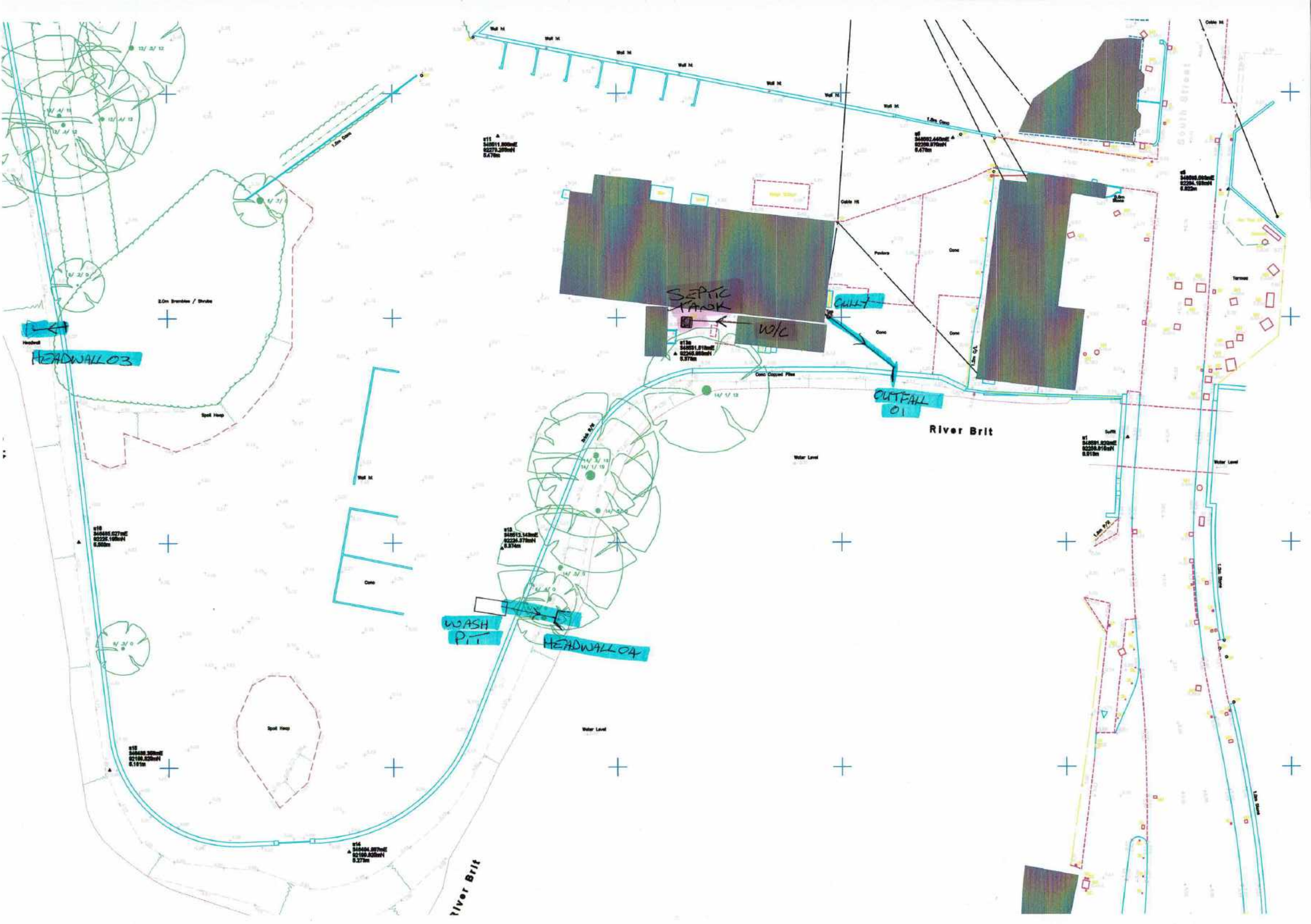
HEADWALL 01

S1
SURCHARGED
ASSUMED ROUTE

5211
SURCHARGED

ASSUMED ROUTE





ST1
340811.800mE
82279.280mN
0.470m

ST
340821.440mE
82288.970mN
0.470m

ST
34088.000mE
82284.100mN
0.820m

SEPTIC
TANK

W/C

ST2
340811.810mE
82245.880mN
0.370m

OUTFALL
01

River Brit

ST
340891.300mE
82288.910mN
0.910m

ST
340485.827mE
82225.160mN
0.660m

WASH
PIT

HEADWALL 04

HEADWALL 03

ST
340488.300mE
82188.820mN
0.190m

ST
340404.887mE
82188.820mN
0.270m

River Brit

Appendix E Wessex Water

James Blyth

From: Ann-Marie Wood <Ann-Marie.Wood@wessexwater.co.uk>
Sent: 05 June 2024 11:31
To: Chris Yalden
Cc: James Blyth
Subject: RE: WW Resp DEV SY49SE/ 34 - 1348 - South Street, Bridport - Foul pump rates enquiry - Standoff Details

Hi Chris

My apologies I missed your call. I am happy with the proposal as shown below, 300mm is a minor encroachment and as it is small localised areas I don't see it as an issue.

Kind regards
Ann-marie

Ann-marie Wood
Planning Liaison Manager

Wessex Water
Claverton Down Bath BA2 7WW
Mobile number 07385 433347
wessexwater.co.uk

These comments are based upon known circumstances prevailing at the time of writing. A review of the contents of this email is required where 18 months or more have elapsed since issue or in the light of significant changes likely to impact upon the response (e.g. changes in development numbers or phasing). Please email review requests to planning.liaison@wessexwater.co.uk

From: Chris Yalden <Chris.Yalden@awpexeter.com>
Sent: Wednesday, June 5, 2024 10:49 AM
To: Ann-Marie Wood <Ann-Marie.Wood@wessexwater.co.uk>
Cc: James Blyth <James.blyth@awpexeter.com>
Subject: RE: WW Resp DEV SY49SE/ 34 - 1348 - South Street, Bridport - Foul pump rates enquiry - Standoff Details

[EXTERNAL EMAIL] DO NOT CLICK links or attachments unless you recognise the sender and know the content is safe.

Hi Ann-Marie,

I just tried to call to discuss your below email – I'm conscious our client is very concerned that the requirement to achieve 4m easement from the sewer could have a high level of impact on their completed BIM design for the proposed buildings. They developed the scheme on the basis of achieving 3.5m easement, from the original WW advice received by Gillian.

Thankfully there was scope to nudge the buildings away from the sewer, but there remain two very small and localised areas where the corner of the buildings encroach the easement by up approx. 300mm:



Given how minor these residual conflicts are and on the basis the client is adapting the design as best they can to revert from original advice at 3.5m, to 4m, can this be agreed? The building foundations would be sufficiently deep to avoid any loading on the culvert, so overall this will have no adverse impact on the culvert. Furthermore, by comparison to existing site conditions, the proposed development will improve accessibility for WW, so presents a betterment.

Best Regards,

Chris Yalden
Technical Director
IEng, MICE



Ada House, Pynes Hill, Exeter EX2 5TU

Mobile: 07843 107790
email: chris.yalden@awpexeter.com
web: www.awpexeter.com

AWP is a regional engineering consultancy providing development planning and infrastructure services to developers and house builders across the south west.

From: James Blyth <James.blyth@awpexeter.com>
Sent: Wednesday, June 5, 2024 10:16 AM
To: Chris Yalden <Chris.Yalden@awpexeter.com>
Subject: FW: WW Resp DEV SY49SE/ 34 - 1348 - South Street, Bridport - Foul pump rates enquiry - Standoff Details

FYI

James Blyth
Senior Engineer
GMICE



Address: Ada House, Pynes Hill, Exeter EX2 5TU
office: 01392 409007
direct dial: 01392 325579
email: james.blyth@awpexeter.com
web: www.awpexeter.com

AWP is a regional engineering consultancy providing development planning and infrastructure services to developers and house builders across the south west.

Private and confidential

This email is sent on behalf of Awcock Ward Partnership Consulting Limited (AWP) and its contents are private and confidential to the named recipient. If you receive this communication in error, please notify the sender immediately and delete any copies without disclosing the contents to any other person.

Awcock Ward Partnership Consulting Limited
Registered Office: c/o Prydis, Senate Court, Southernhay Gardens, Exeter. EX1 1NT
Registered in England: Company No. 8230346

From: Ann-Marie Wood <Ann-Marie.Wood@wessexwater.co.uk>
Sent: Tuesday, May 28, 2024 2:57 PM
To: James Blyth <James.blyth@awpexeter.com>
Cc: Tom Richards <Tom.Richards@awpexeter.com>
Subject: FW: WW Resp DEV SY49SE/ 34 - 1348 - South Street, Bridport - Foul pump rates enquiry - Standoff Details

Hi James

Further to our telephone conversation this afternoon, please find below a copy of my recent response to Verity with regards to capacity in the foul sewer network.

As discussed, there is a 250mm x 600mm oval, brick foul overflow sewer that traverses the site.

Wessex Water requires access to undertake our statutory duties as set out in the Water Industry Act 1991 to maintain and repair our assets. Therefore, there must be no buildings within a minimum of 4m either side of the outer edge of the foul overflow and no tree planting within a minimum of 6m. This includes no surface water attenuation features and associated earthworks in the standoff strip, changes in ground levels resulting in additional loading or excavation can lead to instability in the pipe. Wessex Water require unrestricted access to maintain and repair our apparatus.

I trust the above information clarifies our requirements.

Kind regards
Ann-marie

Ann-marie Wood
Planning Liaison Manager

Wessex Water
Claverton Down Bath BA2 7WW
Mobile number 07385 433347
wessexwater.co.uk

These comments are based upon known circumstances prevailing at the time of writing. A review of the contents of this email is required where 18 months or more have elapsed since issue or in the light of significant changes likely to impact upon the response (e.g. changes in development numbers or phasing). Please email review requests to planning.liaison@wessexwater.co.uk

From: Ann-Marie Wood
Sent: Friday, April 19, 2024 3:33 PM
To: Verity Saunders <Verity.saunders@awpexeter.com>
Cc: Planning Liaison <planning.liaison@wessexwater.co.uk>
Subject: RE: WW Resp DEV SY49SE/ 34 - 1348 - South Street, Bridport - Foul pump rates enquiry

Dear Verity

Thank you for contacting us again with the amended dwelling details.

The small increases from 44 to 48 apartments and 20 to 25 cottages are unlikely to have a great deal of impact on the previously proposed pump rate of 3.8 l/s and as such our comments would remain the same. I have included updated foul comments below based on the increased dwelling numbers; however, it is very much a repeat of our previous response.

Foul Drainage

Wessex Water will accommodate domestic type foul flows in the public foul sewer with connections made on a size for size basis, Developers fund the cost of connecting to the nearest 'size for size' sewer and Wessex Water will manage the sewer network to accommodate foul flows from granted development. We fund this through our infrastructure charging arrangements.

Wessex Water will accept (in principle) the proposed pump connection at a maximum discharge rate of 3.8 l/s to the existing 750mm diameter public combined sewer located on South Street to the east of the site. However, you should be aware that capacity is limited within the existing network and the proposed site is upstream of an existing CSO, as such a capacity appraisal and process review will be required to understand what, if any, improvement works will be necessary to accommodate any additional loading in the system and at the treatment works.

We don't have capacity improvement schemes readily prepared for sites that do not have existing planning permission, upon any grant of planning permission for this site, it will be necessary to undertake a modelling assessment and, if required, plan, design and construct a scheme of capital works to meet the

catchment growth. In such circumstance, we advise that we will need to reach agreement with yourself and the Local Planning Authority upon the timetable if a scheme of capacity works is required. In such circumstance the development should not proceed until Wessex Water has confirmed that capacity can be made available for these new connections.

The point of connection to the public network is by application and agreement with Wessex Water and subject to satisfactory engineering proposals constructed to current adoptable standards. The developer should contact the local development team development.south@wessexwater.co.uk to agree proposals for the Section 104 adoption and submit details for technical review prior to construction. Please Note: No surface water runoff, groundwater or land drainage will be accepted into the foul sewer either directly or indirectly.

Kind regards
Ann-marie

Ann-marie Wood
Planning Liaison Manager

Wessex Water
Claverton Down Bath BA2 7WW
Mobile number 07385 433347
wessexwater.co.uk

These comments are based upon known circumstances prevailing at the time of writing. A review of the contents of this email is required where 18 months or more have elapsed since issue or in the light of significant changes likely to impact upon the response (e.g. changes in development numbers or phasing). Please email review requests to planning.liaison@wessexwater.co.uk

From: Verity Saunders <Verity.saunders@awpexeter.com>
Sent: Friday, April 19, 2024 2:53 PM
To: Ann-Marie Wood <Ann-Marie.Wood@wessexwater.co.uk>
Cc: Planning Liaison <planning.liaison@wessexwater.co.uk>
Subject: RE: WW Resp DEV SY49SE/ 34 - 1348 - South Street, Bridport - Foul pump rates enquiry

[EXTERNAL EMAIL] DO NOT CLICK links or attachments unless you recognise the sender and know the content is safe.

Hi Ann-Marie,

We are progressing this application but note that this week will be 18 months since confirmation of rate/connection (below).

There has been an update to the proposed number of units as follows:

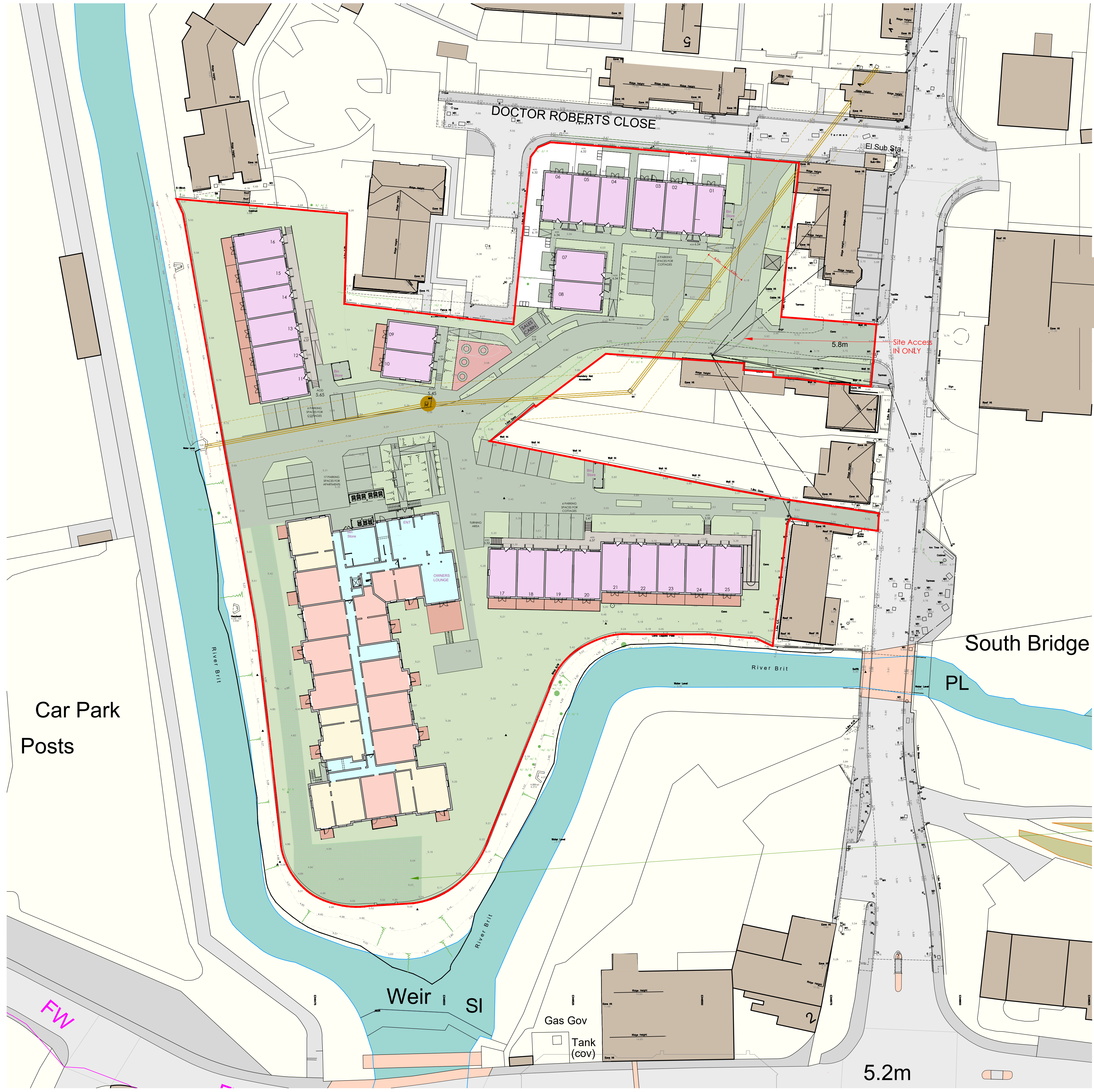
Cottages:	25
Apartments:	48

Can you confirm if this agreed connection and discharge rate is still acceptable and/or update as required to suit the new unit numbers?

Kind regards,

Verity Saunders

Appendix F Proposed Site Plan



REVISIONS

Rev.	Date	By
A xxx	xxxx	xx

APARTMENTS	
1 bed	32
2 bed	16
TOTAL	48
(33.3% 2B)	
COTTAGES	25
TOTAL UNITS	73
SITE AREA	DENSITY
10,587 m ²	69 units/hectare

PARKING	
Apartments (unallocated)	17 (0.35)
Cottages (unallocated)	18 (0.72)
TOTAL	35

- Soft landscape
- Hard landscape
- Balconies/terraces
- Ramps, steps and raised access areas

CHURCHILL RETIREMENT LIVING

planning issues
TOWN PLANNING AND ARCHITECTURAL DESIGN

Rob Jackson RIBA
Design Director - South West
Churchill House * Parkside
Ringwood * Hampshire BH24 3SG
Telephone: (01425) 462372
Fax: (01425) 462101
E-mail: design@planningissues.co.uk

Client

Churchill
Retirement Living

Project Title

Retirement Housing
Hanson and Phillips Depot
Bridport
DT6 3NP

Drawing Title

SITE PLAN
RED FILE

Scale 1:400 @ A1 Date May 2024

Drawn KR Checked RJ

Drawing No. Rev.

10070BP- RF 01

Bridport - Hanson and Phillips Depot, - Proposed Retirement Housing - Site Plan

Appendix G EA Charged Advice

Chris Yalden
Awcockward Partnership
Ada House Pynes Hill
Exeter
EX2 5TU

Our ref: WX/2022/136116/02-L01
Your ref: ENVPAC/1/WSX/00257

Date: 17 June 2022

Dear Mr. Yalden,

FLOOR LEVELS FOR NEW RETIREMENT APARTMENT BUILDING

SKILLING HILL ROAD/SOUTH STREET, BRIDPORT

Thank you for your request. This response is being provided under our pre-application charged advice service agreement ENVPAC/1/WSX/00257. Further to your email dated 16th February 2022 and accompanying drawing 22/SW001/TN02, we can offer the following comments.

Finished Floor Levels

With regards the specific query over finished floor levels, if there are self contained ground floor flats proposed, we would request ground floor levels set no lower than the 1 in 100 year flood level including 47% climate change allowance, plus 600mm freeboard. All development should be designed to be safe both now and in the future, and should assess the residual risks of defence failure and thus should be safe without the reliance upon existing infrastructure. Self contained ground floor flats are particularly vulnerable to flood risk due to lack of internal first floor safe haven, so although this site is within the 'defended floodplain' if these type of units are proposed we would request that this freeboard approach is taken. For two storey dwellings a slightly lower freeboard could be acceptable.

Climate Change

The 47% climate change could be estimated by taking the 'intermediate level' approach of using the existing modelled flood and flow data to construct a stage-discharge rating curve, which can be used to interpolate a flood level based on the required peak flow allowance to apply to the 'design flood' flow. Of course, the developer is also at liberty to use the existing River Brit modelling study to achieve a more robust climate change estimation.

Floodplain Compensation

In accordance with internal EA guidance, floodplain compensation can be necessary in defended areas in some circumstances. In defended areas the need for compensation should be based on the results of a sensitivity test. The test can be assessed using the points discussed below. Evidence and discussion will need to be provided by the developer for review.

- What increase in flood levels may result from development in the defended area if the defences were breached or overtopped?
- What is the effect of this change, how much better or worse will flooding be to properties in particular?
- Are the affects acceptable, and in reality, what mitigation measures can the developer implement to offset the impacts?
- Compensation will be an appropriate solution if the principle of development in the area is in accordance with the NPPF.

Site Layout and EA Flood Alleviation Scheme

With regards the layout of the site, and our Flood Alleviation Scheme, we would need to secure an easement / operational access across the site and adjacent to our Flood alleviation Scheme. Our primary concern is that a suitable access route is available from the site entrance through to the stoplog access through the floodwall at the southern end of the site, and adjacent to the flood wall along its entire length through the site. The proposed layout of properties could restrict this in places so we would require some layout amendments.

We typically need to remove silt from the confluence of the two river channels every 5 years or so. Our access / easement through the site needs to be sufficient for at least a 22T Long reach machine, and 8-Wheel tipper lorries to remove the material from the site. This route would need to be unobstructed and 8 m wide (6m may be sufficient on straight sections). The access route needs to have a surface that will not be damaged by the Plant / machinery (we could matt tarmacked areas for tracked machines, but the surface must be able to support the load of the lorries / machines).

It is likely that our floodwalls around the site will need some repair work in the future, and these activities will require suitable access and working areas. Having been constructed in the 1980's, the flood alleviation scheme is now around 40 years old and some assets & structures are nearing the end of their useful lives. The section of wall to the west of the site (left bank of the River Brit) is currently being monitored on a 6-monthly basis. We have observed some settlement in the wall, and there are clear indications of movement which will need to be addressed.

Any proposed gardens or other private land adjoining the wall must be avoided and there should be no other structures, planting, fencing etc. on or within 8m of the wall. Whilst our preference would be for public open space within 8m of the flood defence scheme to give us the necessary unhindered maintenance area, we would not object to the construction of public highway within this area (subject to detailed design and no impact on the Flood Wall, toe drainage, no increased ground levels etc). The developer would need to consider how the presence of our large machinery in the area may impact on residents. We would need our access routes and working areas to be unobstructed for the duration of any works. The position of any proposed permanent fixtures such as signage, street furniture etc., within public open space within the 8m

zones would also need very careful consideration.

There should be no increase in the existing ground level within 8m of the flood wall, and there should be no impact on the Flood Wall toe drainage. Any proposed resurfacing proposals within this area will need careful design. Drainage for surface water etc. will also need to be considered, and must not impact on the Flood Wall.

Sequential Test and Sequential Approach

We do not believe the site has been allocated through another plan. In order for the development to be considered appropriate in this location a Sequential Test should be undertaken as detailed within the Planning Practice Guidance: Flood Risk and Coastal Change. For the site to pass the Sequential Test it must be satisfactorily demonstrated to the local planning authority (LPA) that there are no alternative sites available for this development at a lower risk of flooding. We recommend that you discuss the requirements of the Sequential Test with Dorset Council at the earliest opportunity.

A sequential approach should be applied within the site to direct development to the areas of lowest flood risk. If the whole site is covered by Flood Zones 2/3, your Flood Risk Assessment (FRA) should still assess the flood characteristics across the site and should direct development, especially the more vulnerable elements, towards those areas with the lowest flood risk.

Flood Defence Consent

Under the Environmental Permitting (England and Wales) Regulations 2016 a prior written Environmental Permit from the Environment Agency is required for all temporary and/or permanent works in, under, over or within 8 metres of the bank top of a designated main river and/or the flood defence asset. This will apply along where the site is bordered by our Flood Alleviation Scheme. Some activities are now excluded or exempt. A permit is separate to and in addition to any planning permission granted. Further details and guidance are available on the GOV.UK website: <https://www.gov.uk/guidance/flood-risk-activities-environmental-permits>. To discuss the scope of the controls please contact the Environment Agency on 03708 506 506.

Final notes

We would also refer you to the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG) for guidance on planning policy and Flood Risk Assessment (FRA) requirements. The scope of the FRA must meet the requirements of the PPG, and as set out under the guidance contained within the following links:

<https://www.gov.uk/guidance/flood-risk-and-coastal-change>

<https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications>

<https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section>

We are unable to be prescriptive as to the scope of any FRA, but we would be pleased to review a draft FRA if one is submitted to us in due course.

Please note that the view expressed in this letter by the Environment Agency is a response to a pre application enquiry only and does not represent our final view in relation to any future planning application made in relation to this site.

We reserve the right to change our position in relation to any such application. You should seek your own expert advice in relation to technical matters relevant to any planning application before submission.

I hope this information proves useful and I appreciate your patience. If you have any further queries regarding our comments or wish us to review a future FRA in detail, please get in touch.

Yours sincerely,

Matthew Pearce
Planning Advisor

Email – swx.sp@environment-agency.gov.uk

Appendix H Flood Levels and Volumes Analysis

The nearest 14 nodes, up to 140m away from the site boundary, are extracted and indicated as points coloured black in Figure 1. Three additional points, coloured white, are included by using linear interpolation along the centre line of the river, by interpolating between the immediate upstream and downstream points.

A final three points are included, coloured yellow. These points are located at the maximum 2D modelled water levels within the site boundary for the 1% and 0.1% AEP events labelled Max 0.1%AEP and Max 1%AEP respectively, using the Digital Terrain Model (DTM) LiDAR and Fluvial Flood Zone maps to locate the two points for the undefended scenario. The third point, labelled Max 1%AEP+47, is located between these two points at the location where the DTM is the same value as the estimated Q100+47% event.

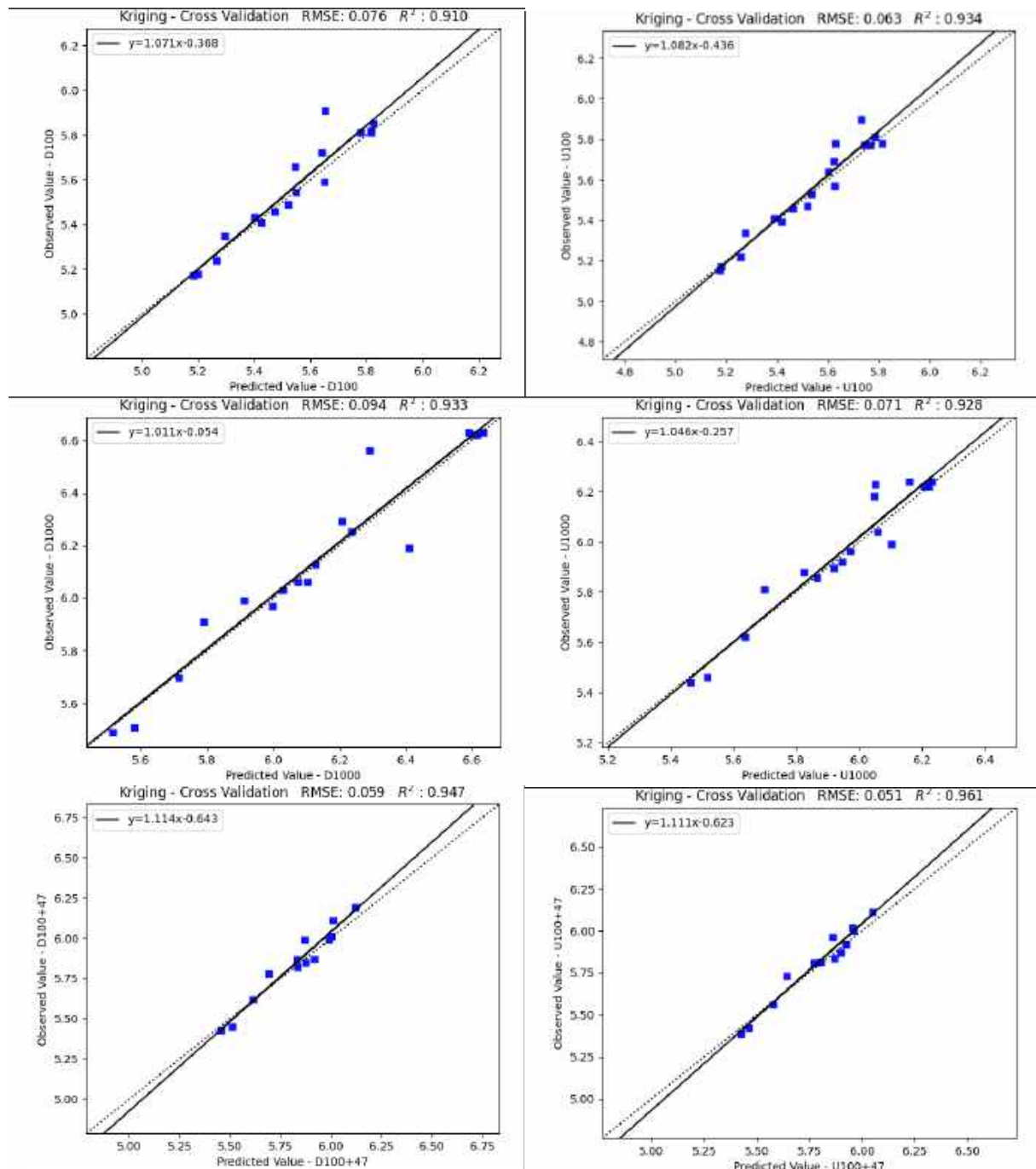
To create a fluvial flood level map for levels across the site, the geostatistical interpolation method of ordinary kriging was used, utilising the QGIS Plugin Smart-Map (version 1.3.3). The model used a linear interpolation with a maximum of 10 neighbours and to a radial distance of 125, which in testing was found to be the best trade-off between accuracy and overfitting of the model.

Validation – Using Flood Levels

Cross-validation of a raster map after kriging is a vital step in assessing the accuracy and reliability of the spatial interpolation. Cross-validation involves systematically removing one data point at a time for the dataset, then the kriging model is used to predict the value at the removed location based on the remaining points.

Ideally, the points should cluster closely around a 1:1 line, indicating that the model's predictions are accurate. The RMSE measures the magnitude of prediction errors. A lower RMSE indicates better model performance. A high correlation coefficient, R^2 , between the observed and predicted values indicates a strong relationship, implying a good model fit.

The cross-validation for all events is presented by plotting the predicted values of the flood levels against the modelled (observed) values in Figure 2 below.

Figure 2 – Cross-Validation of the Ordinary Kriging Method

A cross-validation of the kriging method shows that the R^2 value, remains above 0.90 and RMSE is below 0.10 for all event probabilities. A visual check of the interpolated krig maps found that there were no instabilities of the mapping within the site boundary.

Validation – Using Flood Zones

The undefended 1% and 0.1% AEP flood depth maps are created by subtracting the respective flood levels from the DTM LiDAR levels. The depth maps are compared against

the fluvial flood zone maps. Note that the fluvial flood zone maps remove any islands within the flood zone, such as the stockpiles, while these are evident within the depth maps.

Figure 3 – 0.1%AEP Depth Comparison of Krig to Flood Zone 2



Figure 4 – 1%AEP Depth Comparison of Krig to Flood Zone 3

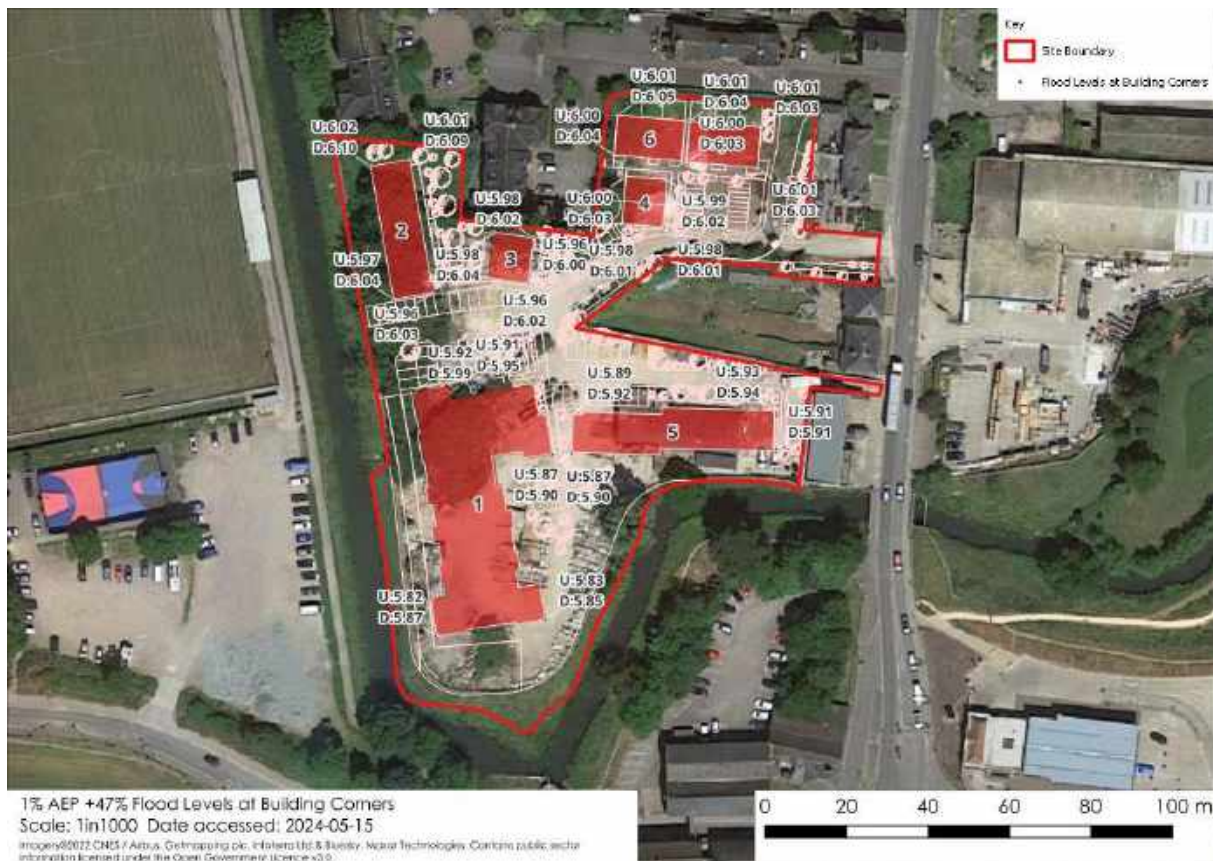
It is shown in Figure 3 that the 0.1% AEP depths match the Flood Zone 2 boundary closely. In Figure 4 showing the 1% AEP event, there are some areas shown to not be flooding in Flood Zone 3; however, these areas are areas of stockpiles or other locally raised features. In other areas, such as the centre of the site where there are no local features, they conform closely with each other.

Considering the above, the interpolated flood levels are validated for both the 1% AEP and 0.1% AEP for the flood storage compensation analysis and the 1% AEP +47% for fixing FFL's across the site.

FFL Analysis

FFLs were determined by extracting the 1% AEP +47% flood levels at the corners of all proposed buildings, considering both defended and undefended scenarios.

Figure 5 – 1%AEP +47% Flood Levels at Building Corners



The defended scenario levels are higher as they represent the water level within the river channel when flood defences are functioning as designed during a 1% AEP event. However, for the purpose of setting FFLs, the undefended scenario is more appropriate as it represents the potential flood level if the defences were to fail or be overtopped.

Flood Compensation Analysis

For the analysis, two stockpiles and an existing building are identified as large features that, when removed, will create extra storage capacity within the site. These are identified in Figure 6 below.

Figure 6 – Existing Features Taking Up Flood Storage

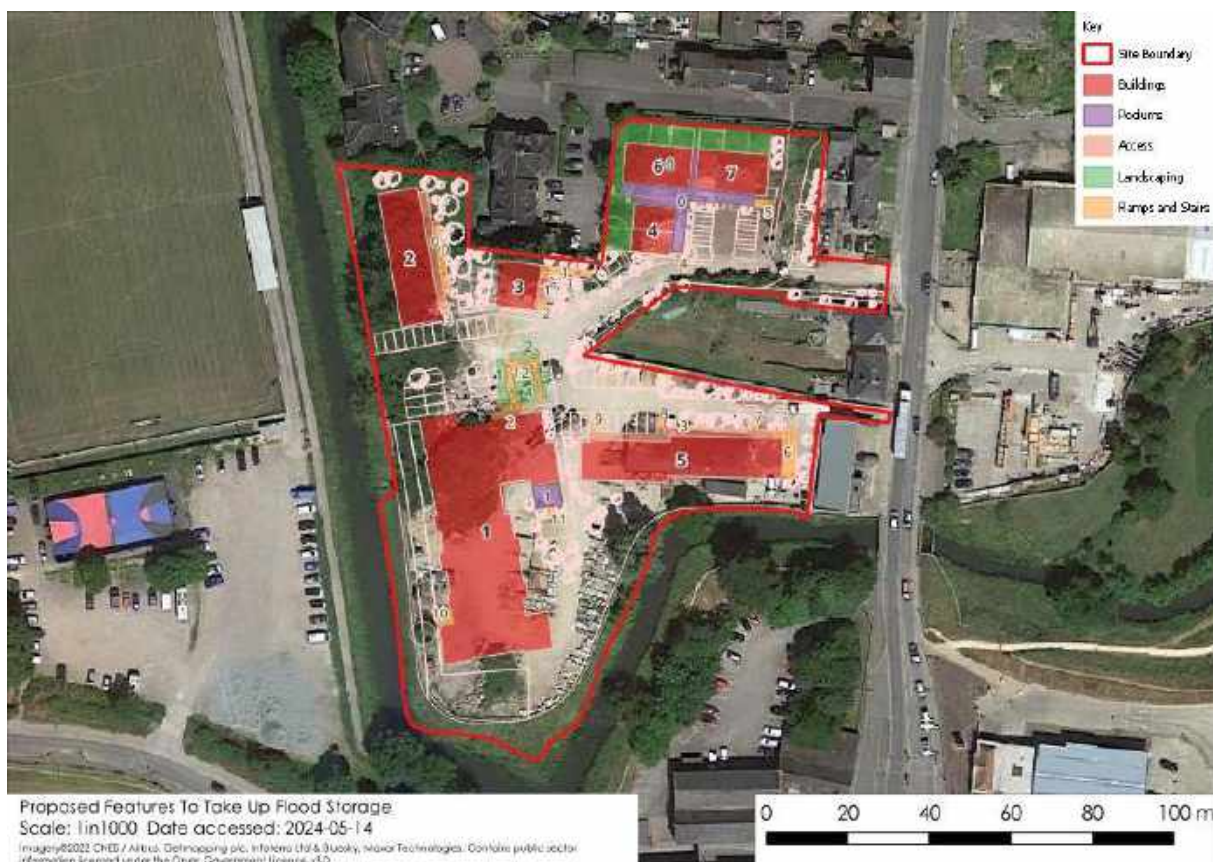


The volume of the stockpiles (SP#) is considered by calculating the flood volume above the stockpile area without the stockpile in place (using the topographic survey – SP#_Topo) and subtracting that from the flood volume above the stockpile area with the stockpile in place (using the Digital Surface Model (DSM) LiDAR – SP#_DSM). This allows a calculation of the stockpile that would offset the flood storage compensation for the different flood levels. Table 1 shows the stockpile volumes with respect to each flood scenario.

All the proposed building extents, stairways, ramps, podiums, raised gardens, landscaping, and accesses that will affect the flood storage required are identified below. Each area is given an ID number.

Table 1 – Stockpile Volumes, m³

Stockpiles	Def Q1000	Undef Q1000	Undef Q100
SP1_Topo	454.4	400.8	170.8
SP1_DSM	155.2	134.0	59.9
SP1	299.2	266.8	110.9
SP2_Topo	86.6	76.5	32.7
SP2_DSM	23.8	19.5	5.6
SP2	62.8	57.0	27.1
TOTAL (SP1+SP2)	362.0	323.8	138.0

Figure 7 – Proposed Features to Take Up Flood Storage

Flood Compensation Results

When calculating the volumes of flooding within each of these areas, a 0.25 m resolution raster of the topography is compared against a 0.5 m raster of the kriged flood levels using the QGIS plugin Volume Calculation Tool (version 0.4) and calculated at a resolution of 0.5 m.

The output presumes that each area has vertical sides, which is a conservative approach for sloped areas such as the stairs, ramps, and landscaping.

Voids are located under buildings 1,2 and 5, and under all the accesses. These voids are presumed to provide 85% flood storage, where 15% is given to the structure. Podium 1 is

Table 2 – Flood Storage Volumes, m³

Feature	Def Q1000	Undef Q1000	Undef Q100
Building 1	1215.9	1071.6	458.6
Building 2	110.0	83.4	0.5
Building 3	47.9	40.4	0.7
Building 4	6.3	4.0	0.0
Building 5	355.0	298.4	89.4
Building 6	26.4	22.0	0.0
Building 7	8.9	6.4	0.0
Build Void 1	-1033.5	-910.9	-389.8
Build Void 2	-93.5	-70.9	-0.4
Build Void 5	-301.8	-253.6	-76.0
Access 0	16.3	13.2	0.3
Access 1	5.1	4.4	0.0
Access 2	9.4	8.4	3.5
Access 3	49.1	39.6	6.5
Access Void 0	-13.9	-11.2	-0.3
Access Void 1	-4.3	-3.7	0.0
Access Void 2	-8.0	-7.1	-3.0
Access Void 3	-41.7	-33.7	-5.5
Podium 0	19.2	14.8	0.0
Podium 1	0.0	0.0	0.0
Landscaping 0	7.7	5.3	0.0
Landscaping 1	20.0	17.8	6.7
Landscaping 2	11.2	10.0	3.4
Landscaping 3	6.5	5.8	2.1
Landscaping 4	36.0	32.2	12.7
Ramps 0	9.2	7.5	0.0
Ramps 1	6.3	5.3	0.0
Ramps 2	1.0	0.8	0.0
Ramps 3	0.9	0.8	0.1
Ramps 4	0.0	0.0	0.0
Ramps 5	0.2	0.0	0.0
Ramps 6	35.7	29.6	11.5
Ramps 7	1.4	1.1	0.3
Ramps 8	1.1	0.9	0.0
Ramps 9	1.4	1.2	0.4
Ramps 10	8.2	7.4	4.0
Ramps 11	2.2	1.9	0.6
Ramps 12	39.3	35.1	13.5



Feature	Def Q1000	Undef Q1000	Undef Q100
Stockpiles	-362.0	-323.8	-138.0
Existing Building	-255.8	-211.1	-48.8
SUM	-56.7	-56.7	-47.0

raised on stilts and therefore is fully offset. Flood volumes are given for each feature in Table 2 below, where negative values in green are flood storage mitigation volumes from the voids, and removal of the stockpiles and existing building.

Output

The removal of the stockpiles, existing building, the inclusion of the voids under building 1, 2, and 5, as well as the voids under all the accesses fully mitigates the flood storage compensation required for all scenarios.

Appendix I Run-off calculations



Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	2 year (l/s)	1.8
Summer CV	0.750	Drain Down Time (mins)	240	30 year (l/s)	5.0
Winter CV	0.840	Additional Storage (m³/ha)	0.0	100 year (l/s)	6.6
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	45	0	0
30	45	0	0
100	45	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	2.40
Greenfield Method	FEH	Growth Factor 100 year	3.19
Positively Drained Area (ha)	0.703	Betterment (%)	0
SAAR (mm)	828	QMed	1.8
Host	1	QBar	2.1
BFIHost	0.652	Q 2 year (l/s)	1.8
Region	7	Q 30 year (l/s)	5.0
QBar/QMed conversion factor	1.136	Q 100 year (l/s)	6.6
Growth Factor 2 year	0.88		

Colebrook-White Pipe Capacity Analysis

Project No.	1348	
Project Title	South Street, Bridport	
Client	Planning Issues Ltd	
Sheet Ref	P:\1348 South Street, Bridport\D Design and Analysis\SPREADSHEETS\01 Drainage\03 Sewer Design\[Colebrook White Equation (pipe velocity & capacity).xlsx]Colebrook-White	

Calcs by	VS
Checked by	JB
Approved by	CPY
Date	06.06.2024
Revision	Initial Issue

Pipe capacity calculation based on the Colebrook White Equation (HR Wallingford, 1990);

$$V = -2\sqrt{(2gDS)} \log_{10} \left(\frac{k_s}{3.7D} + \frac{2.51\nu}{D\sqrt{(2gDS)}} \right)$$

Fluid type:

Surface

Where:

D	Pipe diameter	1 in	150 mm
S	Hydraulic gradient		100 m/m
k _s	Effective pipe roughness		0.6 mm
g	Gravitational acceleration		9.81 m/s ²
ν	kinematic viscosity		1.01E-06 m ² /s
A	Cross-sectional flow area		0.018 m ²
Q	Discharge		17.754 l/s
V	Velocity		1.00 m/s

Catchment area analysis based on Modified Rational Method equation (HR Wallingford, 1990);

$$Q_{BAR} = 2.78 \cdot i \cdot A$$

Hydrological Region:

7

 *see map

Where:	Q _{BAR}	Average discharge (l/s)	
	i	Rainfall intensity (mm/hr)	43.2 mm/hr *see map
	A	Catchment area (m ²)	

Return Period	2yr	30yr	100yr
Growth Factor (Q/QBAR)	0.88	2.4	3.19
Critical Area (ha)	0.1680	0.0616	0.0463

(area that can freely drain)

Brownfield flow rate analysis based on Modified Rational Method (HR Wallingford, 1990);

	2yr	30yr	100yr	QBAR
Area (ha): 0.780	BF flow (l/s): 82.4	224.8	298.8	93.7

Foul capacity analysis for dwellings based on Sewers for Adoption (6th Edition);

l/dwelling/day	0.046
No. dwellings served	383
No. dwellings served +10% infiltration	349

Appendix J Preliminary Drainage Layout



The development has been set back from the existing flood defence in line with advice received from the EA, providing 6m clearance on straights and 8m on bends, to provide access to the southern defence gate which provides access to the confluence of rivers.

Under-Drained Permeable Paving.

Proposed under-drained permeable paving to relieve surface runoff from roof catchments, external hard paving and parking courts to provide treatment and attenuation storage.

Under-slab flood voids to be provided to ensure the proposed development does not reduce flood storage overall, if the defences are breached or overtopped. The voids will be accessed by external flood grills and will comprise internal surfacing material to prevent scour and erosion. The voids will be managed by the building operator and will not be repurposed for any other use (i.e. storage or similar).

Existing Wessex Water combined sewer overflow to be retained. No new connections proposed and built form to remain outside a 4m easement from edge of sewer. 2no. minor relaxations have been agreed for the proposed cottages. Overall access to the existing culvert is being improved compared to existing site conditions.

Exceedance

Beyond the capacity of the proposed surface water network and attenuation, exceedance flows would be directed away from the proposed building and towards areas of landscaping, and/or car parking, wherever possible. Beyond the capacity of the site, flows would continue East onto South Street and South towards the River Brit. Flows at the lower edge of site may become impounded behind existing defences but will not impact buildings due to raised property FFL's.

Foul Water Strategy:

Foul flows generated by the proposed site to connect to the existing adopted combined sewer network in South Street via a new private connection as agreed with Wessex Water.

Notes

- The proposed development has been assessed in line with the NPPF, to allow the planning application to be progressed and to show that the development can be undertaken in an acceptable manner from a flood risk perspective.
- The extents of built development are located with Flood Zone 2/3 and located within an area at risk of reservoir flooding.
- The site is not susceptible to flooding from pluvial and groundwater flooding, and not thought to at risk of flooding from drainage infrastructure or other non-reservoir artificial sources.
- Finished floor levels have been calculated from data provided by the EA in a product 4 data request. FFLs provide a freeboard of at least 600mm for apartments and 300mm to for cottages.
- The effects of the development on flood volume compensation have been determined and with the inclusion of flooded sub-voids the effects of the development on the wider flood plain are expected to be neutral.
- To ensure the development is safe throughout its lifetime, the surface water strategy accounts for runoff in up to the 100 year return period.
- The strategy also safeguards against the upper end allowances for climate change (45%), providing betterment over undeveloped conditions, where the rate and volume of runoff would continue to increase due to climate change.
- Ground conditions precluded the use of soakaways so an attenuated discharge to the main river confluence in proposed.
- The use of SuDS attenuation will enable storm water runoff to be stored on site and discharged to the existing watercourse at rates not exceeding the 1in30yr equivalent greenfield rate, with allowances for climate change. The SuDS will also provide water quality enhancement, together with biodiversity and amenity benefits.
- During exceedance events runoff will be directed towards areas of open green space and the proposed attenuation features, where any freeboard allowances will be utilised. Exceedance flows would not threaten FFLs in any likely scenario and can be discharged to the watercourse via existing site connections protected with flap valves.
- Foul flows generated by the development will benefit from a pumped connection to the existing on-site public foul network.

Existing exceedance routes maintained on western boundary. Exceedance flows will rely on existing site outfalls as far as practicable, beyond which flows would impound in site but will not impact buildings due to raised property FFL's.

Existing flood prevention measures at headwalls to be retained and rehabilitated as required.

Surface Water Strategy:

Surface Water Discharge

Proposed surface water sewer to discharge to the existing outfall into the River Brit. Flap valve installed.

Flow Control

Pumped flow control to pump flows before discharging into existing outfall into the River Brit. The pump is to overcome the risk of surcharged outfall and maintain a positive discharge

Cellular Attenuation

Cellular tanks to receive flows from external hard-standing and roof catchments. Chambers immediately upstream of tank to include silt traps.

Maintenance

Geocellular Attenuation Tank to be fitted with access turrets for maintenance of feature. Minimum 1no. cover to be vented in accordance with manufacturer recommendations.

Key

- Site Boundary
- Net Developable Area
- Flood Defence (Existing)
- Flood Voids (Proposed)
- WW Overflow 4m (either side) easement
- Existing Drainage
 - Adopted Foul Water Rising Main
 - Adopted Foul Water Sewer
 - Adopted Combined Water Sewer
 - Private Surface Water Sewer
 - Adopted Combined Water Manhole
 - Adopted Foul Water Manhole
 - Existing Headwall
- Proposed Drainage
 - Building Catchment
 - Existing Hardstanding Surfacing
 - Under-drained Permeable Paving
 - ACO Drain
 - Private Surface Water Inspection Chamber
 - Private Foul Water Inspection Chamber
 - Private Surface Water Pump
 - Private Foul Water Pump
 - Private Foul Water Sewer
 - Private Surface Water Sewer
 - Private Foul Water Rising Main
 - Private Surface Water Rising Main
 - Private Cellular Attenuation tank
 - Overland Flood Flow Route

Area Summary Schedule

Site Area	1.059 ha
Existing Impermeable Area	0.780ha
Net Developable Area	0.703 ha
Impermeable Area	0.552 ha

Pre-Development Runoff

The site is brownfield however the equivalent greenfield runoff rates have been assessed for the 'Net Developable Areas' using the FEH Method. The whole site brownfield rate has been calculated using the Modified Rational Method (MRM).

Existing Runoff Rates

Return Period	Brownfield Runoff Rate [0.780 ha]	Equivalent Greenfield Runoff Rate [0.703 ha]
2yr	82.43	1.8
30yr	224.82	5.0
100yr	298.82	6.6

Future proposed runoff rates will be limited to 1.8l/s in the 2 year storm period and 5.0l/s in the 30 & 100 year storm period through two pump controls. Limiting discharge rates to 5.0l/s in the 100 year storm provides a betterment of 98% over brownfield conditions.

Attenuation Summary

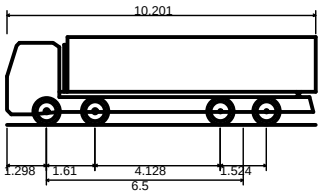
Under-Drained Permeable Paving

Ownership	Private
Catchment	0.197 ha
Hydraulic Control	Ø100mm Orifice @IL
Porosity	30%
Permeable Paving Effective Dimensions:	700m ² x 0.375m
100yr+45%CC Volume	76.9m ³

Cellular Attenuation Tanks

Ownership	Private
Porosity	95%
Catchment	0.355 ha
Tank 1 dimensions	51m ² x 1.2m depth
Tank 2 dimensions	94.25m ² x 1.2m depth
Tank 3 dimensions	130m ² x 1.2m depth
Tank 4 dimensions	45m ² x 1.2m depth
Tank 5 dimensions	63m ² x 1.2m depth
Flow Controls	Pump 1 - 1.8l/s @IL Pump 2 - 5.0l/s @IL+0.414m
100yr+45%CC Volume	422.4m ³
Total 100yr+45% Volume Required:	499.3 m³
Total 2yr+45% Peak Discharge	1.8 l/s
Total 30yr+45% Peak Discharge	5.0 l/s
Total 100yr+45% Peak Discharge	5.0 l/s

A	06.06.2024	INITIAL ISSUE	VS	JB	CPY
REV	DATE	DESCRIPTION	BY	CHK	APD
DRAWING STATUS: PLANNING APPLICATION					
CLIENT: CHURCHILL RETIREMENT LIVING					
PROJECT: SOUTH STREET, BRIDPORT					
TITLE: PRELIMINARY DRAINAGE LAYOUT					
PROJECT No:	1348	DRAWING No:	01-PDL-1001	REV:	A
SCALE @ A2: 0 1:500 25 metres					
DESIGN BY:  awcockward partnership					
Awcock Ward Partnership, Ada House, Pynes Hill, Exeter, EX2 5TU Tel: 01392 409007 Web: www.awpexeter.com					



Large Tipper
Overall Length 10.201m
Overall Width 2.495m
Overall Body Height 2.890m
Min Body Ground Clearance 0.341m
Track Width 2.471m
Lock to lock time 6.00s
Kerb to Kerb Turning Radius 11.550m

						PROJECT: SOUTH STREET, BRIDPORT			 						
C	06.06.2024	UPDATED MASTERPLAN	TMR	DOPA	CPY										
B	20.02.2023	UPDATED MASTERPLAN	CAM	DOPA	CPY	TITLE: TIPPER LORRY VEHICULAR SWEPT PATH ANALYSIS									
A	16.09.2022	INITIAL ISSUE	MR	AJW	AJW										
REV	DATE	DESCRIPTION	BY	CHK	APD										
CLIENT: CHURCHILL RETIREMENT LIVING						PROJECT No: 1348				DRAWING No: 03-ATR-102			REV: C		
DRAWING STATUS: FOR INFORMATION ONLY						SCALE @ 1:500				25			 metres		

Awcock Ward Partnership, Ada House, Pynes Hill, Exeter, EX2 5TU
Tel: 01392 409007 Web: www.awpexeter.com



awcockward
partnership

Awcock Ward Partnership, Ada House, Pynes Hill, Exeter, EX2 5TU
Tel: 01392 409007 Web: www.awpexeter.com

Appendix K Causeway FLOW Calculations



Awcock Ward Partnership
Ada House
Exeter
EX2 5TU

File: 1348-SW-101-A.pfd
Network: Storm Network
Verity Saunders
06/06/2024

Page 1
1348
South Street
Bridport

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	45	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
Paving	0.197	4.00	100.000		0.525
Tank	0.355	4.00	100.000	1200	2.400

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1	Paving	Tank	10.000	0.600	99.475	97.600	1.875	5.3	150	4.04	46.8

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	2 year (l/s)	1.8
Summer CV	0.750	Drain Down Time (mins)	240	30 year (l/s)	5.0
Winter CV	0.840	Additional Storage (m³/ha)	0.0	100 year (l/s)	6.6
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	45	0	0
30	45	0	0
100	45	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	2.40
Greenfield Method	FEH	Growth Factor 100 year	3.19
Positively Drained Area (ha)	0.703	Betterment (%)	0
SAAR (mm)	828	QMed	1.8
Host	1	QBar	2.1
BFIHost	0.652	Q 2 year (l/s)	1.8
Region	7	Q 30 year (l/s)	5.0
QBar/QMed conversion factor	1.136	Q 100 year (l/s)	6.6
Growth Factor 2 year	0.88		

Node Tank Online Depth/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 97.600



Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	1.800	0.412	1.800	0.413	1.800	0.414	5.000	2.400	5.000

Node Paving Online Orifice Control

Flap Valve	x	Design Depth (m)	0.300	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)			
Invert Level (m)	99.475	Diameter (m)	0.100		

Node Paving Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	99.475	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	124	Depth (m)	0.375
Safety Factor	2.0	Width (m)	70.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node Tank Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	97.600	Depth (m)	1.200
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	38.000	Number Required	1
Porosity	0.95	Pit Length (m)	10.000		



Results for 2 year +45% CC Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	Paving	120	99.604	0.129	11.8	25.9431	0.0000	OK
720 minute winter	Tank	705	98.003	0.403	12.2	146.0441	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute winter	Paving	1	Tank	5.9	1.050	0.075	0.0993	
720 minute winter	Tank	Depth/Flow		1.8				99.3



Results for 30 year +45% CC Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Paving	88	99.766	0.291	33.4	60.0920	0.0000	FLOOD RISK
600 minute winter	Tank	570	98.407	0.807	26.0	292.3107	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute winter	Paving	1	Tank	10.3	0.879	0.132	0.1047	
600 minute winter	Tank	Depth/Flow		5.0				190.5



Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.94%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Paving	90	99.846	0.371	41.8	76.8512	0.0000	FLOOD RISK
960 minute winter	Tank	885	98.767	1.167	25.3	422.4375	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute winter	Paving	1	Tank	11.8	0.925	0.152	0.1065	
960 minute winter	Tank	Depth/Flow		5.0				275.0