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LIDL, HAYLING ISLAND

FLOOD RISK ASSESSMENT AND SUDS REPORT

MARCH 2017



Ref: 15045-01-FRA

REVISION B

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Client: Lidl UK GmbH

Revision / Date	Prepared by	Checked by	Approved by
- / 24.03.2017	Elliott Flynn	Andrew Keen	Andrew Keen
A / 09.04.2017	Elliott Flynn	Andrew Keen	Andrew Keen
B / 12.10.2017	Elliott Flynn	Andrew Keen	Andrew Keen

Preamble: Revision B of this report was produced in response to an objection by the Environment Agency to the previous revision on the grounds of inappropriate compensation to fluvial flooding. This report takes account of new river modelling undertaken by JBA Consulting to better understand the flood risk.

1.1 Hemsley Orrell Partnership (HOP) has been instructed by Lidl UK GmbH to carry out a Flood Risk Assessment and SuDS report for a proposed development on land off of Manor Road, Hayling Island, near postcode PO11 0QN – herein referred to as ‘the site’ or ‘the plot’.

1.2 The plot is currently greenspace, being used seasonally as paddocks. Proposals are for a commercial development consisting of a Lidl supermarket with associated access, car-parking, and landscaping.

1.3 According to EA data the plot resides within Flood Zone 2 and 3 and therefore a FRA is required to be submitted as part of the planning application for the development.

1.4 The information contained within this report also provides the evidence required by Hampshire County Council as Lead Local Flood Authority to review the SuDS design against the criteria specified with their Guidance for Developers, Designers and Planners document. A checklist has been provided in Section 11 demonstrating compliance.

1.5 This report has been carried out in accordance with data and guidance provided by JBA Consulting; the Environment Agency (EA); the British Geological Survey (BGS); The Partnership for Urban South Hampshire (PUSH) Strategic Flood Risk Assessment (SFRA); and is in line with the guidance on Flood Risk and Development as provided in the National Planning Policy Framework (NPPF) and its associated Planning Practice Guidance (PPG).

1.6 Information in this report has been received from a number of external parties and HOP does not accept liability for the accuracy of this information. Should there be a material change to the development proposals, legislation or a change in end use, this report will need to be revised to reflect those changes.

1.7 An initial site walkover survey was undertaken by Elliott Flynn and Ivan Ramirez of HOP on 7th February 2017.



Figure 1.1. Location map.

2.0 SITE SETTING

- 2.1 The site location could be considered approximately central within Hayling Island, being located north of most of the island development. The southern shoreline (Hayling Bay) is approximately 2km from site, the western shoreline (Langstone Harbour) is some 1km away and the eastern shoreline (Chichester Harbour) is approximately 700m away. A location map is shown in Figure 1.1.
- 2.2 With reference to the immediate area surrounding the site; the north is bounded by the A3023 Manor Road, small patches of woodland are located to the west, east – beyond which is Church Road – and most of the southern boundary, with a residential plot on the south east corner. Separate drainage ditches surround the plot, except on the south/south-east boundary which features a stream – categorised as a Main River by the EA.
- 2.3 The site is approximately 1.16 ha in size being of approximate rectangular shape – see Figure 2.1. It is currently accessed by vehicles via a gate on the north-west corner. The land is made-up of maintained grass which is utilised as pasture land for horses and, aside from a number of paddock fences, could be considered flat and relatively featureless – see Figure 2.2. The topographical survey by RPS (Appendix II) depicts higher land at an approximate average of 4.25m AOD to the east and lower land at 3.80m on the west, which results in an approximate slope across site of 1:300.



Figure 2.1. Aerial view of the plot

- 2.4 With the exception of the northern boundary mature and semi-mature trees surround the site. The tree roots from the neighbouring trees are mostly limited under the plot, as the majority of tree trunks are featured on the opposing side of the drainage ditches or stream bank to the plot. A preliminary sketch has been undertaken by a RPS Arboriculturalist identifying the no dig zones to date and Tree Protection Orders (TPO's) – See Appendix IX.
- 2.5 The stream to the south east is purportedly known as Church Road Stream according to neighbouring residents, and is referred to as such in this report. The stream flows north

towards the site, bounding the rear of Church Road properties, before returning eastwards as it reaches the site just within the site boundary. As the stream flows eastwards it enters a small patch of woodland beyond the site boundary and reaches a brick headwall with a 225mm diameter outlet which conveys the stream into a public drainage network – see Appendix II for Sewer Records. The EA have confirmed (Appendix III) that the headwall and the 225mm dia outlet is the responsibility of the Highways Authority.

- 2.6 The stream depth that was encountered during the site walkover was not surveyed, however visual observations show that the stream level was approximately 80mm above the surveyed invert level (3.07m) of the discharge pipe depicted in figure 2.3. This gives an approximate top of stream level as 3.15m AOD (above Ordnance Datum) at this location at approximately 11:00am 7th February 2017.
- 2.7 According to forecasts at the time the weather preceding the site visit was understood to have been moderate sustained precipitation over a period of about a week, and the Site Investigation Consultant (Opus) confirmed that the preceding day had substantial, albeit unmeasured, precipitation. The catchment serving the Church Road Stream is relatively small with reference to OS contour maps and has low permeable top soil therefore the catchment is considered ‘flashy’ in nature and reactive to short time periods of precipitation. The conditions and levels of the stream observed during the walkover could be considered ‘typical’ for the wetter winter period.
- 2.8 The surrounding drainage ditches were observed to be generally ‘dry’ during the site walkover, with their depth estimated at about 0.7m deeper than the plot level. A small ponded area of ditch was present on the north east corner about 100mm deep. Ponded water was observed at multiple local low points on the site; this was believed to be due to the recent rain and the clayey makeup of the topsoil.



Figure 2.2. View southwards of the site



Figure 2.3. Church Road Stream Headwall

- 2.9 Information available through the BGS online mapping service shows that the site bedrock geology is anticipated to be of the London Clay Formation, described by BGS as ‘clay, silt and sand’, with superficial deposits recorded as River Terrace deposits, described by BGS as ‘sand, silt and clay’.
- 2.10 An initial site investigation by Opus was undertaken 6th December 2016 which involved borehole drilling and installation of monitoring wells. The descriptions of the soils match what was anticipated from BGS records. The underlying soils were generally clayey with pockets of more sandy soil, while the topsoil was described as clayey sand topsoil.
- 2.11 Return groundwater monitoring visits were undertaken by Opus on at least two other occasions; 16/12/16 and 21/12/16 which recorded variable groundwater levels across the site between 3.79m bgl (below ground level) and 0.52m bgl – See Appendix VIII.
- 2.12 Opus returned to site 6th-7th February 2017 under the request of HOP to undertake shallow soakage tests in locations that were previously identified as having a lower groundwater. Soakage test proved that the ground was not suitable for infiltration, with the groundwater

generally rising to 1.0-0.5m bgl in all test locations. The testing was further complicated by the observations of perched surface water on the topsoil flowing into the open trial pits.

- 2.13 The site is not shown to be within a groundwater Source Protection Zone (SPZ) according to EA online mapping service.
- 2.14 A second site walkover was undertaken by Elliott Flynn of HOP 16th May 2017. The hydrological and hydrogeological conditions observed were as follows: The Church Road Stream exhibited a 'trickle' flow, and a groundwater reading was taken from a historic borehole monitoring well at 0.3m below surface level.

3.0 DEVELOPMENT PROPOSALS

- 3.1 The development proposals include the erection of a food store with a footprint of over 200m² in size, being two storeys in height. A vehicle crossover, access road and parking will serve the site. A significant portion of the land will remain as landscaping as depicted in figure 3.1. Architectural proposals are included in Appendix VI.
- 3.2 Surface water proposals are discussed in Section 5 of this report and some of the landscape proposals and the proposed finished floor level of the building are discussed in Section 6.



Figure 3.1. Extract from architect's proposed plan.

4.0 FLOOD HAZARD DEFINITION

Fluvial and Tidal Flooding

- 4.1 Flood data for the site has been obtained from the EA and is included in Appendix V. The site is shown to be within Flood Zone (FZ) 1, 2 and 3. Flood Zone 3 represents portions of land with the highest probability of flooding – 1 in 100 (1%) chance of flooding each year – from rivers and the sea.
- 4.2 A pre-planning meeting was undertaken with Flood Risk officer Daniel Watson of the EA and Elliott Flynn and Ivan Ramirez of HOP on 08.03.17. In this meeting Daniel Watson confirmed verbally that the modelled flood levels are based on fluvial flooding and not tidal flooding.
- 4.3 Over the following two months there was some ambiguity on the interpretation of the EA data and how to calculate compensation for displaced flood zones. Dan Watson issued updated JFLOW modelled information 05.04.17 which included the impacts of climate change for the 1 in 100 and 1 in 1000 storm return period – See Appendix V. The methodology for calculating incremental flood zone compensation when utilising the JFLOW data was agreed 20.06.17, the details/correspondence of which is documented in Appendix III.
- 4.4 The limitations of the JFLOW model were recognised and therefore in order to better understand the risk associated with fluvial flooding, a detailed fluvial model assessment was commissioned in July 2017, and was undertaken by JBA Consulting. The JBA model and output attached in Appendix XI supersedes the JFLOW model, as it is considered more accurate due to the physical surveying of the channels and culverts, as well as a site specific analysis of the surrounding topography and catchment characteristics. The JBA assessment also allowed a range of storm events to be modelled, which included climate change allowances that are appropriate for this development.
- 4.5 The JBA model has demonstrated that the site does not experience any fluvial flooding for all modelled storm events up to and including the 100 year return period with a 45% allowance for climate change. The 45% climate change allowance represents the higher central allowance and is considered most appropriate for the commercial development in accordance with EA guidelines. As a result of the findings, no flood zone compensation is required as part of the development proposals.
- 4.6 Further analysis was undertaken for larger storm return periods with variable allowance for climate change, the extent of flooding for these events is depicted in the JBA report. Notably the 100 year storm return period with 105% allowance for climate change resulted in flooding under the proposed development hardstanding footprint of 68m².
- 4.7 A blockage assessment was also undertaken to understand the impacts of a blockage at the Church Road Stream headwall.
- 4.8 The original site walkover identified the headwall with the 225mm diameter outfall which serves the Church Road Stream as a location vulnerable to blockages. Substantial leaf litter and branches were observed within the stream channel, which have the potential to block the outfall. The neighbouring land owner on the south east corner of site stated that they clear litter periodically here in an attempt to prevent blockages. Should the stream outfall block then topographical levels suggest that the Church Road Stream would likely back-up around the eastern portion of the plot and within the adjoining east woodland patch before

overflowing to Church Road and the roundabout on Manor Road – this has also been demonstrated by the JBA modelling.

- 4.9 A larger stream is located to the north of Manor Road running parallel to the road, with a flow westwards. The walkover identified a number of pipe connections to this stream, which are likely from highway drainage.
- 4.10 In summary, the recent modelling undertaken by JBA has demonstrated that the risk from fluvial flooding is not as high as EA flood maps suggest, and the site should be considered to reside partly in Flood Zone 1 and 2, and not in Flood Zone 3.

Groundwater Flooding

- 4.11 As discussed in paragraph 2.11 and subsequently in 2.14 the groundwater level at the site was variable, but is generally considered high. The highest groundwater level recorded was 0.30m bgl, and so for the purposes of design this worst case level has been assumed across the site. Groundwater levels were recorded over several winter months, and so whilst it is recognised that the groundwater height will vary seasonally, the recordings were taken during the more onerous winter period.
- 4.12 The PUSH SFRA identifies the area as having low bedrock permeability.
- 4.13 The risk of flooding from groundwater is considered moderate to high if the proposed levels create low spots for water to migrate to.

Surface Water Flooding

- 4.14 Surface water flooding extents have been obtained from the online EA data and show that there is a low risk of surface water flooding for a small portion of land on the north east extent and the central southern boundary, with a very low risk identified for the remaining site.

Flooding from Sewers

- 4.15 The PUSH SFRA identifies one nearby location of 'Southern Water observed flooding incidence' some 80m east of site beside a residential property; the cause of this flooding was unknown.
- 4.16 Anecdotal evidence obtained during the site walkover has suggested that the drainage network that receives the Church Road Stream may be in poor condition or have insufficient capacity. Ponding has purportedly occurred around the roundabout to the north east of site, which has seen a clean-up response from authorities. The exact cause of the flooding and the true extents are unknown.
- 4.17 The PUSH SFRA does not identify any historical flooding around the roundabout, but it does identify an extent of flooding some 80m south of the roundabout within Church Road; the source of this flooding is unknown.
- 4.18 Daniel Watson of the EA stated that he believed there were issues with a sewer within Church Road and recalled a CCTV survey within the vicinity. The CCTV report was requested, but was not received.

Flooding from canals, reservoirs and artificial sources

- 4.19 The risk of flooding from canals, reservoirs and artificial sources is considered to be very low.

Sequential and Exception Tests

- 4.20 The Sequential Test provides a framework for Local Planning Authorities (LPA) through which development is steered towards the most appropriate Flood Zone. A detailed Sequential Test has been presented in the Planning and Retail Statement (Ref LIDW3001) and for the purposes of this report it is considered that the Sequential Test is demonstrated to be passed in this instance.
- 4.21 The proposed development use is commercial which is classified as 'Less Vulnerable Development' according to Table 2 of the NPPF Planning Practice Guidance. As such, the proposals for the development are considered compatible development within Flood Zone 2, as described in Table 3 of the NPPF Planning Practice Guidance and therefore do not require the Exception Test.

5.0 SURFACE WATER DRAINAGE

- 5.1 As a greenfield site the plot does not have any positive drainage networks. A Greenfield runoff rate has been calculated using the HR Wallingford tool, producing a Qbar of 3.27l/s – see Appendix VI.
- 5.2 In line with guidance issued by DEFRA and the EA (report number SC030219) a practical discharge rate of 5l/s can be utilised for the proposed controlled discharge, where greenfield runoff has been calculated less than 5l/s.
- 5.3 Proposed surface water designs are depicted on HOP drawing DR01 but are summarised in the following text: Storm water volume will be managed by attenuating runoff within the proposed high void sub-base (DOT Type 3 material or suitable graded approved material) which will be contained within a membrane tanked system. The surface course of the hardstandings will likely be impermeable and so gradients will be designed to convey runoff to gullies which will discharge to the permeable sub-base material via rigid perforated pipes; roof runoff will also connect to the permeable sub-base material. The perforated pipes will be roddable from both ends via an inspection chamber and gully to assist with maintenance and allow the collection of silt and debris. Runoff will migrate through the permeable sub-base material to multiple outlets that will be restricted by a flow control device to 5l/s. An outlet pipe will then discharge via a bypass separator to the newly constructed headwall in the Church Road Stream.
- 5.4 A flood risk activity permit will be required to connect a headwall outlet to the stream which is designated a Main River by the EA.
- 5.5 The hardstandings consisting of the car-park area and access road make-up approximately 4200m². A 250mm, 300mm, and 350mm deep permeable sub-base with minimum 30% void space will therefore generate 315m³, 378m³ and 441m³ of potential attenuation respectively. The sub-base depth will be determined at detailed design according to the CBR value of the soils, but it is stipulated that the sub-base will be of sufficient depth to contain the 1 in 100 year storm return event + a 20% allowance for climate change, which has been calculated to produce a peak volume of 306m³ with a 5l/s discharge using Microdrainage software – see Appendix VI.
- 5.6 A sump and pump will serve the small loading bay ramped area, which will drain surface water runoff only. The ramp wall will need to be designed to resist the ingress of

groundwater. The rising main will discharge to the Type 3 sub-base and enter the SuDS train as described above.

- 5.7 Flood flow routes are depicted on HOP drawing DR01, the accurate construction of which will ensure that surface water will flow away from the building and surrounding infrastructure into the surrounding landscaping.
- 5.8 Flood Zone compensation is discussed in Section 7.

Water Quality

- 5.9 Reference to Table 26.2 of the SuDS Manual (CIRIA C753) shows that the proposed land use at the development predominantly comprises a commercial car-park with frequent change, which represents a medium risk of pollution hazard level. The guidance for this level of risk is to use the simple index approach to pollution control requirements for discharging to surface waters.
- 5.10 The notes to Table 26.2 state that extra measures may be required for discharges to protected resources, the guidance clarifies that in England and Wales, protected groundwater resources are represented by the catchment of a SPZ 1 classification. As discussed previously, the development site lies outside of any SPZ and therefore no additional pollution control measures are required in this regard.
- 5.11 The simple index approach is outlined in the SuDS Manual and provides pollution hazard indices for different land use classifications. An extract applicable to the development site is provided in Table 5.2 below. This shows total pollution hazard indices of total suspended solids (TSS) 0.7; Metals 0.6; and Hydrocarbons 0.7.

Pollution hazard indices for different land use classifications				
Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7

Table 5.2. Extract of Table 26.2 from the SuDS Manual.

- 5.12 These hazard indices are to be compared against mitigation indices for individual SuDS components, as provided in Table 26.3 of the SuDS Manual, an extract of which is provided in Table 5.3.

Indicative SuDS mitigation indices for discharges to surface waters			
Type of SuDS component	Mitigation indices ¹		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4 ²	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond ⁴	0.7 ³	0.7	0.5
Wetland	0.8 ³	0.8	0.8
Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Table 5.3. Extract of Table 26.3 from the SuDS Manual.

- 5.13 The SuDS Manual also allows for proprietary systems such as oil interceptors, smart filters, membranes and silt/debris traps to be utilised to minimise the risk of watercourse pollution.
- 5.14 The proposed water quality treatment (SuDS Train) is depicted on HOP drawing DR01 with a summary bulleted below:
1. Trapped gullies or drainage channels to assist with sediment and hydrocarbon removal.
 2. Permeable sub-base material providing extensive filtration for total suspended solids, metals and hydrocarbons.
 3. Bypass separator for hydrocarbon removal.
- 5.15 With reference to table 26.3 of the SuDS Manual, the SuDS pollution mitigation indices are greater than each of the three pollution hazard indexes when the hardstanding construction make-up is defined as a 'permeable pavement', and when the proprietary treatments are accounted for, therefore the design is considered fit for purpose in regard to water quality.

SuDS maintenance

- 5.16 Details of SuDS operation and maintenance activities are provided within Chapter 32 of the SuDS Manual. A summary of typical key SuDS components is given in Table 5.4.
- 5.17 As can be seen, all SuDS components require regular inspection and for the first year the guidance states that monthly inspections are carried out and documented to inform the ongoing maintenance regime of the site drainage.
- 5.18 SuDS components at the site will not be adopted and will be maintained for their lifetime by the site owner or the managing company of the development for the site-wide SuDS features.
- 5.19 Contractors should protect SuDS components from adverse sediment runoff during the construction phase and an initial pre-handover inspection is recommended to ensure that the drainage system has been constructed as designed.

Table 5.4. Extract of Table 32.1 of the SuDS Manual.

Typical key SuDS components operation and maintenance activities (for full specifications, see Chapters 11–23)													
Operation and maintenance activity	SuDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter drain	Modular storage	Pervious pavement	Swale/bioretention/trees	Filter strip	Green roofs	Proprietary treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter and debris removal	■	■	■	■	□	■	■	□	■	■	■		□
Grass cutting	■	■	■	■	□	■	■	□	□	■	■		
Weed and invasive plant control	□	□	□	□		□	□		□		□	■	
Shrub management (including pruning)	□	□	□	□					□	□	□		
Shoreline vegetation management	■	■	□										
Aquatic vegetation management	■	■	□										
Occasional maintenance													
Sediment management ¹	■	■	■	■	■	■	■	■	■	■	■		■
Vegetation replacement	□	□	□	□						□	□	■	
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation /repair	□	□	□	□	□	□	□	□	□	□	□	□	
Infiltration surface reconditioning				□	□	□	□		□	□	□		

Key

■ will be required

□ may be required

Notes

1 Sediment should be collected and managed in pre-treatment systems, upstream of the main device.

6.0 FLOOD RISK MANAGEMENT MEASURES

- 6.1 The greatest risk of flooding to the development has been identified from high groundwater. A risk from fluvial sources has only been identified for extreme events beyond the required design criteria for this development. Primary mitigation to reduce the risk of flooding from all sources has been proposed in the form of elevating levels. The building is proposed at a minimum FFL of 4.600m AOD, which is typically 300mm higher than the top of the bank of the Church Road Stream. External hardstanding levels should also be a suggested minimum of 4.300m AOD to protect the users assets (cars) and generally reduce the risk of inundation and potential obstruction to the operations of Lidl.
- 6.2 Surface water runoff is to be managed through SuDS to limit the peak flow from the development to 5l/s – near to the calculated greenfield runoff rate. Flows above this agreed rate will be managed on-site using attenuation proposed in a permeable sub-base released in a controlled manner to the adjoining watercourse.
- 6.3 Private surface water drainage will be designed to accommodate the 1 in 100 year storm event with an allowance of an additional 20% increase in rainfall intensity to mitigate the predicted effects of climate change. This will minimise the risk of surface water flooding at the site by ensuring that surcharged pipework does not manifest in surface flooding up to this storm design parameter.
- 6.4 The ground levels for the development are designed so that potential overland conveyance routes direct water around and away from buildings to less vulnerable landscape areas within the site.

7.0 OFF SITE IMPACTS

- 7.1 Through the use of SuDS to manage surface water runoff at source, the peak rate of runoff from the development to the watercourse can be limited to a level that is near to the existing greenfield runoff rate.
- 7.2 The site-wide levels are to be engineered so that runoff is managed within the site boundaries and that no off-site conveyance routes can be established - unless during an exceedance event or drainage failure.
- 7.3 A blockage assessment by JBA has demonstrated that flooding as a result of the blocked 225mm diameter outlet of the Church Road Stream does not impact the development site, but would spill over into Church Road, therefore the proposed development does not alter the existing scenario.
- 7.4 In an effort to provide betterment to the wider area; an additional flood storage basin is proposed west and south of the site to reduce the impact of flooding offsite during a blockage event, and for storm return periods greater than 1 in 100 +45% CC. >200m³ of available storage is proposed to positively connect to the drainage ditch south east of the site. In the event of the Church Road Stream experiencing a blockage, water levels would build up in the surrounding drainage ditches before overflowing at the headwall. A point of connection to the drainage ditch is proposed where an existing channel level is 3.74mAOD. According to the topographical data, river flows would start to overflow the headwall at 4.02mAOD and so the flood storage basin has utilised the 0.28m level difference for storage.
- 7.5 The proposed flood storage basin will not pose a risk to the proposed development due to the elevated building and hardstanding levels proposed in 6.1. Siltation of this area is would likely occur over a very long period because it is only envisaged to function during rare events and so will not receive a continuous flow of water and does therefore does not require

a sloping conveyance swale, nevertheless the maintenance of this area will need to be incorporated into a drainage maintenance schedule.

- 7.6 A drainage maintenance schedule for the surface water management has been produced and can be viewed in Appendix X. The periodic maintenance of the surrounding ditches and Church Road Stream and headwall should reduce the amount of debris and litter that pass through the outfall and so further reduce the risk of a blockage scenario.
- 7.7 These proposed measures ensure that flood risk to neighbouring and downstream properties is reduced by the development.

8.0 RESIDUAL RISK

- 8.1 Residual risk stems from an extreme rainfall event or failure/blockage of the sewer and river networks. As discussed in Section 6 and 7 the ground levels for the development are designed so that potential overland conveyance routes direct water around and away from buildings to less vulnerable landscaped areas within the site, and risks are further mitigated against for blockage events.
- 8.2 The loading bay ramp area will be drained by a pump due to the low levels relative to the majority of the development. In the event of pump failure through power loss or mechanical malfunction the area is susceptible to substantial ponding. The levels around the ramp are to be designed such that any build-up of water will not reach threshold levels and enter the building. A dual pump system, incorporating a back-up pump and alarmed system is to be utilised

9.0 CLIMATE CHANGE

- 9.1 Increased rainfall volumes, longer storm durations and rising sea levels are all attributed to global climate change. This may increase the risk of fluvial, pluvial, groundwater and surface water flooding. Engineering and drainage designs take into account the effects of climate change by sizing drains and SuDS for the additional rainfall discharge due to climate change.

10.0 FRA CONCLUSIONS

- 10.1 This report demonstrates that the site is predominantly at risk of flooding from groundwater sources, but that mitigation, mainly in the form of elevating the hardstandings, greatly reduces the risk of flooding to acceptable levels.
- 10.2 According to the NPPF, the development is appropriate in Flood Zone 3a without the need for an exception test to be applied.
- 10.3 Surface water discharge to the nearby watercourse is to be limited to 5l/s – near to the calculated greenfield runoff rate of 3.27l/s. The drainage system has been designed to accommodate a 1 in 100 year storm return period + 20% allowance for climate change.
- 10.4 A Flood Risk Activity Environmental Permit is required from the EA to discharge the storm network to The Church Road Stream and to undertake any works within 8m of the bank of the Church Road Stream. Potential access by Environment Agency vehicles cannot be

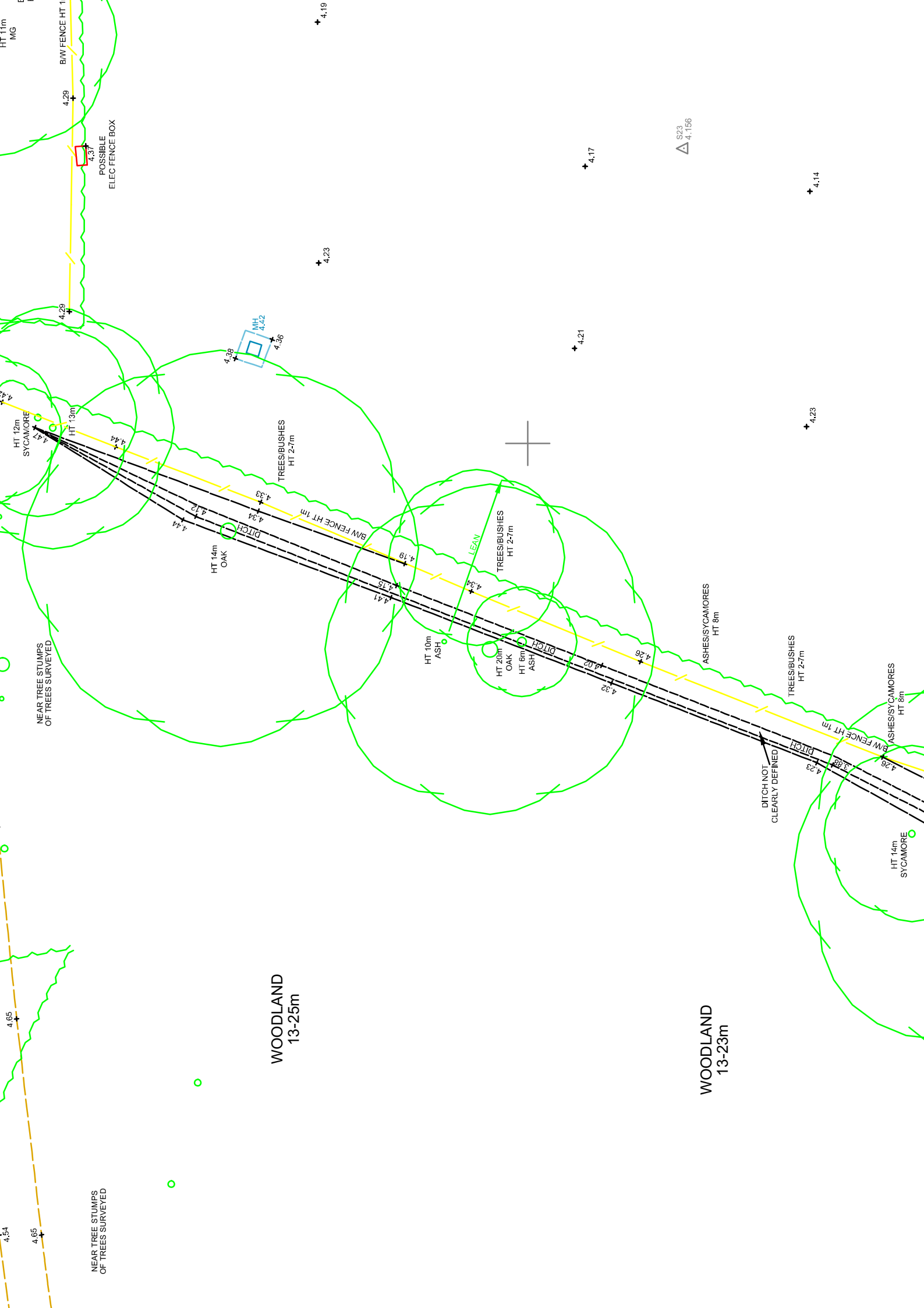
- restricted within 8m of the river bank and so no fences, or walls, or non-removable above ground obstructions are permitted in this zone.
- 10.5 Flood management is further mitigated through the consideration of external levels throughout the site to ensure that any potential overland conveyance routes arising from residual risks are directed away from the building to less vulnerable areas within the site.
- 10.6 Betterment has been proposed for flood risk to offsite areas with the introduction of a flood basin storage in the event of a blockage or extreme events beyond the typical design requirements, and architectural proposals (Appendix IV) feature locations for new log piles as reptile Hibernacula's as well as extensive greenspace and additional trees, offering biodiversity benefits.
- 10.7 This report has identified measures that reduce the risk of flooding to the development and ensures that the runoff volumes are mitigated through the use of attenuation SuDS. This report shows that the proposals for the development can be successfully implemented and managed sustainably and that there should be no increase in risk to future users and neighbouring properties in regard to flooding over the expected lifetime of the development.

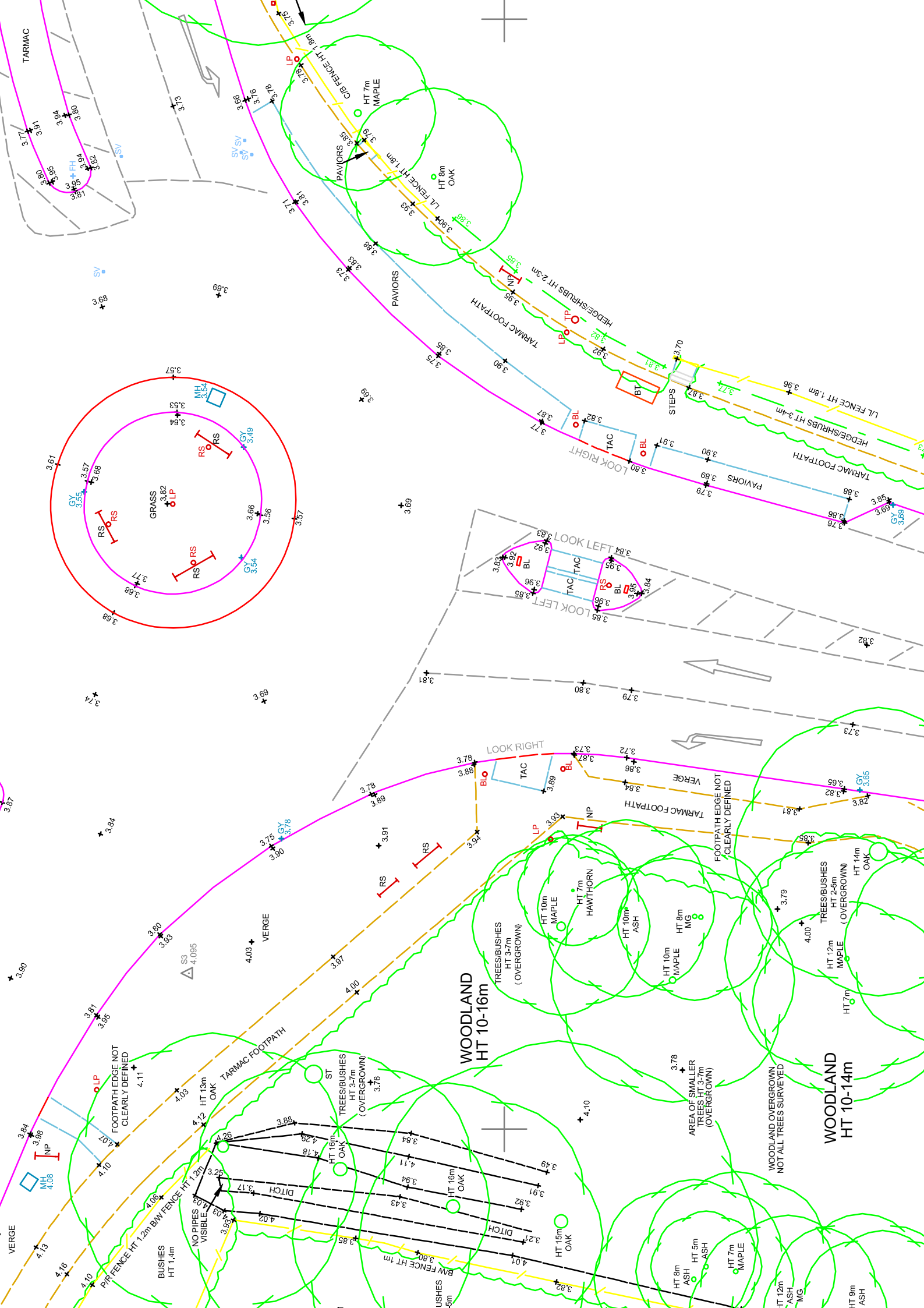
11.0 SUDS CHECKLIST FOR LLFA (HAMPSHIRE CC)

- 11.1 Below is a checklist based on Hampshire County Council (HCC) Guidance for Developers, Designers and Planners document. HCC criteria is stated in italics, while a reference has been provided to direct the reader to the required evidence within this report.
- 11.2 *Information on existing flood risk from modelled and historical sources* – See Section 4.
- 11.3 *Information on the proposed SuDS Strategy* – See Section 5 and HOP drawing DR01.
- 11.4 *Information on the potential discharge points and locations including the sensitivity of those locations* – See Section 5 and HOP drawing DR01. Note that EA data does not provide the sensitivity of the watercourse which is proposed to connect to. The watercourse is conveyed into the public drainage network just beyond the extents of the site and so it is assumed that the watercourse is not significantly sensitive.
- 11.5 *Information on the existing drainage regime of the site including where appropriate existing drainage locations and networks* – See Section 5.
- 11.6 *Information on existing ground conditions: Contamination that may affect the use of infiltration devices; Ground investigation; Groundwater levels; Infiltration tests* – See Section 2 and Appendix VIII. Note that infiltration drainage items are not proposed.
- 11.7 *Information on the existing and proposed runoff rates and volumes* – See Section 5 and Appendix VI.
- 11.8 *Information on how surface water flows and volumes will be contained on site* – See Section 5 and HOP drawing DR01.
- 11.9 *Information on what happens if the proposals exceed the design event* – See Section 8 and HOP drawing DR01.

APPENDIX I

Topographic Survey

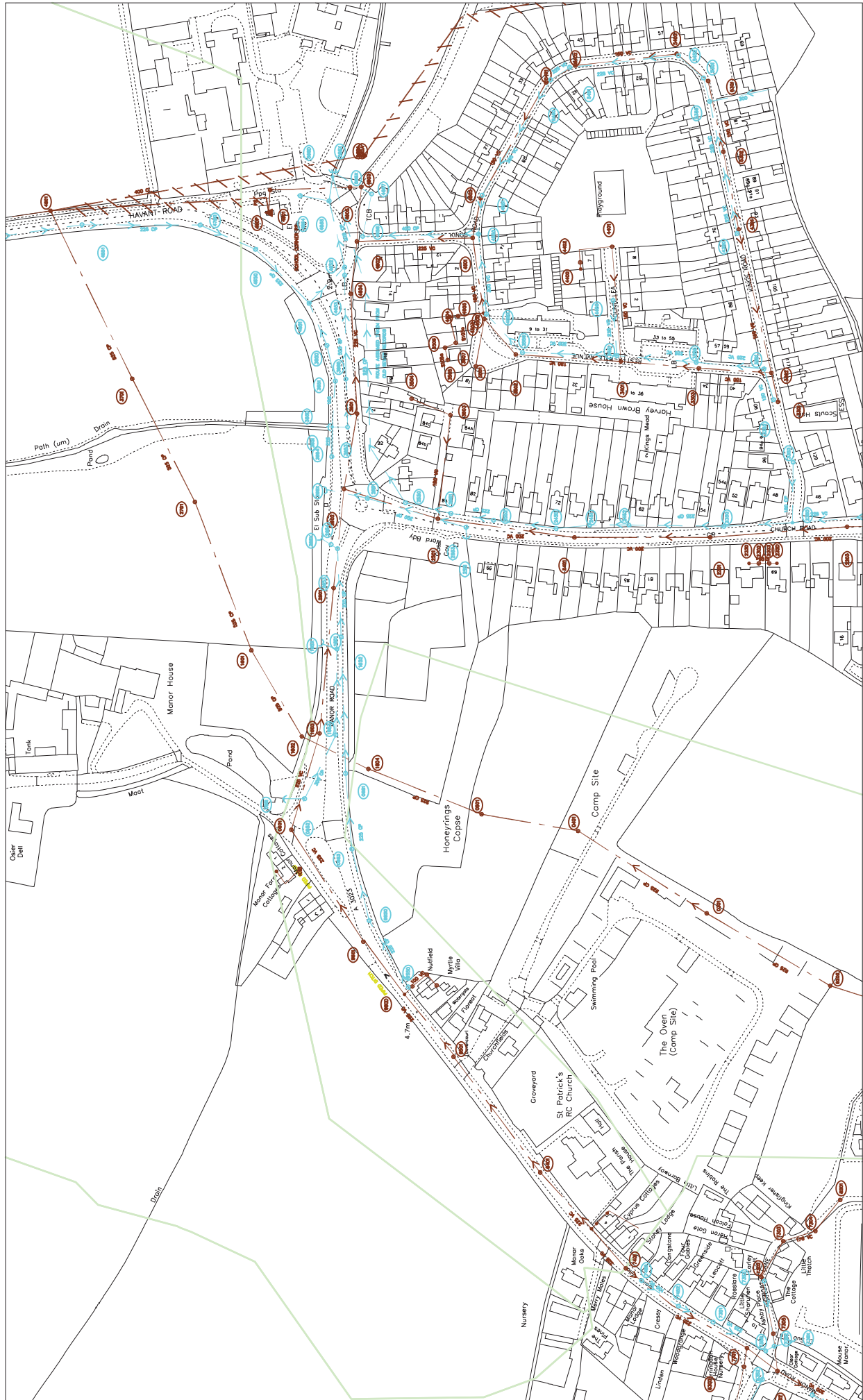




APPENDIX II

Sewer Records

100855



O.S. REF. SU7200NW		Drawn by: yadavsa		The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. WARNING: BAC pipes are constructed of Bonded Asbestos Cement WARNING: Unriven (UNR) manholes may include Bonded Asbestos Cement	 N	
		Scale: 1:2500				
Title: 228330_Hayling Island		Date: 24/11/2016				
Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.						

471673

100277

SEWER RECORDS PAGE 2 OF 2

[illegible]

LEGEND

Materials

- A1: Aluminum
- A2: Steel
- A3: Copper
- A4: Brass
- A5: Titanium
- A6: Inconel
- A7: Carbon Fiber
- A8: Kevlar
- A9: Fiberglass
- A10: Plastic
- A11: Rubber
- A12: Glass
- A13: Concrete
- A14: Wood
- A15: Paper
- A16: Fabric

Node Types

- N1: Round
- N2: Square
- N3: Triangle
- N4: Hexagon
- N5: Octagon
- N6: Star
- N7: Circle
- N8: Diamond
- N9: Heart
- N10: Cross
- N11: Plus
- N12: Minus
- N13: Multiply
- N14: Divide
- N15: Percent
- N16: Hash

SHAPES

- S1: Circle
- S2: Square
- S3: Triangle
- S4: Hexagon
- S5: Octagon
- S6: Star
- S7: Circle
- S8: Diamond
- S9: Heart
- S10: Cross
- S11: Plus
- S12: Minus
- S13: Multiply
- S14: Divide
- S15: Percent
- S16: Hash

NODE IDENTIFICATION SYSTEM

- N1: Round
- N2: Square
- N3: Triangle
- N4: Hexagon
- N5: Octagon
- N6: Star
- N7: Circle
- N8: Diamond
- N9: Heart
- N10: Cross
- N11: Plus
- N12: Minus
- N13: Multiply
- N14: Divide
- N15: Percent
- N16: Hash

MATERIALS

- A1: Aluminum
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- A8: Kevlar
- A9: Fiberglass
- A10: Plastic
- A11: Rubber
- A12: Glass
- A13: Concrete
- A14: Wood
- A15: Paper
- A16: Fabric

Drawn by:	yadvansa
Title:	228330_Hayling Island
Date:	24/11/2016

APPENDIX III

EA Correspondence

Elliott Flynn

From: Watson, Dan <Dan.Watson1@environment-agency.gov.uk>
Sent: 13 March 2017 13:39
To: Elliott Flynn
Cc: Ivan Ramirez; Maskell, Jon
Subject: Preplanning advice Hayling Island

Elliott

It was nice to meet yourself and Ivan last week.

I am writing with regard to the further actions we spoke about in the meeting.

- The volume of flood storage we require to be offset is the level above the existing ground to the level of the 1 in 100 year level including climate change. As we do not have modelling that includes climate change this will need to be done by yourselves.
- The climate change allowance website (<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>)
- Any new meeting would be £84 per person per hour with an additional £84 for project management costs too so probably about £252
- Finished floor levels are required to be above the 1 in 100 year levels and we recommend 600mm.
- The culvert is not owned by the EA so this will most likely be Hampshire County Council if not it will be Highways England.
- I will track down the CCTV records of the culvert.

If you have any queries regarding the above please give me a call

Regards

Daniel Watson
Partnership & Strategic Overview (P&SO)
Hampshire & the Isle of Wight
Solent & South Downs
Environment Agency

0208 474 9127

📄 Romsey District Office
Canal Walk
Romsey
Hampshire
SO51 7LP

✉ dan.watson1@environment-agency.gov.uk
🌐 www.gov.uk/environment-agency



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future of water



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Elliott Flynn

From: Elliott Flynn
Sent: 14 June 2017 15:11
To: Watson, Dan
Cc: Andrew Keen; chris.ambler@lidl.co.uk; Ivan Ramirez
Subject: RE: Lidl Development [Filed 14 Jun 2017 15:11]
Attachments: RE: Lidl Hayling Island - EA Objection Letter Response; Flood Storage Volumes.pdf; Flood Storage Volumes.xlsx; 15045-01-FRA01-A.PDF

Dan

Thank you for the confirmation on the items below, I'll await further clarification on the minimum acceptable swale fall.

As discussed, if we don't pursue the remodelling option and work with parameters according to your recent emails, then can you please confirm my interpretation of your email sent 12th June – attached for convenience.

Please see attached an excel spreadsheet (PDF copy also) which breaks down the volumes into 50mm intervals according to the distribution depicted on our drawing FRA01 that was included in our FRA – also attached.

Method:

- We have worked out ground levels by working backwards from the design flood level of 4.05m AOD in the manner you described.
- We have then set 6No. interval ranges with 50mm increments. The full range across all intervals spans 3.78-4.05m AOD.
- The volumes that were determined for each area zone are depicted on drawing FRA01, which corresponds to the point data within your JFLOW water depth table, have then been individually divided to determine what portion of each zones falls within each interval range.
- The total volume for each interval range has then been calculated to determine what compensation can be applied at what interval elevation. For example, Interval E (>3.98 - <4.03) across the entire site requires compensation of 186.3m³, which will cover a footprint of 3,726m² when divided by 50mm.

I believe this is the most accurate way of determining flood zone compensation according to the parameters provided. Please can you review and confirm that this method is acceptable, in case the additional modelling scenario is not pursued. I'd welcome a phone call to talk the method through if it not clear.

ELLIOTT FLYNN

Civil Engineer



HOP House
41 Church Road
Hove, BN3 2BE
T: +44 (0)1273 223900
W: www.hop.uk.com

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From: Watson, Dan [mailto:Dan.Watson1@environment-agency.gov.uk]
Sent: 14 June 2017 13:09
To: Elliott Flynn <ElliottF@hop.uk.com>
Subject: Lidl Development

Elliott

The riparian ownership of the river extends to the centreline of the ditch. Therefore the opposite side would be owned by the neighbouring land owner and you would therefore need their permission to work on their land.

As previously discussed we would appreciate several weeks notification prior to your submission of the modelling so we can programme it in to the works of the Modelling and Forecasting team. The model should include the modifications to the ditch.

There is no specific guidance documentation to govern the modelling that you submit but if it is carried out by a qualified competent modeller our team will accept the model.

Regarding the ditch gradient, the 1 in 200 would be sufficient but I will give the SuDS manual a reread to see exactly what we would accept as it think it can be slacker and still be effective, which may help you.

Regards

Daniel Watson
Partnership & Strategic Overview (P&SO)
Hampshire & the Isle of Wight
Solent & South Downs
Environment Agency

0208 474 9127

🏢 Romsey District Office
Canal Walk
Romsey
Hampshire
SO51 7LP

✉ dan.watson1@environment-agency.gov.uk
🖱 www.gov.uk/environment-agency



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Click [here](#) to report this email as spam

Elliott Flynn

From: Watson, Dan <Dan.Watson1@environment-agency.gov.uk>
Sent: 20 June 2017 14:27
To: Elliott Flynn
Cc: Andrew Keen; chris.ambler@lidl.co.uk; Ivan Ramirez
Subject: RE: Lidl Development [Filed 20 Aug 2017 10:16]

Elliott

Apologies for the delay in replying. I have reviewed your method of calculating the flood storage area and am satisfied with the resulting volume per interval.

Regards

Daniel Watson
Partnership & Strategic Overview (P&SO)
Hampshire & the Isle of Wight
Solent & South Downs
Environment Agency

0208 474 9127

✉ Romsey District Office
Canal Walk
Romsey
Hampshire
SO51 7LP

✉ dan.watson1@environment-agency.gov.uk
🌐 www.gov.uk/environment-agency



Planning for the
future of water



From: Elliott Flynn [mailto:ElliottF@hop.uk.com]
Sent: 14 June 2017 15:11
To: Watson, Dan <Dan.Watson1@environment-agency.gov.uk>
Cc: Andrew Keen <AndrewK@hop.uk.com>; chris.ambler@lidl.co.uk; Ivan Ramirez <IvanR@hop.uk.com>
Subject: RE: Lidl Development

Dan

Thank you for the confirmation on the items below, I'll await further clarification on the minimum acceptable swale fall.

As discussed, if we don't pursue the remodelling option and work with parameters according to your recent emails, then can you please confirm my interpretation of your email sent 12th June – attached for convenience.

Please see attached an excel spreadsheet (PDF copy also) which breaks down the volumes into 50mm intervals according to the distribution depicted on our drawing FRA01 that was included in our FRA – also attached.

Hayling Island - Lidl Flood Compensation Distribution

Point	Surface Elevation determined by		Volume m³ (Refer to drg FRA01)	A No. Seg.	A Int.		B Int.		C Int.		D Int.		E Int.		F Vol.	Int. Total	Water Depth	Total % (Check)	Total Vol. m³ (Check)				
	Flood level	4.05mAOD			A %	A Vol.	No.	B %	B Vol.	No.	C %	C Vol.	No.	D %						D Vol.	No.	E %	E Vol.
1	3.96		49.2	0	0.000	0.00	0.000	0.00	0.000	0.00	2.022	10.93	5	0.556	27.33	2	0.222	10.93	9	0.09	1.000	49.199	
2	3.95		106.3	0	0.000	0.00	0.000	0.00	0.000	0.00	3.030	31.89	5	0.500	53.15	2	0.200	21.26	10	0.10	1.000	106.300	
3	3.78		65	5	0.185	12.04	5	0.185	12.04	5	0.185	12.04	5	0.185	12.04	2	0.074	4.81	27	0.27	1.000	64.995	
4	4.02		36.4	0	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0	0.000	0.00	1	0.333	12.13	2	0.667	24.26	3	0.03
5	3.98		95.8	0	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0	0.000	0.00	5	0.714	68.40	2	0.286	27.37	7	0.07
6	3.93		32	0	0.000	0.00	0.000	0.00	0.000	0.00	5.046	13.31	5	0.416	13.31	2	0.167	5.33	12	0.12	0.999	95.771	
Total Flood Volume				384.7		12.037		12.037		12.037		68.171		186.365		93.971							384.618

Interval Ref.	Interval Range	Glossary of terms		
		Int.	Intervals	
A	≥3.78 - <3.83	Vol.	Volume - Refer to HOP drg FRA01.	
B	≥3.83 - <3.88	%	Percentage of flood volume attributed to interval.	
C	≥3.88 - <3.93	No.Seg.	Number of 10mm segments in interval	
D	≥3.93 - <3.98			
E	≥3.98 - <4.03			
F	≥4.03 - <4.05			

Elliott Flynn

From: Whittaker, Carrie R <Carrie.Whittaker@environment-agency.gov.uk>
Sent: 19 July 2017 14:52
To: Elliott Flynn
Cc: Maskell, Jon
Subject: Lidl - Land South of, Manor Road, Hayling Island
Attachments: Requirements for completing modelling for FRAs_v7.pdf

Good afternoon Elliott

Please find attached guidance document as discussed. I look forward to receiving your notes on this telephone call and will confirm these/clarify these with you as well.

With regards to the option of having compensation off the site my comments were as follows

With regards to compensation on the site my comments are as follows:
Compensation will need to be connected to but not within the 1 in 100 plus appropriate allowance for Climate Change. To demonstrate your proposed compensation will ensure flood risk is not increased on or off the site, some modelling work may be required due to the limitations of the model available for this site, I will also require a plan showing where the flood plain compensation is proposed, preferable in relation to the modelled extent of the flood zone with table of what is taken up, what is proposed as compensation and then what the net is of this.

We also discussed the need for the meeting next week, and this may be better placed once you have completed further work.

Having reviewed the drawing we discussed on the phone: DR01 revision A, I would also need to confirm with you how close to the Main River any proposed development is. I would strongly recommend a buffer of 8 metres to ensure access and integrity of the river bank is maintained.

There are also opportunities on your site for betterment in terms of flood risk and biodiversity, I would recommend any areas where you could provide these are considered as part of your proposals.

Please do not hesitate to contact me with any further queries.

Thanks and kind regards

Mrs Carrie Whittaker

Flood and Coastal Risk Management Advisor

Partnership and Strategic Overview Team – Solent and South Downs.

Environment Agency, Guildbourne House, Chatsworth Road, Worthing, West Sussex, BN11 1LD.

 02030259455

 carrie.whittaker@environment-agency.gov.uk

Web: www.environment-agency.gov.uk

Our **climate change allowances** for planning were updated on 19 February 2016. The guidance is accessible here:
[Flood risk assessment: Climate change allowances](#)

Thinking big, Acting early

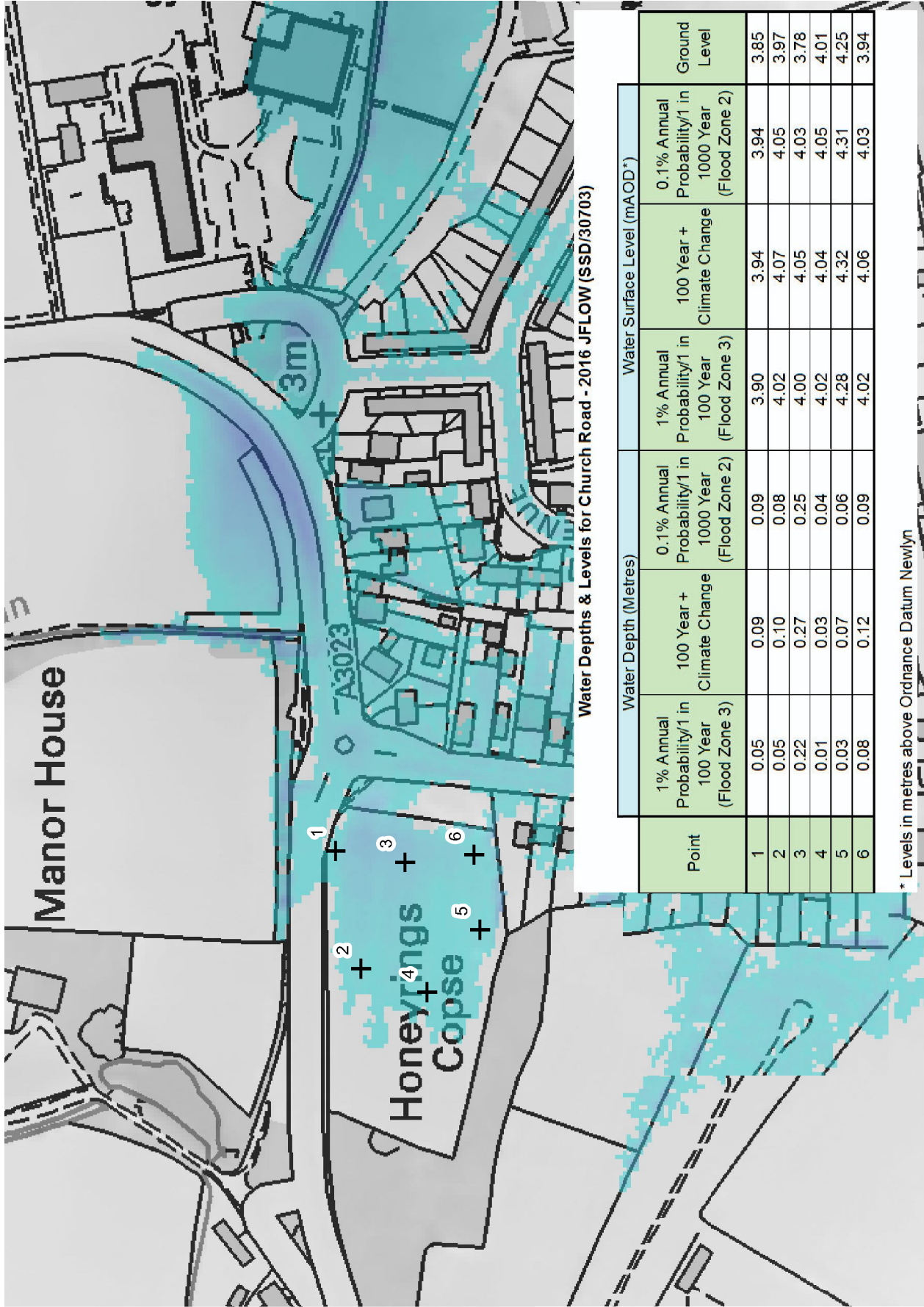
APPENDIX IV

Architectural Proposals



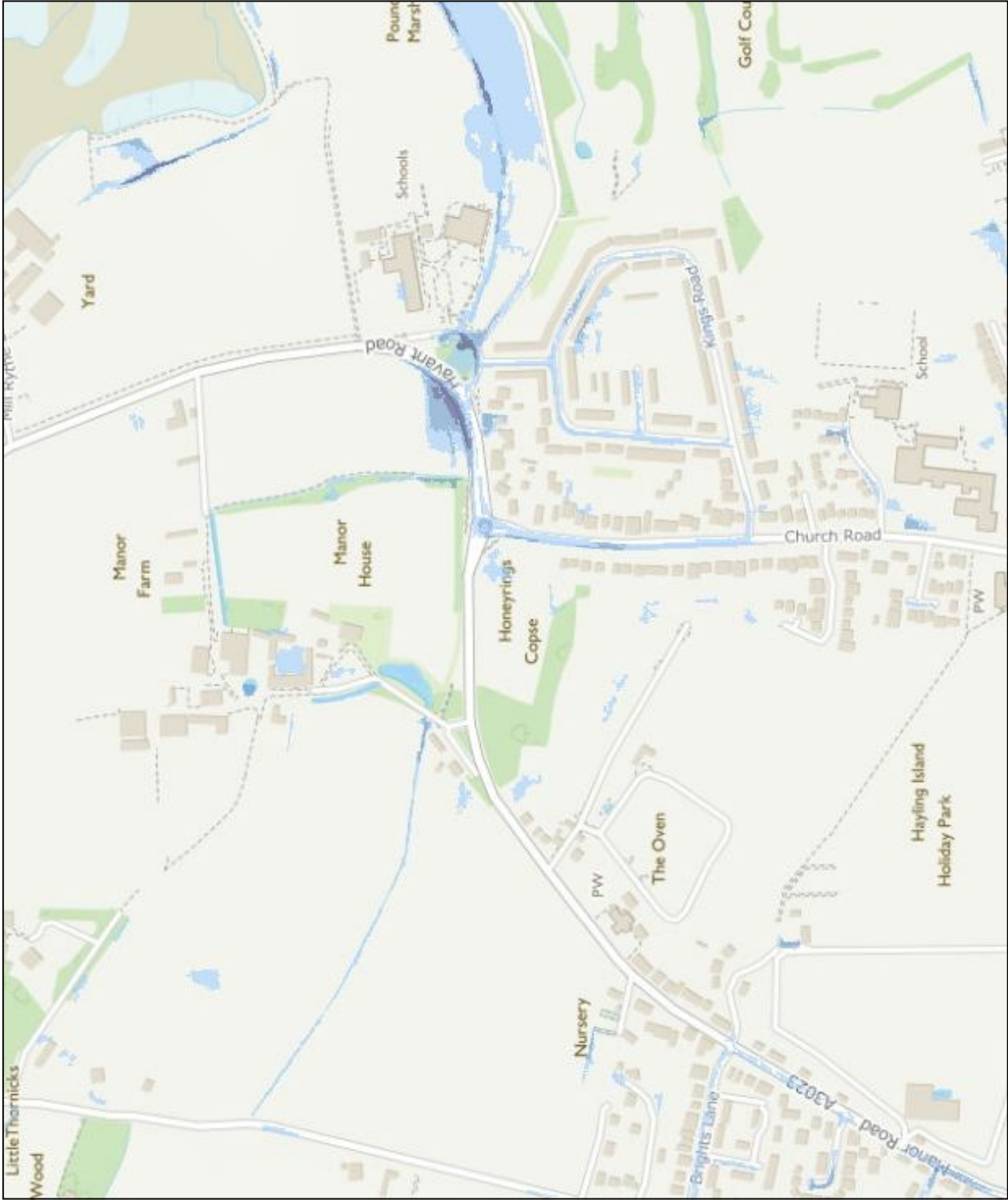
APPENDIX V

EA Flood Data



* Levels in metres above Ordnance Datum Newlyn

Risk of flooding from Surface Water Centred on Church Road - Created 4 January 2017





Environment
Agency

N
W
E
S

Scale 1:6,822

Likelihood of flooding from Surface Water

- High ($\geq 3.3\%$)
- Medium (3.3% - 1%)
- Low (1% - 0.1%)

Very Low

Likelihood of flooding from Surface Water

High: Greater than or equal to 3.3% (1 in 30) chance in any given year

Medium: Less than 3.3% (1 in 30) but greater than or equal to 1% (1 in 100) chance in any given year

Low: Less than 1% (1 in 100) but greater than or equal to 0.1% (1 in 1,000) chance in any given year

Very Low: Less than 0.1% (1 in 1,000) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on our website.

APPENDIX VI

Storm Water Calculations

Hemsley Orrell Partnership

Page 1

HOP House
41 Church Road
Hove BN3 2BE

Date 24/03/2017 17:54
File Sub-Base Storage.SRCX

Designed by ElliottF
Checked by

Micro Drainage

Source Control 2015.1

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 393 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m³)	Status
15 min Summer	4.066	0.271	0.0	6.0	6.0	120.5	Flood Risk
30 min Summer	4.123	0.328	0.0	6.2	6.2	163.7	Flood Risk
60 min Summer	4.180	0.385	0.0	6.4	6.4	206.6	Flood Risk
120 min Summer	4.229	0.434	0.0	6.6	6.6	243.8	Flood Risk
180 min Summer	4.248	0.453	0.0	6.7	6.7	258.0	Flood Risk
240 min Summer	4.254	0.459	0.0	6.7	6.7	262.3	Flood Risk
360 min Summer	4.250	0.455	0.0	6.7	6.7	259.4	Flood Risk
480 min Summer	4.242	0.447	0.0	6.6	6.6	253.6	Flood Risk
600 min Summer	4.233	0.438	0.0	6.6	6.6	246.6	Flood Risk
720 min Summer	4.224	0.429	0.0	6.6	6.6	240.2	Flood Risk
960 min Summer	4.208	0.413	0.0	6.5	6.5	228.0	Flood Risk
1440 min Summer	4.177	0.382	0.0	6.4	6.4	204.2	Flood Risk
2160 min Summer	4.131	0.336	0.0	6.3	6.3	169.9	Flood Risk
2880 min Summer	4.090	0.295	0.0	6.1	6.1	138.6	Flood Risk
4320 min Summer	4.021	0.226	0.0	5.9	5.9	86.9	O K
5760 min Summer	3.966	0.171	0.0	5.7	5.7	49.6	O K
7200 min Summer	3.916	0.121	0.0	5.5	5.5	24.8	O K
8640 min Summer	3.870	0.075	0.0	5.3	5.3	9.4	O K
10080 min Summer	3.828	0.033	0.0	5.1	5.1	1.8	O K
15 min Winter	4.088	0.293	0.0	6.1	6.1	137.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	106.828	0.0	125.5	19
30 min Summer	71.819	0.0	173.1	33
60 min Summer	46.096	0.0	225.9	62
120 min Summer	28.574	0.0	282.7	122
180 min Summer	21.285	0.0	316.5	182
240 min Summer	17.148	0.0	341.1	240
360 min Summer	12.605	0.0	376.5	324
480 min Summer	10.130	0.0	404.5	384
600 min Summer	8.542	0.0	426.5	446
720 min Summer	7.427	0.0	444.9	514
960 min Summer	5.951	0.0	475.4	652
1440 min Summer	4.347	0.0	519.9	924
2160 min Summer	3.168	0.0	566.2	1320
2880 min Summer	2.528	0.0	600.2	1704
4320 min Summer	1.836	0.0	648.7	2460
5760 min Summer	1.461	0.0	682.5	3168
7200 min Summer	1.223	0.0	708.8	3816
8640 min Summer	1.059	0.0	731.1	4496
10080 min Summer	0.937	0.0	749.2	5144
15 min Winter	106.828	0.0	142.0	18

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Hemsley Orrell Partnership						Page 2	
HOP House 41 Church Road Hove BN3 2BE							
Date 24/03/2017 17:54 File Sub-Base Storage.SRCX				Designed by ElliottF Checked by			
Micro Drainage				Source Control 2015.1			
<u>Summary of Results for 100 year Return Period (+20%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	4.152	0.357	0.0	6.3	6.3	185.9	Flood Risk
60 min Winter	4.217	0.422	0.0	6.6	6.6	234.9	Flood Risk
120 min Winter	4.275	0.480	0.0	6.8	6.8	278.8	Flood Risk
180 min Winter	4.300	0.505	0.0	6.8	6.8	297.5	Flood Risk
240 min Winter	4.310	0.515	0.0	6.9	6.9	305.3	Flood Risk
360 min Winter	4.312	0.517	0.0	6.9	6.9	306.2	Flood Risk
480 min Winter	4.302	0.507	0.0	6.8	6.8	299.3	Flood Risk
600 min Winter	4.291	0.496	0.0	6.8	6.8	290.9	Flood Risk
720 min Winter	4.279	0.484	0.0	6.8	6.8	281.8	Flood Risk
960 min Winter	4.256	0.461	0.0	6.7	6.7	263.9	Flood Risk
1440 min Winter	4.208	0.413	0.0	6.5	6.5	227.7	Flood Risk
2160 min Winter	4.138	0.343	0.0	6.3	6.3	175.3	Flood Risk
2880 min Winter	4.077	0.282	0.0	6.1	6.1	129.0	Flood Risk
4320 min Winter	3.979	0.184	0.0	5.7	5.7	57.6	O K
5760 min Winter	3.889	0.094	0.0	5.3	5.3	14.9	O K
7200 min Winter	3.795	0.000	0.0	4.9	4.9	0.0	O K
8640 min Winter	3.795	0.000	0.0	4.2	4.2	0.0	O K
10080 min Winter	3.795	0.000	0.0	3.7	3.7	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	71.819	0.0	195.3	33			
60 min Winter	46.096	0.0	254.1	62			
120 min Winter	28.574	0.0	318.1	120			
180 min Winter	21.285	0.0	356.4	178			
240 min Winter	17.148	0.0	383.4	234			
360 min Winter	12.605	0.0	423.4	344			
480 min Winter	10.130	0.0	454.6	442			
600 min Winter	8.542	0.0	479.0	476			
720 min Winter	7.427	0.0	500.0	550			
960 min Winter	5.951	0.0	534.2	704			
1440 min Winter	4.347	0.0	584.6	1008			
2160 min Winter	3.168	0.0	636.9	1428			
2880 min Winter	2.528	0.0	675.5	1816			
4320 min Winter	1.836	0.0	730.6	2548			
5760 min Winter	1.461	0.0	770.1	3168			
7200 min Winter	1.223	0.0	800.5	0			
8640 min Winter	1.059	0.0	825.9	0			
10080 min Winter	0.937	0.0	847.5	0			
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Hemsley Orrell Partnership		Page 3
HOP House 41 Church Road Hove BN3 2BE		
Date 24/03/2017 17:54 File Sub-Base Storage.SRCX	Designed by ElliottF Checked by	
Micro Drainage Source Control 2015.1		

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.690

Time (mins)	Area
From:	To: (ha)
0	4 0.690

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Hemsley Orrell Partnership		Page 4
HOP House 41 Church Road Hove BN3 2BE		
Date 24/03/2017 17:54 File Sub-Base Storage.SRCX	Designed by ElliottF Checked by	
Micro Drainage Source Control 2015.1		

Model Details

Storage is Online Cover Level (m) 4.350

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	50.2
Membrane Percolation (mm/hr)	1000	Length (m)	50.2
Max Percolation (l/s)	700.0	Slope (1:X)	225.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	3.795	Cap Volume Depth (m)	0.000

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0112-5000-0500-5000
Design Head (m)	0.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	112
Invert Level (m)	3.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0
Flush-Flo™	0.178	4.9
Kick-Flo®	0.370	4.3
Mean Flow over Head Range	-	4.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	7.4	3.000	11.5	7.000	17.3
0.200	4.9	1.400	8.0	3.500	12.4	7.500	17.9
0.300	4.7	1.600	8.5	4.000	13.2	8.000	18.5
0.400	4.5	1.800	9.0	4.500	13.9	8.500	19.0
0.500	5.0	2.000	9.5	5.000	14.7	9.000	19.6
0.600	5.4	2.200	9.9	5.500	15.3	9.500	20.1
0.800	6.2	2.400	10.3	6.000	16.0		
1.000	6.8	2.600	10.7	6.500	16.6		

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