



Figured dimensions only are to be used. All dimensions to be checked onsite. Differences between drawings and between drawings and specification or bills of quantities to be reported to the PRC Group.

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Revisions: _____ Drawn/Chkd: _____ Date: _____

PHASE 3A				GEA			
Ut	GF (m²)	FF (m²)	Total (m² / ft²)	Ut	GF (m²)	FF (m²)	Total (m² / ft²)
8.	2,294	405	2,699 / 29,051	2,817	30,321		
9.	1,624	286	1,910 / 20,559	1,996	21,484		
SUB			4,609 / 49,610	4,813	51,806		
PHASE 3B				GEA			
10.	2,159	296	2,455 / 26,425	2,546	27,404		
11.	2,313	409	2,722 / 29,299	2,831	30,472		
12.	4,437	606	5,043 / 54,282	5,214	56,123		
SUB			10,220/11,000	10,591/114,000			
TOTAL			14,829/159,618	15,404/166,074			

- KEY
- PHASE 3A / 3B BOUNDARY
 - SOFT LANDSCAPE
 - TARMACADAM SURFACING
 - BRUSHED CONCRETE SERVICE YARD
 - NATURAL BLOCK PAVING TO VEHICLE PARKING BAYS
 - CHARCOAL BLOCK PAVING TO VEHICLE AREAS
 - CHARCOAL BLOCK PAVING TO PEDESTRIAN AREAS
 - WELL CONSOLIDATED GRAVEL
 - RETAINING WALL, HANDRAIL TO TOP OF WALL
 - 2.4m HIGH SECURITY FENCE
 - TWO TIER CYCLE SHELTER - PROVIDING 20 SPACES PER SHELTER
 - DOUBLE ELECTRIC VEHICLE CHARGING POINTS / DUCTS FOR FUTURE POINT (10%)
 - DUCTS FOR FUTURE DOUBLE CHARGING POINTS (20%)
 - CAR SHARE PARKING SPACES (5%)
 - DROP KERB
 - PROPOSED TREES
 - EXISTING TREES TO BE RETAINED
 - EXISTING TREES APPROVED FOR REMOVAL UNDER OUTLINE CONSENT (AS PER ECOLOGIST SURVEY)
 - INDICATIVE LOCATION OF BAT BOXES (AS PER ECOLOGIST SURVEY)
 - INDICATIVE LOCATION OF BIRD BOXES (AS PER ECOLOGIST SURVEY)
 - PEDESTRIAN PRIORITY ROUTE

PARKING PROVISIONS:

Layout proposes a total of 342 car parking spaces.

Unit 8 - 62 car parking spaces.
Unit 9 - 41 car parking spaces.
Unit 10 - 42 car parking spaces.
Unit 11 - 62 car parking spaces.
Unit 12 - 135 car parking spaces.

CYCLE STORAGE PROVISIONS:

The layout proposes a total storage for 100 cycles across the site.



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Architecture
Landscape
Town Planning
Masterplanning
Urban Design

Client: HAVANT SARL

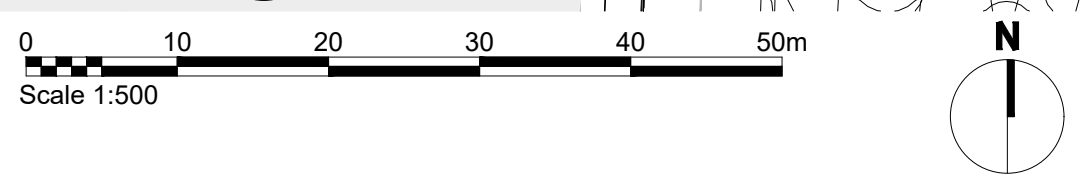
Project: LANGSTONE PHASE 3A / 3B

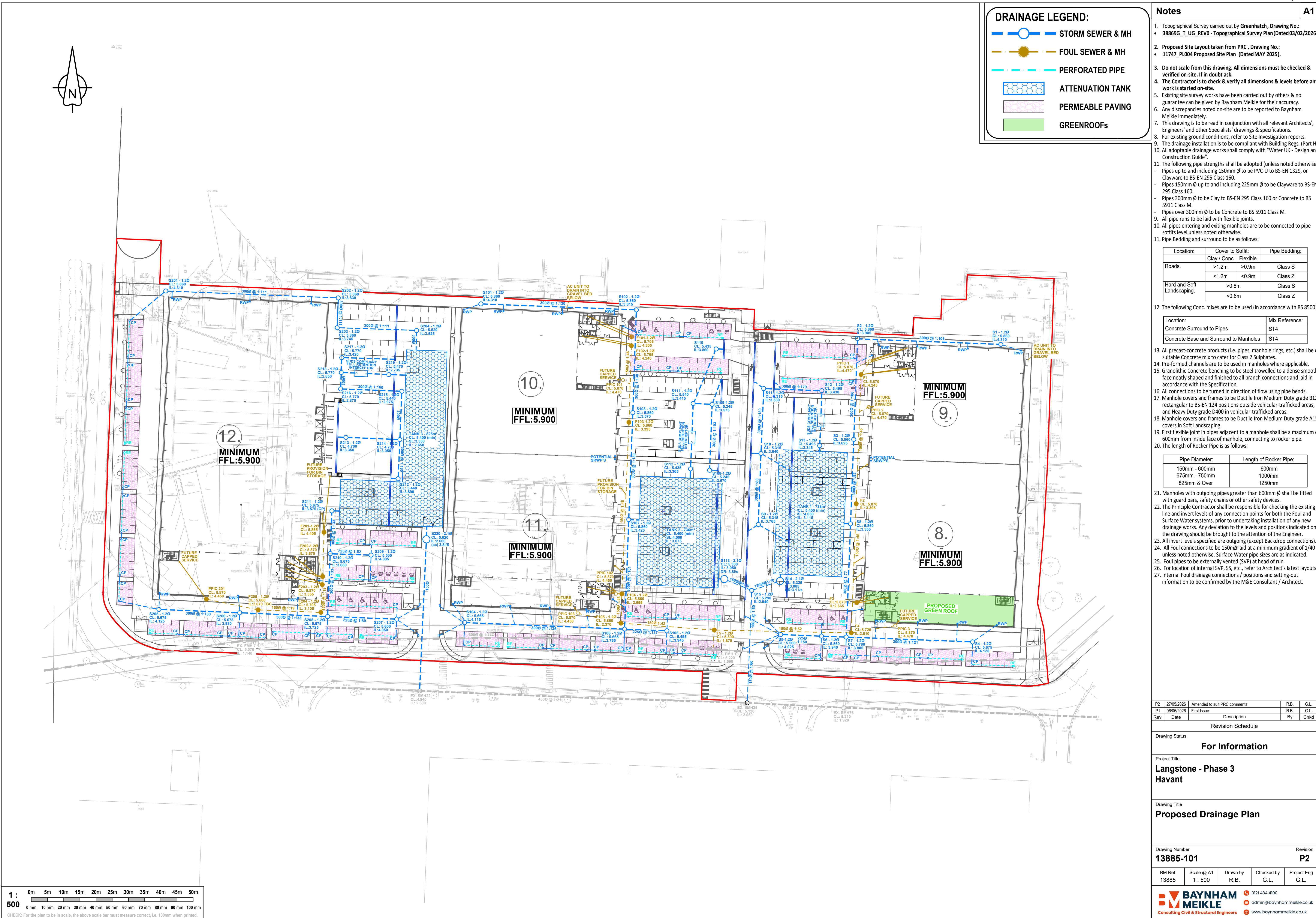
Drawing Title: PROPOSED SITE PLAN

Job No: 11747 Project Stage: PL Status: PLANNING
First Issue Date: MAY 26 Scale: 1:500 Lead Checker: ME

Project:	Originator:	Zone:	Level:	Type:	Role:	Eng No:	Rev:
-	-	-	-	-	-	004	-

BSM File Name: _____





1. Do not scale from this drawing. All dimensions must be checked & verified on-site. If in doubt ask.
2. The Contractor is to check & verify all dimensions & levels before any work is started on-site.
3. Existing site survey works have been carried out by others & no guarantee can be given by Baynham Meikle for their accuracy.
4. Any discrepancies noted on-site are to be reported to Baynham Meikle immediately.
5. This drawing is to be read in conjunction with all relevant Architects', Engineers' and other Specialists' drawings & specifications.
6. For existing ground conditions, refer to Site Investigation reports.
7. All Retaining Wall heights provided on this plan denote the height of retainment required, not height of retaining wall.

EXTERNAL WORKS LEGEND:

- FFL:0.00** FINISHED FLOOR LEVEL
- +0.00** PROPOSED EXTERNAL LEVEL
- +EX0.00** EXISTING EXTERNAL LEVEL
- 1:40** GRADIENT
- EMBANKMENT**
- RW** RETAINING WALL
- STEPS**
- PERMEABLE TARMAC**
- PERMEABLE BLOCK PAVING**
- YARD GULLY**
- LINEAR DRAIN**
- TRP ZONE**

P2	28/05/2026	Amended to include retaining to Sub-Stations.	R.B.	G.L.
P1	06/05/2026	First Issue.	R.B.	G.L.
Rev	Date	Description	By	Chkd

Revision Schedule

Drawing Status

For Information

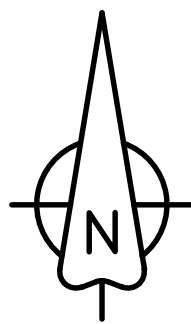
Project Title
**Langstone - Phase 3
Havant**

Drawing Title
Proposed Levels Plan

Drawing Number
13885-102

Revision
P2

BM Ref 13885	Scale @ A1 1 : 500	Drawn by R.B.	Checked by G.L.	Project Eng G.L.
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LARGE CONCRETE RAMP.
CURRENTLY RETAINED BY
RETAINING WALL ON
BUILDING PROPOSED TO
BE DEMOLISHED.

EXISTING EMBANKMENT TO BE
RE-GRADED TO SUIT RAISED
BUILDING SLAB LEVEL. (BANK
STEEPNESS TO BE REDUCED)
SUFFICIENT LAND-DRAINAGE TO
BE INSTALLED.

GRADIENT OF 1:30
APPLIED IN THIS
AREA. EXTERNAL
LEVELS 600mm
SHORT OF MIN FFL
AT CORNER OF U11.



CHECK: For the plan to be in scale, the above scale bar must measure correct, i.e. 100mm when printed.

Appendix D – Additional information

- D.1 Applied Geology Phase 3A Ground Investigation - Pg. 11-21. / Applied Geology Phase 3B Ground Investigation - Extract Pg. 5-10
- D.2 Hampshire Council PFRA (April 2011) – Extract Pg. 22-24
- D.3 SFRA Part 1 Main Report FINAL - Extract Pg. 15-32
- D.4 PfSH_CoastalModelling_Figure9_MaxFloodDepth_Undefended_0.1_2122 – Extract Pg. 5
- D.5 Applied Geology Phase 2 Ground Investigation - Extract Pg. 18-30.

5.0 GROUND CONDITIONS

5.1 Strata Encountered

The investigation has proven Made Ground to depths of between 0.50m and 1.60m bgl, locally increasing to 2.60m bgl towards the southwestern site boundary, overlying natural Superficial strata of River Terrace Deposits, proven to depths of between 4.50m and 6.50m bgl. Solid strata of Undifferentiated Chalk were encountered beneath the Superficial Deposits and were proven to depths of between 17.00m and 17.30m bgl.

Full details of the strata encountered are given on the exploratory hole records presented in Appendix B. SPT N value results are plotted against depth in Appendix A. A generalised ground profile is presented below to summarise the information.

Stratum	Depth to Top of Strata (m bgl)	Thickness (range) (m)	Comments
Made Ground	GL	0.50–1.60 and locally up to 2.60	Encountered across the entire site, increasing in thickness towards the southwestern part of the site. The base of the Made Ground was proven in all exploratory holes, with the exception of TP03 (base depth of 2.60m bgl)
River Terrace Deposits	0.50–1.60	4.00–5.90	Encountered at all locations, apart from TP03, where the base of the Made Ground was not proven.
Undifferentiated Chalk	4.50–6.50	10.80+	Encountered in the CP boreholes (CP04 and CP05) only. Depth to the top of the stratum generally increased towards the north. Base not proven.

5.2 Made Ground

Granular Made Ground was encountered in all exploratory holes from ground level, generally to depths of between 0.50m and 1.60m bgl, locally increasing to 2.60m bgl towards the south-western site boundary.

The previous ground investigation undertaken by Clancy Consulting Ltd in 2019 along the southern boundary of Phase 3A identified Made Ground to depths of 1.20m (WS1), 1.40m (HTP1) and 1.20m bgl (HTP2), which generally correlates with the findings of this recent investigation. The base of the Made Ground was proven at a depth of 1.30m bgl in WS1.

The Made Ground generally comprised greyish brown/brown sandy silty gravel, locally with a low to medium cobble content. The gravel comprised fine to coarse angular to subrounded flint, concrete, brick, chalk and asphalt, with frequent wood, metal and plastic fragments.

No odours were reported within the Made Ground. Headspace testing undertaken on samples of the Made Ground recorded negligible VOC concentrations of between less than the instrument limit of detection (<0.1ppm) and 0.2 ppm.

5.3 River Terrace Deposits

Natural superficial strata of River Terrace Deposits were encountered directly beneath the Made Ground in all exploratory holes, (apart from TP03 where the base of the Made Ground was not proven at depth of 2.60m bgl) across the site and were proven to depths of between 4.50m and 6.50m bgl, achieving thicknesses of between 4.0m and 5.90m.

The stratum was predominately described as yellowish brown/greyish brown sandy clayey/silty gravel. The gravel comprised fine to coarse angular to subangular flint and chalk.

The stratum was encountered as a cohesive soil between 3.60m and 4.50m bgl in CP04, in the southeastern corner of the site. The material comprised firm yellowish brown slightly sandy slightly gravelly clay. The gravel comprised fine to coarse angular to subangular flint and chalk.

The previous ground investigation undertaken by Clancy Consulting Ltd along the southern boundary of Phase 3A encountered River Terrace Deposits in WS1 at a depth of 1.3m bgl, proven to a depth of 3.70m bgl. The material was described as very soft to soft brown brownish white sandy very gravelly clay. The gravel included flint and chalk.

Five particle size distribution tests undertaken on samples of the River Terrace Deposits generally recorded fines contents of between 2% and 49%, sand contents of between 9% and 22%, and gravel contents of between 29% and 89%, indicating the soil to be silty/clayey sandy gravel and slightly sandy, slightly gravelly silt/clay, which is in general accordance with the field descriptions.

A single Atterberg limit test carried out on a sample of the cohesive River Terrace Deposits (CP04 at 4.00m) recorded a plastic limit of 14%, a liquid limit 24%, a plasticity index of 10% (corrected to 8%), indicating the soil to be clay of low plasticity and low volume change potential. A moisture content test recorded a value of 16%.

Ten in-situ Standard Penetration Tests (SPTs) undertaken in the granular River Terrace Deposits generally recorded 'N' values of between N=13 and N=20 (medium dense). As single SPT N value of N=5 (loose) was recorded at 2.0m bgl in DCS09. However, it is noted that this coincided with a water strike at the same depth and as such is considered unlikely to be wholly representative. A single SPT was undertaken in the cohesive River Terrace Deposits at a depth of 3.60m bgl in CP04 and recorded a 'N' value N=11.

5.4 Undifferentiated Chalk

Undifferentiated Chalk was encountered directly beneath the River Terrace Deposits in the cable percussion boreholes (CP04 and CP05), from depths of between 4.50m bgl and 6.50m bgl and was proven to depths of between 17.00m and 17.30m bgl. The base of the Undifferentiated Chalk was not proven.

The cable percussion drilling method severely disturbs any structure present within Chalk strata, resulting in the recovery of highly disturbed samples. Although full engineering descriptions were generally not possible, the Undifferentiated Chalk was generally described as structureless chalk recovered as cream gravelly silt, Grade

Dc. The clasts comprised extremely weak, cream-coloured chalk fragments of gravel size, and the matrix comprised cream-coloured calcareous silt.

Sixteen in-situ SPT test were carried out within the Undifferentiated Chalk, recording 'N' values of between N=12 and N=>50. Consistent 'SPT refusals' with extrapolated N values of between N=64 and N=556, were generally recorded from depths of 11.00m bgl.

Three Saturation Moisture Content (SMC) tests were undertaken on samples of Chalk and recorded dry density values of between 1.61Mg/m³ and 1.67Mg/m³, indicating medium density chalk. The tests also recorded saturated moisture contents of between 23% and 25%.

During the previous Clancy Consulting Ltd investigation, a single borehole WS1 encountered a white gravelly clay, interpreted as weathered bedrock from a depth of 3.70 m bgl and proven to 5.45m bgl. This is generally consistent with the findings recorded in CP04 along the southern boundary. Two SPTs undertaken in the shallow weathered chalk in WS1 recorded values of N=13 and N=15, which is in accordance with the findings of the current investigation.

5.5 Groundwater

Groundwater strikes were encountered during the ground investigation as summarised in the table below.

Location	Stratum	Depth of Groundwater
CP04	Undifferentiated Chalk	7.30m bgl no rise
CP05	River Terrace Deposits	2.10m rising to 1.80m bgl
DCS09	River Terrace Deposits	2.00m bgl
TP02	River Terrace Deposits	1.40m bgl
TP03	Made Ground	0.60m bgl
TP04	River Terrace Deposits	1.70m bgl
TP05	River Terrace Deposits	1.60m bgl

TP01 located along the northwestern corner of the Phase 3A area, remained dry during the ground investigation.

The previous boreholes along the southern site boundary, by Clancy Consulting Ltd, recorded groundwater at a depth of 2.00m, rising to 1.80m bgl after 20 minutes within the River Terrace Deposits, which is generally consistent with the findings of the recent investigation.

Subsequent groundwater level monitoring was undertaken on four occasions between 9th March and 25th March 2026. An additional monitoring visit was also completed on 17th April 2026, as CP04 and DCS09 were inaccessible during the third visit on 25th March 2026. Groundwater levels recorded during the monitoring visits are summarised in the table below:

Location	Stratum	Response Zone (m bgl)	Water level (m bgl)
CP04	River Terrace Deposits / Chalk	1.00–7.00	1.80 - 1.96 (3.02–2.86m AOD)
CP05	River Terrace Deposits	1.00–6.00	1.16 - 1.72 (3.33–2.77m AOD)
DCS09		1.00–2.00	Dry - 1.46 (2.82m AOD)

DCS09 was recorded as Dry during 3 out of the 4 groundwater visits.

It should also be noted that groundwater levels may vary beyond that observed during the fieldwork period due to seasonal effects throughout the year.

Based on the data collected, it is considered that the River Terrace Deposits and Chalk are likely to be in hydraulic continuity. The groundwater flow direction was unable to be determined as the levels are generally consistent across the site, however, it is likely to be towards the east and Lavant Stream.

5.6 Ground Gas

Variable thicknesses of Made Ground were encountered in all exploratory hole locations across the Phase 3A area. Apart from this, no other significant on-site sources of ground gas were observed during the site investigation.

Monitoring of the standpipes on a total of four occasions has recorded methane concentrations at less than detection limit (0.1% by volume). Carbon dioxide concentrations were recorded between less than detection limit (0.1% by volume) and 0.2% by volume. Oxygen concentrations were recorded between 11.3% (depleted) and 20.4% (atmospheric) by volume.

The boreholes were also screened using a Photo Ionisation Detector (PID) to determine the presence of VOCs, which recorded concentrations generally between less than the instrument detection limit (0.1ppm) and up to 0.4ppm in the standpipes (i.e. negligible).

Flow readings were taken over a three-minute period and reported maximum steady flow rates of less than the instrument detection limit (0.1l/hr).

Gas Screening Values (GSVs) have been calculated for each borehole, and the results are detailed in the table below.

Stratum	BH	Response Zone (m bgl)	Ground water level (m bgl)	Max. Methane (%)	Max. Carbon Dioxide (%)	Max. Steady Flow (l/hr)	GSV Methane (l/hr)	GSV Carbon Dioxide (l/hr)
RTD	DCS09	1.00 – 2.00	Dry – 1.46	0.1	0.1	0.1	0.0001	0.0001
	CP05	1.00 – 6.00	1.16 – 1.72	0.1	0.2	0.1	0.0001	0.0002
RTD/Chalk	CP04	1.00 – 7.00	1.80 – 1.96	0.1	0.1	0.1	0.0001	0.0001

RTD = River Terrace Deposits; Chalk = Undifferentiated Chalk
Green highlighted cells indicate CS-1 conditions.

5.7 Contamination

Apart from the presence of brick, concrete, asphalt and rare plastic fragments noted throughout the Made Ground there was no visual or olfactory evidence of significant potential contamination was noted. Specifically, no visual or olfactory of hydrocarbon or solvent contamination was identified during the fieldwork.

Headspace testing undertaken on samples of the Made Ground recorded negligible VOC concentrations of between <0.1ppm and 0.2ppm.

6.0 GEOENVIRONMENTAL ASSESSMENT

6.1 Human Health Risk Assessment

Although the current proposals allow for some minor areas of soft landscaping, mostly to the perimeter of the site, the proposed development generally comprises a large percentage of hardcover. Considering this and the context of the proposed development (commercial/industrial warehouses) and that the site levels will be raised in the order of 1m (although not confirmed, anticipated to comprise a combination of stockpiled granular demolition arisings and imported granular material), the source-pathway-receptor linkages to potential end users are effectively broken, and as such, there is considered to be a negligible risk to Human Health from potential contaminants in the ground. However, to account for the potential minor areas of proposed soft landscaping, a comparison of the chemical test results against generic screening criteria for a commercial/industrial end usage has been undertaken. The results of chemical testing on soils have been assessed as described in Appendix E, assuming 1% SOM in the soil.

The spreadsheets summarising the laboratory results and relevant screening values for each dataset are presented in Appendix D.

In respect of benzo(a)pyrene and other genotoxic PAHs, various PAH ratios have been plotted and compared against data from the Culp et al study and found to be generally within the same range, therefore the use of the surrogate marker approach is justified.

None of the chemical testing undertaken on the Made Ground samples exceeded their corresponding screening values based upon the currently proposed commercial/industrial end usage.

All volatile compounds, including Naphthalene, BTEX and 'lighter end' hydrocarbon fractions (<C₁₀) were recorded below the laboratory limit of detection. Total phenols were also recorded below the laboratory limit of detection.

Measurable concentrations of PAHs have been detected in the Made Ground across the site, although well below the adopted screening criteria. Based on the source signature double ratio plots, the PAHs identified are considered likely to be predominantly coal derived.

Although no exceedances have been identified when compared to the adopted screening criteria, measurable concentrations of heavier end petroleum hydrocarbon fractions (C₁₀-C₃₅) were reported in four of the five samples of Made Ground, at total TPH concentrations of between 52.5mg/kg and 423mg/kg. The highest concentration

of 423mg/kg was reported in DCS09, at 0.3m bgl adjacent to the western site boundary. This could however be attributed to the presence of PAHs in the same samples.

Laboratory screening for asbestos did not detect any ACM within any of the samples screened.

The spreadsheet summarising the laboratory results and relevant screening values are presented in Appendix E.

Based on the above assessments to date, it is considered that the site presents a negligible risk to end users with regards to Human Health. As the site levels are to be raised by c. 1.0m, any material used to achieve this uplift must comprise clean, suitable imported fill that does not pose a risk to future site users.

6.2 Controlled Waters Risk Assessment

Although no exceedances against the relevant Human Health screening criteria have been identified (or visual evidence of hydrocarbon impacted soils) across the Phase 3A development area, the soil testing has recorded some elevated concentrations of PAH and heavier end TPH (C₁₀-C₃₅) in the Made Ground soils.

Considering the results of chemical testing on the soil samples and the site history, testing was also undertaken on two groundwater samples during the investigation, collected from CP04 and CP05 at depths of 1.80m and 1.72m bgl within the natural strata respectively. The response zones are detailed below:

Stratum	BH No.	Response Zone (m bgl)	Aquifer classification
River Terrace Deposits	CP05	1.00 – 6.00	Secondary 'A' Aquifer
River Terrace Deposits/ Undifferentiated Chalk	CP04	1.50 – 7.00	Secondary 'A' Aquifer/ Principal Aquifer

The testing undertaken on the groundwater samples has identified only marginal exceedances of some PAHs from the sample collected at CP05. However considering that the proposed development will mostly comprise hardstanding this will therefore limit any leaching potential and migration of contaminants from the Made Ground into the underlying groundwater. It is also noted that historically the surrounding area has been utilised for numerous industrial uses which could potentially impact groundwater.

Therefore, based on the context of the site and the proposed redevelopment, there is considered to be a negligible to low risk to Controlled Waters.

The spreadsheet summarising the laboratory results and relevant screening criteria of the dataset is presented in Appendix D.

6.3 Disposal of Soil Arisings

The results of chemical testing on the Made Ground indicates that much of the material tested would likely be classified as non-hazardous waste if sent for disposal at landfill (for which WAC testing is not required).

The natural soils are likely to be classified as inert waste, , however if natural soils are to be disposed of from site, inert WAC testing will likely be required to classify the soils for disposal.

The results of chemical testing should be used to assist with the classification of the soils for disposal.

General comments regarding the procedures for the assessment of waste soil for off-site disposal purposes is included in Appendix E.

7.0 GEOTECHNICAL ASSESSMENT

7.1 General

The proposals for the Phase 3A development area comprise the construction of two new commercial/industrial units (8 and 9), together with associated yard/loading areas and car parking. It is understood that site levels across the site will also be raised in the order of approximately 1.0m above existing ground level. No loading information was available at the time of writing this report, though conventional commercial/industrial loadings are envisaged.

The ground investigation has identified granular Made Ground, generally to depths of between 0.50m and 1.60m bgl, locally increasing to 2.60m bgl towards the south-western site boundary. The base of the Made Ground was not proven in the southwestern part of the site. The Made Ground was underlain by Superficial strata comprising granular River Terrace Deposits, proven to base depths of between 4.50m bgl and 6.50m bgl. Solid strata comprising Undifferentiated Chalk were encountered at depths of 4.5m and 6.5m and proven to depths of between 17.0m and 17.30m bgl.

Groundwater strikes were predominantly recorded in the Superficial River Terrace Deposits at depths of between 1.4m and 3.0m bgl, with a single groundwater strike recorded in the Undifferentiated Chalk at 7.3m bgl. Subsequent monitoring of the standpipes has generally recorded groundwater levels at depths of between c1.00m and 1.96m bgl.

7.2 Foundation Design and Floor Slabs

Prior to foundation construction, we understand that existing levels will be raised by approximately 1.00m. At this stage, the detailed nature of the proposed upfill is not known, though it is understood this would likely comprise a combination of stockpiled granular demolition crush and imported granular material. Prior to placement of upfill, it is recommended that any hardstanding and known obstructions are removed as they would represent potential obstructions to future construction and create hard spots which could influence future settlement of placed fills and foundations.

Placement of upfill above the existing ground surface will result in induced settlements within the underlying Made Ground and natural strata as a result of the additional surcharge. The majority of settlements within the granular Made Ground and granular River Terrace Deposits would occur quickly, though induced settlements within the cohesive River Terrace Deposits would be ongoing for a longer period. A detailed geotechnical assessment would be required to determine both the magnitude and duration of potential total and differential settlements.

A number of foundation solutions for column loads may be feasible, though these would need to be carefully considered alongside options for floor slabs, due to the proposed upfilling, as follows:

Deep Spread Foundations on Natural Strata

Based on the strata encountered, traditional pad foundations could be considered, founded on the medium-dense granular River Terrace Deposits encountered at depths of between 1m and c.2.5m below existing ground level across the site. Pad foundations placed within granular River Terrace Deposits may be designed to an allowable bearing pressure of up to 125kN/m². This is based on a lower-bound SPT N value of N=13 and using traditional methods of bearing capacity calculations e.g. as set out in Tomlinson 7th Edition and a factor of safety against a factor safety of 3 against bearing capacity failure whilst limiting total settlement to 25mm. However, taking into account the depth of the Made Ground and the proposal to raise site levels by the order of 1m, the River Terrace Deposits would be at increased depth following upfilling, resulting in potential overbreak/collapse and the requirement to remove greater volumes of soil.

Ground Improvement

Ground improvement by vibro-replacement or rigid inclusions could also be considered to support column loads and slabs following upfilling (or potentially prior to upfilling in association with upfill acting as an engineered load transfer platform), subject to the nature of the proposed upfill. This would however be subject to consultation with specialist contractors to assess the suitability of the soils to be treated. We understand this approach has been adopted on earlier development phases to the immediate south. Other proprietary forms of ground improvement may also be feasible and the advice of specialist contractors should be sought.

Where vibro-replacement was proposed prior to upfilling, proposed upfill could comprise suitably engineered granular material, or potentially other suitably engineered fill (including possible modified or stabilised clay fills). It should however be noted that the placement of the upfill material (either prior to or following vibro-replacement ground improvement), would result in total and differential consolidation settlement of any cohesive Made Ground and ground improvement would not wholly prevent this. It should be possible to manage this settlement with time and possibly some additional surcharging, although this would require careful technical appraisal and time allowance for the induced settlement to take place. The same effects would also need to be taken into account beneath ground floor slabs. It is recommended that discussions are undertaken with specialist contractors to establish whether they consider this solution to be feasible. Subject to specialist contractors confirming suitability for treatment and appropriate management of surcharge induced settlements, shallow reinforced foundations could be possible together with ground bearing floor slabs. Allowable bearing pressures would be defined by the appointed specialist contractor, though typically we would expect allowable bearing pressures in the range 100 – 150kN/m² to be feasible, potentially higher. Such a solution would reduce the required depth of excavation compared to spread foundations in natural strata and minimise risk of groundwater entry into foundation excavations.

Piled Foundations

A piled solution for both the foundations and floor slabs may be considered, which represents a low-risk solution to address the various technical considerations. This would also minimise the volume of arisings for potential disposal. Piles would need to extend through any imported upfill, existing Made Ground, Superficial Deposits and gain support via skin friction and end bearing, within the Undifferentiated Chalk. The use of bored, CFA or driven piles is likely to prove suitable for the site, however it is recommended that the advice of a specialist piling contractor is sought with regard to detailed design, including suitable pile diameters, capacities and confirmation of suitable pile types. The nature and thickness of the upfill material will also need to be taken in to account with regards to pile mat design.

Earthworks

Another potential option would be to excavate the existing Made Ground and replace suitable soils to an engineered specification. This would however require careful and detailed assessment and would require further ground investigation works in order to obtain bulk samples for earthworks testing. It should be noted that the engineered fill would also need to be placed to raise levels. Following such earthworks, shallow reinforced foundations on engineered fill should be possible together with ground bearing floor slabs. Allowable bearing pressures would be a function of the earthworks specification, though it is envisaged that allowable bearing pressures for pads in the range 100 – 150kN/m² would typically be feasible following a competent, controlled earthworks exercise.

If ground conditions encountered during construction differ from those recorded during the investigation, further geotechnical input should be sought to refine the foundation design.

7.3 Floor Slab Gas Protection

Based on the gas monitoring undertaken to date and the calculated GSVs the site is likely to be characterised as Characteristic Situation 1 (CIRIA C665). The site is also not in a Radon affected area. Therefore, gas protection measures are not considered necessary for the proposed development.

7.4 Excavations

Excavation depths will depend on the chosen foundation solution at the site. Any excavations on site can be expected to be in a combination of granular Made Ground and predominantly granular River Terrace Deposits. During the investigation, instability of the trial pit walls was observed in four out of five trial pits.

In general, excavations will likely be prone to some instability particularly where advanced into the granular River Terrace Deposits and in particular once groundwater is encountered. As such, excavations into these soils may need to be graded back to a stable angle or trench support be provided. Trench support or the angle of batter should be designed by an appropriately qualified engineer or competent person to suit the required depth and the ground and groundwater conditions. Furthermore, due to the potential for groundwater ingress (from depths of 1.4m below existing ground level), it is recommended provision for groundwater control is made, particularly if any deeper excavations are proposed.

7.5 Buried Concrete and Services

The Design Sulphate Class and the Aggressive Chemical Environment for Concrete (ACEC) class have been assessed for each of the strata encountered. The characteristic values calculated for each stratum are outlined in the table below.

Strata	No of samples tested	Soluble Sulphate (g/l) ^{*1}	Total Potential Sulphate (%)	Potentially Pyritic	pH	Design Sulphate Class	ACEC ^{*2}
Made Ground	8	548	-	No	8.5	DS-2	AC-2
River Terrace Deposits	6	217	-	No	8.8	DS-1	AC-1
Undifferentiated Chalk	2	17	-	No	9.1	DS-1	AC-1
Groundwater (River Terrace Deposits/Chalk)	2	19	-	-	7.4	DS-1	AC-1

Notes:

*1: Characteristic values are rounded to the nearest 10mg/l. In a data set of less than 5 samples, the highest sulphate value and lowest pH is taken as the characteristic value. In a data set of between 5 and 9 the mean of the highest two sulphate test results has been taken as the characteristic value. In a data set in excess of 9, the mean of the highest 20% has been taken as the characteristic value.

*2: Assumes mobile groundwater.

The results of the sulphate tests carried out have identified the Design Sulphate Class to be DS-2 with the Aggressive Chemical Environment for Concrete (ACEC) being AC-2 for the Made Ground as defined by the BRE Special Digest 1, Concrete Aggressive Ground, 2005 for a brownfield site and mobile groundwater regime. For the River Terrace Deposits and Undifferentiated Chalk, the sulphate test results indicate DS-1 and AC-1 conditions. Groundwater samples collected from standpipes in the River Terrace Deposits and Undifferentiated Chalk, also indicate DS-1 and AC-1 conditions.

Further reference should be made to BRE Special Digest 1 for requirements in respect of types of cement and aggregate to be used and variations in type of concrete construction.

No 'light end' (less than C₁₀) TPHs, BTEX, or MTBEs, were detected during the ground investigations undertaken. Locally, typically low concentrations of 'heavier end' (C₁₂ to C₃₅) TPH fractions were detected in the Made Ground at concentrations of between 52.5mg/kg and 423mg/kg. Subject to detailed proposals, some restrictions on buried water supply pipeline materials may be necessary. However, the chosen pipeline materials should be discussed and agreed with the local Water Authority once water supply pipe routes and depths are known.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Geo-environmental

The risk assessments in Section 7.0 have indicated a negligible risk to human health and low risk to Controlled Water receptors based on the proposed development. Therefore, no further action is considered warranted. However, should any suspected

contamination be encountered during redevelopment appropriate advice should be sought.

8.2 Geotechnical

Based on the findings of the recent ground investigation, ground improvement techniques such as vibro-replacement or rigid inclusions are considered likely to provide an appropriate foundation solution for the proposed units and associated floor slabs. However, further consultation with specialist ground improvement contractors will be required to verify the suitability of the in-situ soils for treatment and to confirm the most appropriate method.

The proposed upfill will influence the design of ground improvement solutions (and piling if adopted) and will also influence the design of the external areas, in terms of induced settlements (which need to be assessed), likely CBR values, working platform design, sulphate classification etc.

Based on the gas monitoring undertaken on site, it is considered that Characteristic Situation 1 (CIRIA C665) applies, and gas protection measures are not required.

A Design Sulphate Class of DS-2 and ACEC Class AC-2 is considered appropriate for buried concrete.

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Chemical testing was scheduled by Applied Geology based upon the desk study, walkover and site observations during the fieldwork. Testing was carried out at UKAS accredited laboratory (SOCOTEC UK Ltd) (UKAS Lab No. 1252) with asbestos testing by The Testing Lab PLC (UKAS Lab No. 7758). Nine samples of the Made Ground soils were analysed for the following suite of contaminants:

- Selected metals suite [arsenic, boron, beryllium, cadmium, chromium (total, trivalent and hexavalent), copper, lead, mercury, nickel, selenium, vanadium and zinc];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
- Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG); Benzene, Toluene, Ethylbenzene, and Xylene (BTEX);
- Methyl-tertiary-butyl-ether (MTBE);
- Phenols;
- pH;
- Soluble sulphate, and;
- Soil organic matter.

Nine samples of the Made Ground soils were also submitted for Asbestos testing (presence, identification, and quantification, where applicable).

A single sample of the shallow natural Alluvium collected from DCS03 (in close proximity to the on-site electricity substation located on the western part of the site) was also submitted for PCB analysis at a UKAS accredited laboratory (Chemtest Eurofins Ltd, UKAS Lab No. 2183).

Five samples of groundwater were obtained from the standpipes installed in CP01, CP02, CP03 and DCS05 (Alluvium) and DCS06 (River Terrace Deposits) and were tested for the following suite of contaminants:

- Selected metals suite [arsenic, boron, beryllium, cadmium, chromium (total, trivalent and hexavalent), copper, lead, mercury, nickel, selenium, vanadium and zinc];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAHs);
- Phenols (total);
- Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG) with BTEX and MTBE;
- VOC & SVOCs;
- Hardness;
- pH;
- Water soluble sulphate; and
- Total Organic Carbon.

Laboratory test results are included in Appendix D.

GROUND CONDITIONS

The ground investigation has proven Made Ground (including hardstanding and Made Ground/Topsoil) to depths of between 0.19m and 1.60m bgl overlying natural Superficial strata of Alluvium and River Terrace Deposits, proven to depths of between 3.00m and 7.10m bgl. Solid strata of Undifferentiated Chalk were encountered beneath the Superficial Deposits and were proven to depths of between 14.45m and 17.00m bgl.

Hardstanding/Subbase

Hardstanding was encountered as concrete, up to 0.21m thick, in the service yard area to the north and west of Building 5000. In the car park areas to the south of the site, the hardstanding was encountered as asphalt, between 0.05m and 0.11m thickness. A 0.07m thick flagstone, together with associated bedding sand, was identified at DCS02, adjacent to the northwestern corner of Building 5000.

Made Ground/Topsoil

Within the soft landscaped areas in the south-western parts of the site, strata designated “Made Ground/Topsoil” were encountered from ground level and proven to depths of between 0.19m and 0.22m bgl and generally described as soft brown sandy gravelly clay with frequent roots and rootlets. The gravel comprised angular to subrounded brick, chalk and flint. This stratum has been described as ‘Made Ground/Topsoil’ as the presence of Made Ground beneath suggests this soil was placed rather than being a naturally derived material.

Made Ground

Granular and cohesive Made Ground was encountered in all exploratory holes across the site, directly beneath the hardstanding and Made Ground/Topsoil apart from CP03 and DCS04 and was proven to depths of between 0.60m and 1.10m bgl, locally increasing to 1.60m bgl towards the northwestern site boundary. The material was generally described as brown to grey sandy silty gravel and very gravelly clay locally with a low cobble content. The gravel comprised angular to subangular flint and chalk with rare brick, concrete, quartzite and asphalt. The cobbles comprised subangular flint with rare concrete. Two in-situ Standard Penetration Tests (SPTs) undertaken in the Made Ground recorded N values of N=9 and N=22. The previous ground investigation undertaken by Clancy Consulting Ltd in 2019 and 2020 along the southwest boundary of Phase 3B identified Made Ground to depths of between 0.60m and 1.40m bgl, which generally correlates to the findings of this recent investigation.

The previous ground investigation undertaken by Clancy Consulting Ltd in 2019 identified hydrocarbon contamination within the Made Ground at exploratory hole location WS2 in the southwestern part of Phase 3B. Olfactory evidence of hydrocarbon contamination was recorded between depths of 1.00m and 2.10m bgl. Clancy Consulting Ltd subsequently carried out a supplementary intrusive investigation in the vicinity of WS2 in 2020. A total of five exploratory holes was advanced in this area. Three of the five exploratory holes recorded hydrocarbon contamination at shallow depths within both the Made Ground and the underlying natural Superficial strata, at depths of between 0.80m and 2.40m bgl. During the current investigation, DCS05 was drilled in close proximity to WS2. Although no evidence of hydrocarbon-impacted soils was recorded in the vicinity of DCS05, a distinct hydrocarbon odour was noted within the Made Ground at DCS06, located to the east of the previously identified hydrocarbon-contaminated area reported by Clancy Consulting Ltd. The odour was encountered between 0.11 m and 1.10 m bgl. Headspace testing of this interval recorded a VOC concentration of 0.4 ppm.

Alluvium

Superficial strata interpreted as Alluvium were locally encountered in the western and southwestern parts of the site (CP01, CP02, DCS03, DCS04 and DCS05) and in the southern part of the site (CP03) from depths of between 0.20m and 1.60m bgl and proven to depths of between 2.63m and 3.00m bgl. The Alluvium generally comprised soft to firm grey sandy gravelly silt and very soft to firm orangish brown slightly sandy gravelly clay, locally with a low cobble content. The gravel comprised fine to coarse angular to subrounded flint and chalk.

The results of four Atterberg limit tests carried out on samples of Alluvium recorded plastic limits of between 15% and 20%, liquid limits of between 30% and 37%, plasticity indices of between 15% and 17% (corrected to 12% and 16%), indicating the soil to be clay of low to medium plasticity and low volume-change potential. The results of the four moisture content tests recorded values of between 17.2% and 26.5%. A single sample of Alluvium collected from CP01 at 1.80m bgl, was recorded as non-plastic, with a moisture content of 11.8%.

A single quick undrained triaxial test carried out on a sample of the Alluvium at 2.00m bgl and recorded an undrained shear strength of 34kN/m² indicating low strength. Eleven SPT tests undertaken in the Alluvium recorded N values of between N=3 and N=22, generally showing an increase with depth.

By applying the empirical relationship between SPT 'N' value, mass shear strength and using an average plasticity index of 17.5% and a corresponding f_1 of 5, this generally indicates mass shear strengths of between 15kN/m² to 110kN/m² (very low to high strength). This is generally consistent with the visual field assessments of soil strength and the laboratory triaxial testing. An SPT N value versus depth plot is included in Appendix A.

River Terrace Deposits

River Terrace Deposits were encountered beneath the Made Ground and where present beneath the Alluvium from depths of between 0.80m and 2.90m bgl and were proven to depths of between 6.00m and 7.10m bgl in the cable percussive boreholes. The strata were generally described as light grey to brown silty sandy gravel.

The previous ground investigations undertaken by Clancy Consulting Ltd in 2019 and 2020 across the southwestern part of Phase 3B identified River Terrace Deposits in boreholes WS2 and WS19 to WS23 from depths of between 0.60m and 1.40m bgl, to depths of between 0.98m and 3.85m bgl, although the base was not proven.

Two particle size distribution tests undertaken on samples of River Terrace Deposits recorded fines contents of 3% and 29%, sand contents of 20% and 24% and gravel contents of 47% and 77%, indicating the soil to be a very clayey/silty very sandy gravel and slightly clayey/silty sandy gravel, which is in general accordance with the field descriptions.

Twenty-three in-situ SPTs tests undertaken in the River Terrace Deposits generally recorded N values of between N=10 and N=30 (medium dense), with two N values of N=39 and N=47. An SPT N value of N=4 (very loose) was recorded at 2.30m bgl in DCS08 and an SPT N value of 7 (loose) was recorded in DCS08 at 3.00m bgl. However, it is noted that these relatively lower N values coincided with water strikes at the same depth and as such is considered unlikely to be wholly representative.

Undifferentiated Chalk

Solid strata of Undifferentiated Chalk were encountered directly beneath the natural Superficial strata in CP01, CP02 and CP03 at depths of between 3.00m and 7.10m bgl and were proven to depths of between 14.45m and 17.00m bgl in the cable percussive boreholes. The base of the Undifferentiated Chalk was not proven. The depth to the top of the Undifferentiated Chalk decreased towards the east of the site.

The cable percussion drilling method severely disturbs any structure present within chalk strata, resulting in the recovery of highly disturbed samples. Although full engineering descriptions was generally not possible, the Undifferentiated Chalk was generally described as structureless chalk recovered as cream silty gravel, Grade Dc. The clasts comprised

extremely weak, cream-coloured chalk fragments of gravel size, and the matrix comprised cream-coloured calcareous silt.

Twenty-two in-situ SPTs tests undertaken in the Undifferentiated Chalk recorded N values of between N=9 and N=37 with a general increase strength with depth.

Two Saturation Moisture Content (SMC) tests were undertaken on samples of Undifferentiated Chalk and recorded dry density values of 1.49Mg/m³ and 1.50Mg/m³, indicating low density chalk. The tests also recorded saturated moisture contents of 28.1% and 28.9%.

Groundwater

Groundwater strikes were encountered during the ground investigation at depths of between 1.50m and 3.20m bgl in the natural Superficial strata and at a depth of 3.20m bgl in the Undifferentiated Chalk (CP03 only). Subsequent monitoring of the standpipes (installed in the Superficial strata and Undifferentiated Chalk) on four occasions between 9th and 31st March 2026 generally recorded resting groundwater levels between 1.57m and 3.06m bgl. DCS08 was recorded as dry during the third monitoring visit.

Ground Gas

A variable thickness of Made Ground has been encountered across the Phase 3B area, with hydrocarbon odours noted in DCS06 during this investigation. Apart from this, no other significant on-site sources of ground gas were observed during the site investigation.

The monitoring results did not record any methane concentrations above detection limit (0.1% by volume), and all carbon dioxide concentrations were well below 5%. Flow readings were taken over a three-minute period and reported maximum steady flow rates of between less than the instrument detection limit (0.1l/hr) and 0.3 l/hr.

Gas Screening Values (GSVs) have been calculated for each borehole, and the results are detailed in the table below.

Stratum	BH	Response Zone (m bgl)	Ground water level (m bgl)	Max. Methane (%)	Max. Carbon Dioxide (%)	Max. Steady Flow (l/hr)	GSV Methane (l/hr)	GSV Carbon Dioxide (l/hr)
Alluvium	CP03	1.00 - 3.00	1.95 – 2.10	0.1	0.9	0.3	0.0001	0.0027
	DCS05	1.00 – 3.00	2.53 – 2.63	0.1	0.8	0.1	0.0001	0.0008
RTD	DCS06	1.50 - 2.50	2.01 – 2.12	0.1	2.6	0.1	0.0001	0.0026
	DCS07	1.00 - 2.00	1.61 – 1.71	0.1	1.0	0.1	0.0001	0.001
	DCS08	1.00 - 2.00	Dry - 1.57	0.1	1.7	0.1	0.0001	0.0017
Alluvium/ RTD	CP01	2.00 - 6.00	2.25 – 2.35	0.1	0.9	0.1	0.0001	0.009
	CP02	2.00 - 7.00	2.88 – 3.06	0.1	3.5	0.1	0.0001	0.0035
	DCS03	1.00 - 3.00	2.23 – 2.36	0.1	1.2	0.1	0.0001	0.0012
	DCS04	2.00 - 4.00	2.72 – 2.86	0.1	4.1	0.1	0.0001	0.0041

RTD = River Terrace Deposits; Chalk = Undifferentiated Chalk
Green highlighted cells indicate CS-1 conditions.

Based on the ground conditions encountered and the monitoring undertaken, there is no identified source of soil/ground gas, and the site can be classified as CIRIA Characteristic Situation 1, for which no gas protection measures are required.

Contamination

The investigation has proven a variable thickness of predominantly granular Made Ground across the site. The Made Ground generally contained brick, concrete, asphalt and rare plastic fragments.

A distinct hydrocarbon odour was noted at a depth of 0.11m and 1.10m bgl in DCS06. Headspace testing undertaken on samples of the Made Ground recorded negligible VOC concentrations of between <0.1ppm and 0.4ppm.

PRELIMINARY GEOENVIRONMENTAL ASSESSMENT

Human Health Risk Assessment

Although the current proposals allow for some minor areas of soft landscaping, mostly to the perimeter of the site, the proposed development generally comprises a large percentage of hardcover. Considering this and the context of the proposed development (commercial/industrial warehouses) and that the site levels will be raised in the order of 1m (although not confirmed, anticipated to comprise a combination of stockpiled granular demolition arisings and imported granular material), the source-pathway-receptor linkages to potential end users are effectively broken, and as such, there is considered to be a negligible risk to Human Health from potential contaminants in the ground. However, to account for the potential minor areas of proposed soft landscaping, a comparison of the chemical test results against generic screening criteria for a commercial/industrial end usage has been undertaken, which would also consider potential indoor air pathways as the site is to include occupied buildings. The results of chemical testing on soils have been assessed as described in Appendix E, assuming 1% SOM in the soil.

A spreadsheet summarising the laboratory results and relevant screening values are presented in Appendix D.

In respect of benzo(a)pyrene and other genotoxic PAHs, various PAH ratios have been plotted and compared against data from the Culp et al study and found to be within the same range, therefore use of the surrogate marker approach is justified.

A review of the chemical testing undertaken on the soil samples analysed has identified that none of the determinants tested for were found to exceed the corresponding Human Health screening values for a Commercial/Industrial end use.

Measurable concentrations of PAHs have been detected in the Made Ground across the site, although well below the adopted screening criteria. Based on the source signature double ratio plots, the PAHs identified are considered likely to be predominantly coal derived.

Although no exceedances were identified, measurable concentrations of total petroleum hydrocarbons (TPH) were identified in the nine samples tested, comprising both heavy-end (C₁₀ to C₃₅) aliphatic and aromatic fractions between 46.6mg/kg to 152.3mg/kg. Although again well below the adopted screening criteria, a sample of the Made Ground collected from DCS06 at 0.40m bgl recorded a total TPH concentration of 111mg/kg. A sample of the Made Ground collected from DCS05, located in proximity to previously identified hydrocarbon-impacted soils during the previous Clancy Consulting Ltd ground investigations recorded a total TPH concentration of 152.3mg/kg. Notably, no hydrocarbon odour or visual evidence of contamination was observed during the logging of DCS05 in the recent investigation.

Measurable concentrations of total phenols were identified in the Made Ground soils, concentrations were recorded between less than the laboratory limit of detection and 0.83mg/kg, although well below the relevant soil screening value of 440mg/kg.

PCBs were not identified in the soil sample collected in the vicinity of the former on-site electricity substation (DCS03 at 0.70m bgl) to the western part of the site.

The results from the MTBE and BTEX suites have reported concentrations below the laboratory limit of detection.

No Asbestos fibres were detected in the samples.

Controlled Waters Risk Assessment

Although no exceedances against the relevant Human Health screening criteria have been identified across the Phase 3B development area, the soil testing has recorded some elevated concentrations of PAH and heavier end TPH (C₁₀–C₃₅) fractions in the Made Ground soils, alongside some evidence of hydrocarbon impacted soils as identified via hydrocarbon odours in DCS06.

Considering the results of chemical testing on the soil samples, the olfactory evidence of hydrocarbon impacted soils and previous findings by Clancy Consulting in 2019/2020, testing was undertaken on five groundwater samples collected from CP01, CP02, CP03, DCS05 and DCS06 at depths of between 1.98m and 2.99m bgl within the Alluvium and River Terrace Deposits.

The test results have been compared and screened against criteria derived from UK Drinking Water Standards (DWS) and Water Framework Directive Environmental Standards (WFD ES). The screening assessment is presented in Appendix D.

Testing of the groundwater has identified marginal exceedances of several PAHs in CP01, CP02, DCS05 and DCS06.

The samples collected from DCS06, where a hydrocarbon odour was noted and from DCS05 in the vicinity of hydrocarbon impacted soils as identified by Clancy Consulting in 2019/2020, identified exceedances of heavy-end aromatic and aliphatic hydrocarbon fractions (C₂₁–C₃₅) at concentrations of between 20µg/l and 220 µg/l, compared to a waters screening value of 10µg/l. Total TPH in the groundwater samples collected from DCS05 and DCS06 was reported at 150µg/l (DCS05) and 400µg/l (DCS06).

VOCs, SVOCs, BTEX and total phenols were reported below the laboratory limit of detections and as such below the relevant water screening values.

The investigation has identified some TPH concentrations in groundwater, though at relatively low concentrations which are not indicative of a significant source of contamination in soils or the presence of free product. No significant source has been identified in soils as part of the recent Applied Geology investigation and only localised impact was previously identified by others. Based on current lines of evidence, the site is not considered to pose a significant risk to Controlled Waters, though supplementary investigation is recommended following demolition, following which an updated risk assessment should be carried out.

In the absence of a significant currently unidentified source being encountered as part of future ground investigation or more significant concentrations of hydrocarbons being encountered in future groundwater samples, specific remedial actions are not considered warranted, though

ensure information is as up to date as possible and allows the relevant people access to the information.

Data security is essential given the range of data confidentiality requirements. As part of the quality assurance records all data classed as sensitive or restricted is highlighted and stored on secure local servers. The quality assurance record also includes information on update requirements and any specific requirements on data usage.

Hampshire County Council as a local authority, is subject to the Freedom of Information Act meaning that if a request is made for this data, it has to be provided within a certain timeframe. The only data that can be withheld is that containing personal or financial information. If data is requested that is held by a third party, the person requesting it is directed to that data owner and the County Council does not release it. This is particularly pertinent to data provided by the water companies.

5 Past Flood Risk

5.1 Introduction

Flooding within Hampshire can occur for a number of reasons. With an extensive coastline, Hampshire is susceptible to coastal flooding. There are a number of communities extremely close to sea level which are most susceptible to tidal influence and potential sea level rise.

Hampshire also has numerous river networks which ultimately discharge into the sea. With a combination of high tides and high river levels, there is a high potential for river or surface water flooding where rivers in flood are unable to discharge into the sea due to high tides.

There is also a large area of chalk bedrock within central Hampshire and this is particularly susceptible to groundwater flooding caused when water held within aquifers under the ground reaches ground level following periods of heavy rainfall.

One particular issue linked with groundwater flooding is the emergence of 'winterbournes'. These are channels that run dry through the summer but become watercourses from the groundwater stored in the aquifer that is forced to the surface during winter. Because they are dry in summer, and sometimes over a longer period dependant on rainfall levels throughout the year, they can be forgotten and poorly maintained giving rise to a potential flooding problem when the water returns. They only occur in areas of chalk bedrock and as such are a key cause of groundwater flooding in Hampshire.

Surface water flooding is also a problem in Hampshire both within urban areas, where there is a high concentration of properties that could be at risk, and in rural areas where there is minimal drainage. In both cases, critical transport routes can be affected. Surface water flooding is not as well understood or managed when compared to other forms of flooding, especially as it is not confined to flood plains and is very dependant on the location of rain storms. One of the key purposes of the Floods Directive and the Flood and Water Management Act is to improve the understanding and management of surface water flooding thereby reducing the risk of this type of flooding in the future.

5.2 Historic Flooding

In 2000 – 2001, there was exceptional rainfall within Hampshire with return periods ranging from 1:50 to 1:200. Following this exceptional rainfall flooding occurred in 76 parishes with flooding at 713 properties to varying extents. Flooding was primarily caused by high groundwater levels and springflows in the Upper and Middle Test, Itchen, Meon, Wallington and Lavant valleys. Flooding incidents in the lower reaches of these valleys were more commonly associated with rainfall runoff from saturated ground. This was also the main trigger in the New Forest and Hamble catchments although springflows from local minor aquifers also contributed to flooding in some locations.

Since this flood event, there have been a number of other substantial flood events in varying locations across the County. These tend to be attributable to surface water flooding or the interaction of surface water and river flooding. There are also some areas along Hampshire's coastline which are susceptible to coastal flooding given their low lying nature and whilst these are identified and logged as part of this report, they will undergo a more detailed assessment through the shoreline management plans.

Figure 11 shows the distribution of known flooding incidents across Hampshire. It should be noted, however, that this only shows known incidents of flooding and gives no indication of the severity of flooding. Nor does it identify incidents of flooding not captured through the above data collection process.

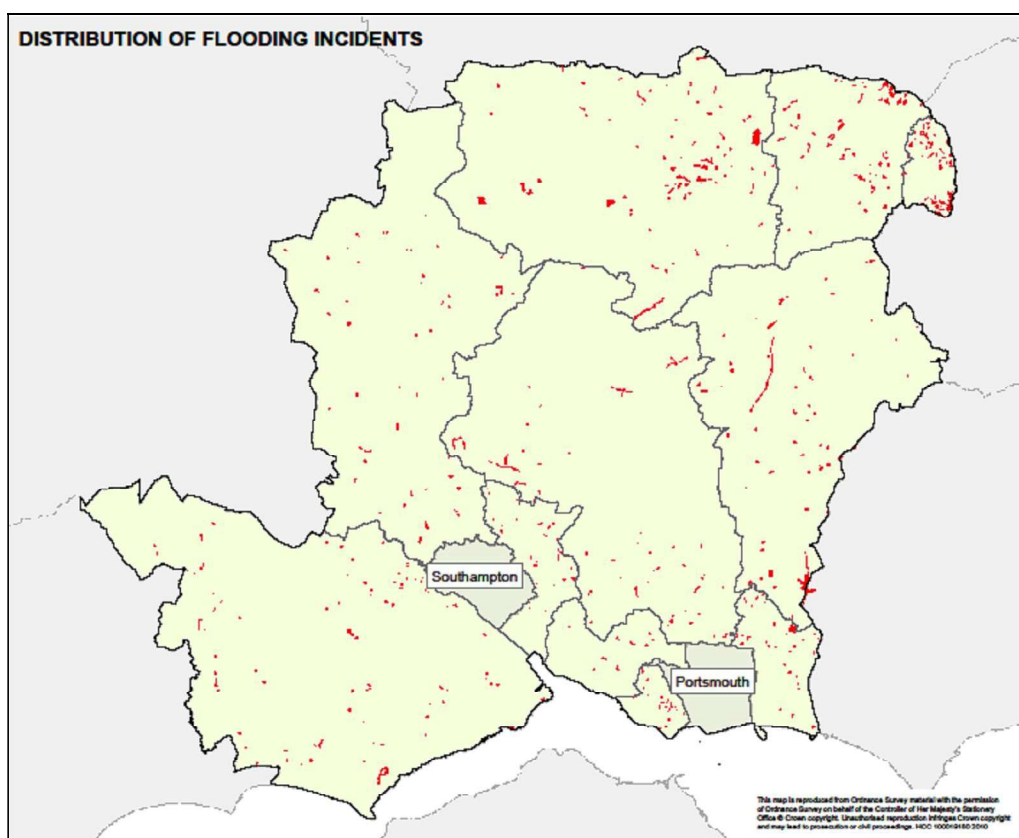


Figure 11 – Flooding Incidents within Hampshire

5.3 Consequences of Past Floods

In order to assess the risk of flooding, probability and consequence must be assessed. Probability should be assessed as an annual probability of that flood re-occurring, i.e. the return period, and is relatively straightforward to determine providing the date the flooding occurred is known.

Consequence is far more complex and needs to include a wide range of information although this can be considered under three general areas as identified below;

- human health - this includes property flooding and critical services such as hospitals, nursing homes etc
- the economy – this includes non-residential or commercial properties, infrastructure and agricultural land.
- the environment and heritage – consequences of pollution and the impact on designated environmental and heritage sites.

Although the consequences can be identified for floods that have occurred relatively recently through an assessment of the flood extent, it is not as straightforward to assess the overall priority each consequence would have. For its own purposes Hampshire County Council has developed a risk matrix to utilise the information consistently available from flood events using a methodology consistent with PPS25, planning policy statement for flood risk and including criteria relating to human health and the economy. This allows an initial assessment of flood risk which can then be looked at in more detail to include consequences to the environment and heritage.

The Preliminary Flood Risk Assessment requires details of past flooding incidents with significant adverse consequences to be recorded in Annex 1 for submission to Europe. The specification for sites that are entered into this annex are informed from guidance issued by the Environment Agency and from the requirements set out by Europe. Only sites that were of a scale that registered nationally should be entered into this annex and then only if sufficient information on the consequences of the event are recorded.

Historic flood events within Hampshire have been relatively poorly recorded in the past and there is only minimal data on the consequences of each event. The level of information required for reporting to the European Commission is extensive and the only flood event in Hampshire with sufficient recorded information is the 2000-01 groundwater flood. This event will be reported as a significant flood event within Annex 1 of this Preliminary Flood Risk Assessment. Although other flood incidents will not be reported to Europe, they will still be recorded, assessed and used to influence the Local Flood Risk Management Strategy.

6 Future Flood Risk

6.1 Introduction

The Environment Agency has historically provided a substantial amount of information about the potential risk from river and coastal flooding. This has been primarily for use in flood risk assessments required under PPS25. Following the Pitt review, a substantial amount of work has been undertaken to translate this information and experience into producing potential flood risk maps relating to surface water flooding. Two different surface water flood risk datasets are available for use at present as defined in section 4.1.3, each with their own advantages and limitations.

6.2 Locally Agreed Surface Water Information

Upon analysis of the available flood risk data, Hampshire County Council, the District Councils, the Environment Agency and the water companies have agreed that three datasets are considered to best represent flood risk in Hampshire. These datasets are illustrated on Figures 12 and 13 and consist of:

- Area susceptible to surface water flooding (figure 12)
- Flood Map for Surface Water 1:200 (figure 13)
- Localised Flooding Incidents (figure 13)

The Environment Agency has produced a 'Susceptibility to Groundwater Flooding' map. However, due to the extreme groundwater flooding that occurred in Hampshire in 2000-01, partners agreed that the existing records are likely to be more accurate than the modelling information. Groundwater is also extremely complex to model so it is unlikely to provide sufficient accuracy at this time.

Although these datasets have been agreed as the most suitable at this time, it is recognised that this list will require review as new information emerges.

3. Datasets

SFRAs rely on a large number of datasets and information from a range of stakeholder organisations. This section describes the datasets that have been obtained and the methods that have been applied to assess the risk from all sources of flooding across the study area.

3.1 Assessing Risk of Flooding from Rivers

3.1.1 Flooding from rivers occurs when water levels rise higher than bank levels, causing floodwater to spill across adjacent land (floodplain). The main reasons for water levels rising in rivers are:

- Intense or prolonged rainfall causing runoff rates and flows to increase in rivers, exceeding the capacity of the channel. This can be exacerbated by wet conditions and where there is significant groundwater base flow.
- Constrictions in the river channel causing flood water to back up.
- Constrictions preventing discharge at the outlet of the river e.g., locked flood gates.

Datasets

3.1.2 The datasets described in Table 3-1 have been used in the assessment of flooding from rivers.

Table 3-1 Datasets for river flooding

Dataset	Notes	Data Source
Detailed River Network	A consistent standardised GIS shapefile representing the river network. Identifies the watercourse centreline, and numerous parameters e.g., type (primary river, secondary, culvert, canal), surface or below ground, main river status, name, width, flow direction.	Environment Agency
OS Open Rivers	GIS shapefile which provides a high level view of watercourses. Contains over 144,000 km of water bodies and watercourses map data. These include freshwater rivers, tidal estuaries, and canals.	Ordnance Survey free download https://www.ordnancesurvey.co.uk/business-government/products/open-map-rivers
Catchment boundaries	GIS shapefiles obtained from the Catchment Data Explorer have been used to identify the river basin districts, management catchments and water body catchments in the PfSH SFRA project area.	Environment Agency Catchment Data Explorer https://environment.data.gov.uk/catchment-planning
Flood Zone 2 and Flood Zone 3a	GIS shapefiles which identify the probability of river and sea flooding, including the future impacts of climate change, ignoring the presence of defences as mapped on the Environment Agency Flood Map for Planning (rivers and sea). Flood Zone 1: Land having a less than 1 in 1,000 annual probability of river or sea flooding. (All land outside Flood Zones 2 and 3). Flood Zone 2: Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. Flood Zone 3a: Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.	Defra Data Services Platform https://environment.data.gov.uk/dataset/86ec354f-d465-11e4-b09e-f0def148f590 https://environment.data.gov.uk/dataset/87446770-d465-11e4-b97a-f0def148f590
Defences	Contains the locations of flood defences currently owned, managed or inspected by the Environment Agency, including structures, buildings, earth banks, stone and concrete walls, and sheet-piling that is used to prevent or control the extent of flooding.	Environment Agency
Flood Storage Areas	Contains flood storage areas, including balancing reservoirs, storage basins and balancing ponds whose purpose is to attenuate an incoming flood peak or to delay the timing of the peak.	Defra Data Services Platform https://environment.data.gov.uk/dataset/86ca7c80-d465-11e4-afe1-f0def148f590

Dataset	Notes	Data Source
Reduction in Risk of Flooding from Rivers and Sea due to Defences	<p>Reduction in Risk of Flooding from Rivers and Sea due to Defences is a spatial dataset that indicates where areas have reduced flood risk from rivers and sea due to the presence of flood defences.</p> <p>The dataset has been created to help initiate conversations about the impact our flood defences have on the risk of flooding from the rivers and sea, and as a prompt to find out more about the flood defences in a particular area of interest. It does not replace any local, more detailed information.</p>	<p>Defra Data Services Platform</p> <p>https://environment.data.gov.uk/dataset/7b5cf457-6853-4b50-a812-b041d9da003a</p>
Recorded Flood Outlines	<p>Contains all records of historic flooding from rivers, the sea, groundwater, and surface water since 1946. Takes account of the presence of defences, structures and other infrastructure that existed at the time of flooding. A companion dataset Historic Flood Map contains a subset of these Recorded Flood Outlines which satisfy certain criteria.</p>	<p>Defra Data Services Platform</p> <p>https://environment.data.gov.uk/dataset/8c75e700-d465-11e4-8b5b-f0def148f590</p>

Hydraulic models

- 3.1.3 A number of hydraulic river models were provided by the Environment Agency at the start of the project. The models were checked for completeness, date of preparation and the hydrological methods used. Outputs from the models have been used to define Flood Zone 3b functional floodplain and to map the impacts of climate change on floodplain extents in the future, as described in the following subsections.
- 3.1.4 Where necessary and appropriate models were re-run for the latest climate change allowances as part of this SFRA. In some cases, updates to the hydrological analysis informing the model have been updated. Table 3-3 summarises the models that have been received, how they have been used in the SFRA and any updates that have been undertaken as part of the SFRA. Full details of re-simulations are documented in separate standalone Technical Notes.

Functional floodplain

- 3.1.5 The SFRA should identify areas of Flood Zone 3b functional floodplain, which is defined as land where water has to flow or be stored in times of flooding. This is identified by the normal form of the river channel and land that would flood with an annual probability of 1 in 30 (3.3%) or greater in any year, with existing flood risk management features and structures operating effectively. It is also identified by land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).
- 3.1.6 Where the 3.3% annual exceedance probability (AEP) flood extent is available from received hydraulic models, it has been used to delineate Flood Zone 3b functional floodplain. As noted in Table 3-3, where the received hydraulic models did not include a 3.3% annual exceedance probability (AEP) flood extent, alternative approaches have been adopted. In some cases, this involves using the 4% AEP (1 in 25 year) 5% AEP (1 in 20 year), or the 2% AEP (1 in 50 year) flood extent.
- 3.1.7 Where a suitable flood extent is not available to identify the functional floodplain, the extent of Flood Zone 3a should be used as a surrogate for Flood Zone 3b to ensure the risk isn't underestimated. The Environment Agency guidance 'How to prepare a strategic flood risk assessment' ³ encourages the use of site specific flood risk assessments to determine whether a site is affected by functional floodplain. If sites are proposed for development in such areas in any of the LPA's Local Plans, it may be necessary to undertake additional assessment to map the location of the functional floodplain as part of a Level 2 SFRA.

Impact of climate change on peak river flow

- 3.1.8 Climate change is expected to increase the frequency, extent, and impact of flooding, reflected in peak river flows. Wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff and there may be increased storm intensity in summer. Rising river levels may also increase flood risk.
- 3.1.9 LPAs are required to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Current guidance on the climate change allowances that should be

applied are set out by the Environment Agency¹⁴. Peak river flow allowances show the anticipated changes to peak flow by management catchment. Management catchments are sub-catchments of river basin districts. The range of allowances is based on percentiles. A percentile describes the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it, and half fall above it. The:

- *central* allowance is based on the 50th percentile
 - *higher central* allowance is based on the 70th percentile
 - *upper end* allowance is based on the 95th percentile
- 3.1.10 An allowance based on the 50th percentile is exceeded by 50% of the projections in the range. At the 70th percentile it is exceeded by 30%. At the 95th percentile it is exceeded by 5%.
- 3.1.11 These allowances (increases) are provided, in the form of figures for the total potential change anticipated, for three climate change periods:
- The '2020s' (2015 to 2039)
 - The '2050s' (2040 to 2069)
 - The '2080s' (2070 to 2125)
- 3.1.12 The time period that should be used in an assessment depends upon the expected lifetime of the proposed development. Residential development should be considered for a minimum of 100 years, whilst the lifetime of a non-residential development depends upon the characteristics of that development.
- 3.1.13 The guidance states that for *SFRAs* LPAs should assess both the *central* and *higher central* allowances.
- 3.1.14 When designing safe access, escape routes and places of refuge, the central allowance should be used for all development types except for essential infrastructure. For essential infrastructure the higher central allowance should be used.
- 3.1.15 The management catchments in the PfSH SFRA project area include:
- East Hampshire (South East river basin district)
 - Test and Itchen (South East river basin district)
 - New Forest (South East river basin district)
 - Avon Hampshire (South West river basin district)
- 3.1.16 Table 3-2 presents the peak river flow allowances for these management catchments.

¹⁴ Flood risk assessments: climate change allowances <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> First published February 2016. Last updated May 2022.

Table 3-2 Peak river flow allowances by management catchment (based on 1981 to 2000 baseline)

Management catchment	River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2125)
East Hampshire	South east	Upper end	37%	51%	88%
		Higher central	24%	30%	51%
		Central	19%	22%	37%
New Forest	South east	Upper end	29%	51%	86%
		Higher central	16%	30%	50%
		Central	11%	22%	35%
Test and Itchen	South east	Upper end	45%	61%	127%
		Higher central	24%	28%	56%
		Central	16%	17%	35%
Avon Hampshire	South west	Upper end	33%	52%	102%
		Higher central	19%	27%	56%
		Central	12%	16%	38%

3.1.17 Table 3-3 summarises the models that have been received, to inform this SFRA, how they have been used in the SFRA, and additional model simulations that have been undertaken as part of the SFRA.

Table 3-3 River models in PFSH study area *

Hydraulic Model	LPA	Type and Date of Received Model	Model Information	Flood Zone 3b Functional Floodplain	Approach undertaken within this SFRA to map the risk in the future as a result of climate change
River Anton (including Pillhill Brook)	Test Valley BC	1D-2D model (FMP-TUFLOW), August 2014, JBA.	2 models (lower and upper catchment)	3.3% AEP (1 in 30 year) extent available to map Flood Zone 3b functional floodplain.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (35%) and higher central (56%) allowances.
Kimpton (Mullens Brook)	Test Valley BC	1D-2D model (FMP-TUFLOW), September 2016, Environment Agency.	Small area modelled in Kimpton village. Mullens Brook flows through Kimpton to confluence with Pillhill Brook at Mullens Pond.	No suitable AEP event to map the functional floodplain available.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (35%) and higher central (56%) allowances.
Romsey	Test Valley BC	1D-2D model (FMP-TUFLOW), September 2018, Royal Haskoning DHV.	Flood alleviation scheme model, Do Nothing and Do Something scenarios modelled.	2% AEP (1 in 50 year) extent used to map Flood Zone 3b functional floodplain.	Hydrology checked and confirmed suitable. Model re-run by AECOM for the Do Something scenario for the 1% AEP plus central (35%) and higher central (56%) allowances.
River Bourne (Tidworth & Shipton Bellinger)	Test Valley BC	TUFLOW, 2005, Capita Symonds.	Steady state TUFLOW modelling.	2% AEP (1 in 50 year) extent used to map Flood Zone 3b functional floodplain.	Hydrology updated. Model re-run for 1% AEP plus central (38%) and higher central (56%) allowances.
Tadburn Lake Stream	Test Valley BC	FMP 1D, December 2004, Atkins.		2% AEP (1 in 50 year) extent used to map Flood Zone 3b functional floodplain.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP and 0.1% AEP flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
Tanners Brook	Test Valley BC Southampton CC	FMP, February 2010, Royal Haskoning.		No suitable AEP event to map the functional floodplain available.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP and 1% AEP plus 20% climate change allowance flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
Monks Brook	Test Valley BC Eastleigh BC	FMP, August 2008, Halcrow Group Ltd.		4% AEP extent used to map Flood Zone 3b functional floodplain	No additional work undertaken. The Environment Agency are developing a new model for the Monks Brook. The available 1% AEP and 1% AEP plus 20% climate change allowance flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).

Hydraulic Model	LPA	Type and Date of Received Model	Model Information	Flood Zone 3b Functional Floodplain	Approach undertaken within this SFRA to map the risk in the future as a result of climate change
Monks Brook (upstream sections)	Eastleigh BC	FMP-TUFLOW, May 2018, Jacobs	Model focused on Chandlers Ford Area. Atkins developed FMP TUFLOW model in 2016 to evaluate risk for Monks Brook Flood Alleviation Scheme. The model was based entirely on LIDAR data and site observations, hence is subject to significant uncertainty. Review by Jacobs 2018: although the Atkins model contains significant data gaps and uncertainties, it was considered appropriate to adopt for this study. More rigorous modelling will be required for any future stages of work.	2% AEP (1 in 50 year) extent available to map Flood Zone 3b functional floodplain	Due to the age of this model and the fact that the Environment Agency are developing a new model for the Monks Brook this model has not been re-run for the SFRA. The available 0.5% AEP and 0.1% AEP flood extents have been mapped in this SFRA to provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
Itchen	Winchester CC Eastleigh BC Southampton CC	FMP-TUFLOW, JFLOW, May 2019, JBA	Model split into 3. JFLOW for upstream catchment, FMP-TUFLOW between Easton and Woodmill.	3.3% AEP extent used to map Flood Zone 3b functional floodplain.	Environment Agency are planning to update CC scenarios. Therefore, no additional work undertaken for the SFRA; the existing available climate change allowances have been mapped (35%, 45% and 105%).
Itchen tributaries	Bow Lake (Winchester CC) Colden Common Stream (Winchester CC) Hatch Green Brook (Eastleigh BC) Moorgreen Brook (Eastleigh BC) Otterbourne Stream (Winchester CC) Townhill Stream (Eastleigh BC)	FMP-TUFLOW, May 2019, JBA	Separate models for each tributary. Model has been run for the following climate change allowances 35%, 45% and 105%.	3.3% AEP extent us to map Flood Zone 3b functional floodplain.	Environment Agency are planning to update CC scenarios. Therefore, no additional work undertaken for the SFRA; the existing available climate change allowances have been mapped (35%, 45% and 105%).
River Meon	Winchester CC Fareham BC	FMP-TUFLOW, August 2009, Halcrow Group Ltd	Comprises 8 models, each are short sections of river at key locations identified by Environment Agency. Two sections are in the SFRA study area: Titchfield (Fareham BC) and Wickham (Winchester CC).	Wickham: Winchester CC have selected to use the 1.3% AEP (1 in 75 year) flood extent through Wickham as this is a built-up area that has experienced flooding issues in the past and therefore a conservative approach is justified. Titchfield: Fareham BC have selected to use the 5% AEP (1 in 20 year) flood extent. Given its location, there is very minimal chance of any development being allocated here in any emerging Local Plan. The area is covered by a variety of nature conservation designations including parts within a SPA and Ramsar as well as the whole valley being classes as an Area of Special Landscape Quality.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP, 1% AEP plus 20% climate change allowance and 0.1% AEP flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).

Hydraulic Model	LPA	Type and Date of Received Model	Model Information	Flood Zone 3b Functional Floodplain	Approach undertaken within this SFRA to map the risk in the future as a result of climate change
River Wallington	Winchester CC Fareham BC	FMP-TUFLOW, April 2011, Hyder Consulting.	This is more detailed than JFLOW modelling. However, there is low confidence in the extents at the moment.	2% AEP extent (1 in 50 year) used to map Flood Zone 3b functional floodplain for River Wallington and its tributaries upstream of North Fareham.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP, 1% AEP plus 20% climate change allowance and 0.1% AEP flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
River Wallington	Fareham BC	FMP-TUFLOW, November 2018, JBA.		3.3% AEP extent used to map Flood Zone 3b functional floodplain for lower part of the River Wallington from North Fareham through Wallington to the A27 roundabout.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (37%) and higher central (51%) allowances.
Hermitage Stream and Lavant Stream	Havant BC	Infoworks RS, March 2008, Atkins.	Separate sub-model of Park Lane Stream build in RS for the Warren Dam.	No suitable AEP event to map the functional floodplain available.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP, 1% AEP plus 20% climate change allowance and 0.1% AEP flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
Hampshire Avon: Fordingbridge	New Forest DC and NPA	FMP-TUFLOW, 2018, JBA		5% AEP extent used to map Flood Zone 3b functional floodplain.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (38%) and higher central (56%) allowances.
Ringwood Ordinary Watercourses	New Forest DC and NPA	FMP-TUFLOW, 2018, JBA		5% AEP extent used to map Flood Zone 3b functional floodplain.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (38%) and higher central (56%) allowances.
Bransgore	New Forest DC and NPA	FMP-TUFLOW, 2018, JBA		5% AEP extent used to map Flood Zone 3b functional floodplain.	Hydrology checked and confirmed suitable. Model re-run by AECOM for 1% AEP plus central (38%) and higher central (56%) allowances.
Hampshire Avon: Ringwood	New Forest DC and NPA	FMP-TUFLOW, 2011, JBA		2% AEP extent (1 in 50 year) used to map Flood Zone 3b functional floodplain.	This model has not been re-run for the SFRA. The available 1% AEP, 0.5% AEP and 0.1% AEP flood extents have been mapped in this SFRA to provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).
River Mude	New Forest DC and NPA	2009		5% AEP extent used to map Flood Zone 3b functional floodplain.	Due to the age of this model, it has not been re-run for the SFRA. The available 1% AEP, 1% AEP plus 20% climate change allowance and 0.1% AEP flood extents have been mapped in this SFRA provide an indication of the impact of climate change. GIS Floodplain Analysis also undertaken to provide indication of areas that could be susceptible to flooding if flood levels were to increase (refer to next section).

Hydraulic Model	LPA	Type and Date of Received Model	Model Information	Flood Zone 3b Functional Floodplain	Approach undertaken within this SFRA to map the risk in the future as a result of climate change
Avon Water, Bartley Water, Danes Water, Dark Water and Walkford Brook	New Forest DC and NPA	HEC-RAS 2020, Capita AECOM	1D models of watercourses in New Forest. Outputs available for 10%, 3.3%, 1% and 0.1%. Climate change runs available for 35%, 45% and 105%.	3.3% AEP extent used to map Flood Zone 3b functional floodplain.	Current outputs deemed suitable for the SFRA. In the New Forest management catchment (in which these watercourses are located), the central and higher central allowances are 35% and 50% respectively. The modelled outputs for 1% AEP plus 35% and plus 45% are therefore suitable indications of the likely impacts of climate change.
Calmore Canal, Testwood Stream and the Bartley Water Tributary	New Forest DC and NPA	InfoWorks Integrated Catchment Model, March 2022, JBA Consulting	Detailed 1D-2D linked fluvial and integrated hydraulic models for the Calmore and Totton study area. Represents rivers, sewers, and surface water. The model was built to update flood risk mapping and flood warning systems, and to test flood alleviation options.	5% AEP extent used to map Flood Zone 3b functional floodplain.	The available climate change allowances have been mapped for the 1% AEP flood event: 35%, 45% and 105%.

* Watercourses not listed in this table that have Flood Zones 2 and 3 associated with them on the Flood Map for Planning (rivers and sea) are derived from national generalised modelling (JFLOW). Detailed hydraulic models containing extents for Flood Zone 3b or including the impacts of climate change are not available for these watercourses.

GIS Floodplain Analysis

- 3.1.18 Some of the watercourses in the study area have only been modelled using national generalised modelling (JFLOW). In these cases, Flood Zone 2 and Flood Zone 3 extents are available, but there are no extents for Flood Zone 3b functional floodplain or consideration of the how the extent of flooding could change in the future as a result of the impacts of climate change.
- 3.1.19 Where significant development is proposed, there is a case for hydraulic modelling to be carried out to determine the risk of from these watercourses. For example, the Environment Agency are currently developing new hydraulic models for the River Test and the Monks Brook. The Environment Agency are also updating the Itchen and Itchen tributary models with the latest climate change allowances as part of their ongoing programme of modelling.
- 3.1.20 In other areas, full hydraulic modelling cannot be justified at this stage, but more information would be valuable for LPAs to enable them to understand those areas of the floodplain that may be sensitive to changes in flood level. To facilitate this understanding, the scope of the SFRA has been extended to include GIS analysis of the extents of Flood Zone 2 and 3 and local LIDAR topographic survey.
- 3.1.21 The GIS floodplain analysis involved recreating the Environment Agency Flood Zone 3 flood extents in ArcGIS Pro by extracting elevation points along the boundary of the Flood Zone 3 flood extent from DTM LiDAR data and interpolating a new water surface. Additional water depths of 300 and 600mm were added on to this water surface to provide an indication of those areas of floodplain that could become flooded if the water level were to increase. This mapping does not show the expected impacts of specific climate change predictions, rather it highlights areas which could be sensitive to an increase in flood level. It also identifies areas of floodplain which comprise a more well defined valley and are therefore less sensitive to changes in flood level.
- 3.1.22 This is considered a suitable level of information to inform the application of the Sequential Test by the LPAs. However, if the LPAs are considering development within the extents of Flood Zone 2 and 3 associated with these watercourses detailed modelling should be undertaken.
- 3.1.23 Further details are provided in the Technical Note in Appendix B.

3.2 Assessing Risk of Flooding from Surface Water

- 3.2.1 Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding. The PPG states that an SFRA should identify areas at risk from surface water flooding and drainage issues, taking account of climate change and of the surface water flood risk published by the Environment Agency as well other available information.

Hampshire County Council records

- 3.2.2 As the LLFA for most of the LPA administrative areas, Hampshire County Council have a duty to lead on the management of surface water flood risk. To inform the SFRA, HCC have provided GIS shapefiles of recorded highway flooding incidents and locations of flood investigations.

Risk of flooding from Surface Water mapping

- 3.2.3 The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying those areas at risk of surface water flooding during three annual probability events: 1 in 30 year (3.33% annual probability), 1 in 100 year (1% annual probability) and 1 in 1,000 year (0.1% annual probability). The extents of the latest version of the mapping have been made available for the Level 1 SFRA as GIS layers. This mapping is referred to as 'Risk of Flooding from Surface Water' (RoFSW) and is also available online on the [Long Term Flood Risk Map](https://flood-warning-information.service.gov.uk/long-term-flood-risk)¹⁵.
- 3.2.4 The RoFSW mapping provides all relevant stakeholders, such as the Environment Agency, LPAs, and the public access to information on surface water flood risk which is consistent across England and Wales. The modelling helps the Environment Agency take a strategic overview of flooding and assists

¹⁵ Environment Agency Long Term Flood Risk Map <https://flood-warning-information.service.gov.uk/long-term-flood-risk>

LLFAs in their duties relating to management of surface water flood risk. For the purposes of this SFRA, the mapping allows an improved understanding of areas within the study area which may have a surface water flood risk.

3.2.5 It should be noted that this national mapping has the following limitations:

- Use of a single drainage rate for all urban areas,
- It does not show the susceptibility of individual properties to surface water flooding,
- The mapping has significant limitations for use in flat catchments,
- No explicit modelling of the interaction between the surface water network, the sewer systems and watercourses,
- In a number of areas, modelling has not been validated due to a lack of surface water flood records, and
- As with all models, the ROFSW mapping is affected by a lack of, or inaccuracies, in available data.

Impact of climate change on peak rainfall intensity

3.2.6 Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This will lead to an increased volume of water entering land and urban drainage systems, consequently resulting in surface water flooding.

3.2.7 LPAs are obliged to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Current guidance on the climate change allowances that should be applied are set out by the Environment Agency¹⁶. Table 3-4 shows anticipated changes in peak rainfall intensity in small catchments (less than 5km²), or urbanised drainage catchments¹⁷.

Table 3-4 Peak rainfall intensity allowance in small catchments (less than 5km²) or urban drainage catchments (based on a 1981 to 2000 baseline)

Management catchment	River basin district	AEP	Epoch 2050s (2022-2060) or 2070s (2051-2125)	Central Allowance	Upper End Allowance
East Hampshire	South east	3.33%	'2050s'	20%	35%
		3.33%	'2070s'	25%	40%
		1%	'2050s'	20%	40%
		1%	'2070s'	25%	45%
New Forest	South east	3.33%	'2050s'	20%	35%
		3.33%	'2070s'	25%	40%
		1%	'2050s'	20%	40%
		1%	'2070s'	25%	45%
Test and Itchen	South east	3.33%	'2050s'	20%	35%
		3.33%	'2070s'	25%	40%
		1%	'2050s'	20%	40%
		1%	'2070s'	25%	45%
Avon Hampshire	South west	3.33%	'2050s'	20%	35%
		3.33%	'2070s'	25%	40%
		1%	'2050s'	25%	40%
		1%	'2070s'	25%	45%

¹⁶ Flood risk assessments: climate change allowances <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> First published February 2016. Last updated May 2022.

¹⁷ For large rural drainage catchments use the peak river flow allowances described in Table 3-2.

- 3.2.8 The guidance encourages the use of the upper end allowances for the 2070s epoch when preparing SFRAs.
- 3.2.9 Climate change must be considered in evaluating the flood risk from all sources, including surface water. The RoFSW does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding and it is not within the scope of this SFRA to undertake widespread surface water modelling to apply all the allowances within the guidance. However, a range of three annual probability events have been modelled within the RoFSW, 3.3%, 1% and 0.1%, and therefore it is possible to use with caution the 0.1% outline as a substitute dataset to provide an indication of the implications of climate change.

3.3 Assessing Risk of Flooding from Groundwater

- 3.3.1 Groundwater flooding usually occurs in low lying areas underlain by permeable rock and aquifers that allow groundwater to rise to the surface through the permeable subsoil following long periods of wet weather. Low lying areas may be more susceptible to groundwater flooding because the water table is usually at a much shallower depth and groundwater paths tend to travel from high to low ground.
- 3.3.2 There are many mechanisms associated with groundwater flooding which are linked to high groundwater levels and can be broadly classified as:
- Direct contribution to channel flow – where the river channel intersects the water table and groundwater enters the streambed increasing water levels and causing flooding,
 - Springs erupting at the surface,
 - Exceptionally large flows from perennial springs or large flows from intermittent or dormant springs,
 - Rise of typically high groundwater levels to extreme levels in response to prolonged extreme rainfall.
- 3.3.3 The main impacts of groundwater flooding are:
- Flooding of basements of buildings below ground level – in the mildest case this may involve seepage of small volumes of water through walls, temporary loss of services etc. In more extreme cases larger volumes may lead to the catastrophic loss of stored items and failure of structural integrity,
 - Overflowing of sewers and drains – surcharging of drainage networks can lead to overland flows causing significant but localised damage to property. Sewer surcharging can lead to inundation of property by polluted water. Note: it is complex to separate this flooding from other sources, notably surface water, or sewer flooding,
 - Flooding of buried services or other assets below ground level – prolonged inundation of buried services can lead to interruption and disruption of supply,
 - Inundation of roads, commercial, residential and amenity areas – inundation of grassed areas can be inconvenient; however, the inundation of hard-standing areas can lead to structural damage and the disruption of commercial activity. Inundation of agricultural land for long durations can have financial consequences,
 - Flooding of ground floors of buildings above ground level – can be disruptive and may result in structural damage. In addition, typically a groundwater flood event will have a long duration (when compared to other flood sources) which adds to the disruptive nature of the flood event.

Areas Susceptible to Groundwater Flooding

- 3.3.4 'Areas Susceptible to Groundwater Flooding' is a national dataset produced by the Environment Agency which shows the proportion of 1km squares where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring but provides a useful tool to identify where further studies may be useful.

Susceptibility to Groundwater Flooding

- 3.3.5 The BGS has produced the first national dataset on the susceptibility of groundwater flooding. Based on geological and hydrogeological information, the digital data can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. Note, it is a susceptibility set, it does not indicate hazard or risk, i.e., it does not provide any information on the depth to which groundwater flooding occurs or the likelihood of the occurrence of an event of a particular magnitude.
- 3.3.6 The 'Susceptibility to Groundwater Flooding' dataset is divided into three classes – High, Medium, and Low risk as follows:
- High – areas with the potential for groundwater flooding to occur at the surface
 - Medium – areas which may experience groundwater flooding of property situated below the ground surface i.e., basements
 - Low – areas with limited potential for groundwater flooding to occur.
- 3.3.7 The BGS state that the dataset is suitable for use for regional or national planning purposes where the groundwater flooding information will be used along with a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with a large number of other factors, e.g., records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information, to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. The susceptibility data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding.
- 3.3.8 The Susceptibility to Groundwater Flooding dataset provided by the BGS can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.

Impact of Climate Change on Groundwater Flood Risk

- 3.3.9 Climate change must be considered in evaluating the flood risk from all sources, including groundwater. Groundwater flooding occurs primarily as a response to extended periods of rain during late autumn and early winter¹⁸. With climate change bringing wetter winters, an increased risk of groundwater flooding may be seen. However, the complex relationship between rainfall, recharge, groundwater storage and flow make the response to climate change uncertain. For this reason, the effect of climate change on groundwater flood risk has not been evaluated.

3.4 Assessing risk of flooding from Sewers

- 3.4.1 During heavy rainfall, flooding from the sewer system may occur if:
- The rainfall event exceeds the capacity of the sewer system/drainage system: Sewer systems are typically designed and constructed to accommodate rainfall events with an annual probability of 3.3% (1 in 30 chance each year) or greater. Therefore, rainfall events with an annual probability less than 3.3% would be expected to result in surcharging of some of the sewer system. While sewerage undertakers recognise the impact that more extreme rainfall events may have, it is not cost beneficial to construct sewers that could accommodate every extreme rainfall event.
 - The system becomes blocked by debris or sediment: Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris (e.g., litter).
 - The system surcharges due to high water levels in receiving watercourses: There is potential for surface water outlets to become submerged due to high river levels. Once storage capacity within the sewer system itself is exceeded, the water will overflow into streets and potentially into houses.

¹⁸ Hampshire County Council, October 2013, Hampshire Groundwater Management Plan
<https://www.hants.gov.uk/landplanningandenvironment/environment/flooding/strategies/groundwater-management-plan>

Historic records

- 3.4.2 Water companies are required to maintain a register of properties which are at risk of flooding due to hydraulic overloading of the sewers (the sewer pipe is too small, or at too shallow a gradient).
- 3.4.3 Within the context of strategic planning, identification of these locations of previous flooding can inform LPAs of areas where further development may have a significant impact on the existing sewer system, and where Southern Water may be required to invest in measures to improve capacity to support the proposed development. However, it should be noted that the incidents may have been addressed through Southern Water's ongoing asset management programme and may no longer reflect an area where incapacity is a problem or where flooding is likely to occur.

Climate Change

- 3.4.4 Climate change is anticipated to increase the potential risk from sewer flooding as summer storms become more intense and winter storms more prolonged. This combination is likely to increase the pressure on the existing efficiency of sewer systems, thereby reducing their design standard and leading to more frequent localised flooding incidents. Any sewer flooding that may occur could be exacerbated as a result of surface water runoff during extreme rainfall events.
- 3.4.5 Water Companies continue to monitor the risk of sewer flooding and put plans in place to manage the risk, as required, based on their business plan and priorities. The LPAs can work with Southern Water to identify flooding hotspots and locations of known sewer capacity issues where risk could be exacerbated. Water companies prioritise investment for potential flood alleviation schemes depending on the severity and frequency of flooding, but this can only be identified where affected property owners report the incident to the water company.

3.5 Assessing Risk of Flooding from Reservoirs

- 3.5.1 The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The PPG obliges LPAs to identify any impounded reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment it is located within, and / or whether emergency draw-down of the reservoir will add to the extent of flooding. Furthermore, the PPG obliges LPAs to evaluate the potential damage to buildings or loss of life in the event of dam failure, compared to other risks, when considering development downstream of a reservoir.
- 3.5.2 Areas at risk of reservoir flooding are included on the Environment Agency's Long Term Flood Risk Map¹⁹. This dataset shows the individual flood extents for all large, raised reservoirs in the event that they were to fail and release the water held.
- 3.5.3 Two extents are provided; one for a "dry day"²⁰, when river levels are normal, and one for a "wet day"²¹ when local rivers had already overflowed their banks.
- 3.5.4 The data represents a prediction of a credible worst case scenario, however it's unlikely that any actual flood would be this large. The data gives no indication of likelihood or probability of reservoir flooding. Flood extents are not included for smaller reservoirs or for reservoirs commissioned after the reservoir modelling programme began in October 2016.

¹⁹ Environment Agency Long Term Flood Risk Map <https://www.gov.uk/check-long-term-flood-risk>

²⁰ Defra Data Services Platform Reservoir Flood Extents – Dry Day (National)
<https://environment.data.gov.uk/dataset/c66ee97f-49d2-454e-9a19-d48a47bd22ad>

²¹ Defra Data Services Platform Reservoir Flood Extents – Wet Day (National)
<https://environment.data.gov.uk/dataset/d81646cf-37e5-4e71-bbcf-b7d5b9ca3a1c>

3.6 Assessing Risk of Flooding from the Sea

Datasets

- 3.6.1 Some of the datasets described in Table 3-1 have been used in the assessment of flooding from sea, including 'Flood Zones', 'Defences' and 'Reduction in Risk of Flooding from Rivers and Sea due to Defences'.

Coastal modelling

- 3.6.2 The Environment Agency have supplied the following coastal models for the study area:
- East Solent Study (including 3 inundation models for Hayling Island, Portsea Island, and Gosport to Warsash)²²
 - Southampton Water Coastal Modelling Study²³
 - New Forest Coastal Modelling Study²⁴
- 3.6.3 These models simulate the impact of a combination of extreme sea levels and wave overtopping. Simulations are included for defended scenarios including the presence of flood defences, and undefended scenarios.
- 3.6.4 No changes were required for the New Forest Coastal Model to inform the SFRA. For the East Solent models and the Southampton Water model it was necessary to update the tidal boundaries are re-run these for new epochs to tie in with the new plan periods for the LPAs. Some modifications were also required to flood defence crest levels on Portsea Island.

Impact of climate change on sea levels

- 3.6.5 LPAs are required to make allowances for climate change in Local Plans to help minimise vulnerability and provide resilience to flooding. Current guidance on the climate change allowances that should be applied are set out by the Environment Agency²⁵.
- 3.6.6 There are a range of allowances for each river basin district and epoch for sea level rise. The allowances for the south west and south east river basin district are included in Table 3-5.
- 3.6.7 The guidance states that LPAs should assess both the *higher central* and the *upper end* allowances for SFRAs.

Table 3-5 Sea level allowances by river basin district for each epoch in mm for each year (based on 1981 to 2000 baseline) – the total sea level rise for each epoch is in brackets

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
South east	Higher central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
South east	Upper end	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60
South west	Higher central	5.8 (203)	8.8 (264)	11.7 (351)	13.1 (393)	1.21
South west	Upper end	7 (245)	11.4 (342)	16 (480)	18.4 (552)	1.62

- 3.6.8 AECOM have obtained the latest Coastal Flood Boundary (CFB) dataset and calculated the revised extreme still water levels using UKCP18 climate change projections for RCP 8.5 at 70th (higher central) and 95th (upper end) percentiles for the follow epochs:
- 2022 (present day scenario)

²² JBA Consulting, 2015, East Solent Study.

²³ JBA Consulting, 2014, Southampton Water Coastal Modelling Study.

²⁴ JBA Consulting, 2022, New Forest Coastal Modelling Study.

²⁵ Flood Risk Assessments Climate Change Allowances <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> First published February 2016. Last updated May 2022.

- 2055 (to provide consistency with the Shoreline Management Plan)
- 2122 (100 year for residential development and to inform plan making)

3.6.9 Full details are provided in the Technical Notes²⁶ included in Appendix B.

3.6.10 The models have been run and maximum depth and maximum hazard rating mapping produced to inform the SFRAs for each LPA. Maximum water level grids have been supplied to the LPAs as ASCII grid files.

3.7 Assessing the cumulative impact of development

3.7.1 The NPPF states that strategic policies should be informed by a strategic flood risk assessment, and should consider cumulative impacts in, or affecting, local areas susceptible to flooding (paragraph 166).

3.7.2 When allocating land for development consideration should be given to the potential cumulative impact on flood risk within a catchment. Development typically increases the impermeable area within a catchment, which, if not effectively managed, can cause increased rates and volumes of surface water runoff and changes to floodplain storage, thereby resulting in increased flood risk further downstream. Whilst individual development with appropriate site mitigation measures should not result in measurable local effects with respect to hydrology and flood risk, the cumulative effect of multiple development may be more severe at downstream locations in the catchment. Locations where there are existing flood risk issues will be particularly sensitive to cumulative effects.

3.7.3 The cumulative impact should be considered throughout the planning process, from the allocation of sites within the Local Plan, to the planning application and development design stages.

3.7.4 As part of this SFRA an assessment of the study area has been undertaken to identify those catchments where there is greater potential for cumulative effects on flood risk.

3.7.5 Catchments were identified across the study area using the river water body catchments and surface water management catchments from the Catchment Data Explorer. Minor adjustments were made to combine catchments where these were very small. This resulted in the identification of 81 catchments across the project study area.

3.7.6 For each catchment, consideration has been made of the:

- i. The size and nature (rural or urban) of the catchment.
- ii. The risk of flooding in the catchment from rivers, the sea, surface water and groundwater. This is based upon data provided by HCC from the Hampshire Catchment Prioritisation Tool²⁷ and considers the number of properties calculated to be at risk of flooding from rivers, the sea, surface water, groundwater according to available mapping datasets and as well as historic records of flooding. A rating of high, medium, and low was assigned to each catchment based on the data provided.
- iii. The scale of potential future development in the catchment. This is based upon a high level review of potential development sites and growth locations provided by LPAs as well as information publicly available on the LPA websites.

3.7.7 Based on a qualitative assessment of these three criteria, a red, amber, green rating has been assigned to each catchment to highlight those catchments where there is a higher, medium, and lower potential for cumulative effects on flood risk. In those areas with a medium or higher potential for cumulative impact on flood risk, it is recommended that LPAs consider area specific policies or guidance for new development to help reduce the cumulative impact, and where possible, identify opportunities for new development to provide cumulative betterment with respect to flood risk. Further detail of these types of measures are included in Sections 6 and 7 of each LPA Report.

²⁶ AECOM, March 2022, East Solent Flood Inundation Model re-Simulations Technical Note.

AECOM, March 2022, Southampton Water Flood Inundation Model Re-Simulations Technical Note.

²⁷ Atkins, January 2017, Hampshire Catchment Prioritisation Tool.

3.8 Assessing cross boundary considerations

- 3.8.1 Many of the catchments within the PfSH SFRA project area cross borders between LPA administrative areas. Watercourses and overland flowpaths pass from one LPA to a neighbouring one. Therefore, future development in one LPA has the potential to affect flood risk to existing development and surrounding areas in another LPA area. It is important that LPAs work together and take a catchment approach to consider the wider impacts of any proposed development.
- 3.8.2 Within the SFRA for each LPA, (Parts 2 – 10) a review of the catchments and watercourses has been undertaken to determine where runoff from one LPA naturally flows into another. This will help identify which LPAs will need to work together to discuss the opportunities to reduce the causes and impacts of flooding.

3.9 Avoiding flood risks

- 3.9.1 The LPAs should use the datasets identified in section 3.1 to 3.8 of this document to apply the sequential approach to site selection so that development is, as far as reasonably possible, located where the risk of flooding from all sources is lowest, taking account of climate change and the vulnerability of future users to flood risk. Further information on the application of the Sequential Test is provided in Section 4.

3.10 Controlling and mitigating flood risks

Defences

- 3.10.1 Data provided by the Environment Agency from their Asset Information Management System (AIMS) has been used to identify flood risk management measures already in place with the study area.
- 3.10.2 The following project area wide datasets have been obtained to help identify opportunities to reduce the causes and impacts of flooding across the PfSH SFRA project area. Locally specific opportunities are identified in SFRA Parts 2 – 10.

Programme of FCERM Schemes

- 3.10.3 The Environment Agency manage an investment programme to reduce flood risk and coastal erosion in England. The current 6 year flood and coastal erosion risk management investment programme runs from 1 April 2021 to 31 March 2027. Completed and planned capital schemes are shown on the online map²⁸ and details are provided within SFRA Parts 2 – 10 for each LPA.
- 3.10.4 Coastal Partners is a partnership between five local councils (Fareham BC, Gosport BC, Portsmouth CC, Havant BC, and Chichester DC) formed in 2012, which aims to deliver a comprehensive, shared coastal management service for 246km of coastline. Capital schemes undertaken by Coastal Partners in the study area include the extension of a revetment at Nore Barn Woods, a new Beach Management Plan for Eastoke Peninsula, the North Portsea Island Scheme, and the Hill Head Coastal Protection Project. Further details about these capital schemes are provided within SFRA Parts 4-7.

Working with Natural Processes

- 3.10.5 There are a number of opportunities available to reduce the causes and impacts of flooding through Working with Natural Processes (WWNP)²⁹. This involves implementing measures that help to protect, restore, and emulate the natural functions of catchments, floodplains, rivers, and the coast. WWNP takes many forms and can be applied in urban and rural areas, and on rivers, estuaries, and coasts.
- 3.10.6 As part of a research project undertaken by the Environment Agency and Flood and Coastal risk Management Research and Development Programme, a series of spatial datasets have been generated

²⁸ Programme of flood and coastal erosion risk management (FCERM) schemes

<https://www.gov.uk/government/publications/programme-of-flood-and-coastal-erosion-risk-management-schemes>

²⁹ Environment Agency and Flood and Coastal Risk Management R&D Programme, Published February 2021, Working with Natural Processes to Reduce Flood Risk <https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/working-with-natural-processes-to-reduce-flood-risk?web=1&wdLOR=c56AD7DAC-BB7B-471B-94B4-B5C5B91DEEE4>

for these natural processes³⁰, identifying their best estimate of locations in the country where the methods can be applied.

Table 3-6 Description of WWNP datasets

Natural Process	Benefits	Most Effective Conditions	Notes
Floodplain Woodland Planting Potential	Slows floodwaters and increases water depth on the floodplain. Reduces flood peaks, delays flood peak timing and desynchronises flood peaks. Enhances sediment deposition on the floodplain.	Middle and lower river reaches of middle to large catchments.	Based upon Flood Zone 2. Information is largely based on modelled data and open constraints data and is indicative rather than specific.
Riparian Woodland Planting Potential (woodlands on land immediately adjoining a watercourse)	Slows flood flows. Reduces sediment delivery to the watercourse. Reduces bankside erosion. Creates below ground storage.	At the reach scale in middle and upper catchments.	Based upon a 50m buffer of available OS Open Data river networks. Information is largely based on open data and is indicative rather than specific.
Wider Catchment Woodland	Intercepts, slows, stores and filters water. Reduces flood peaks, flood flows and frequency.	Small events on small catchments – extent of reduction decreases as flood magnitude increases.	Based upon the 1:50k BGS geology survey and relies upon identifying drift and bedrock geologies that are characteristic of slowly permeable soils. Information is largely based on the 100m gridded version of BGS data and open constraints data and is indicative rather than specific.
Floodplain Reconnection Potential (reconnecting watercourses and floodplains)	Encourages more regular floodplain inundation and flood water storage Decreases the magnitude of flood peaks and reduces downstream flood depths.	High frequency, low return period floods.	Designed to support signposting of areas where there is currently poor connectivity such that flood waters are constrained to the channel and flood waves may therefore propagate downstream rapidly Based upon the Risk of Flooding from Rivers and Seas probability maps and identifies areas of low and very low probability that are close to a watercourse, but do not contain residential property or key services (may contain non-residential property – important to consider).
Runoff Attenuation Features (3.3% and 1% AEP) (includes swales, ponds, and sediments traps)	Delays and flattens the hydrograph and reduces peak flow locally for small flood events.	A cluster of features working as a network throughout the landscape.	Based upon the Risk of Flooding from Surface Water datasets and identifies areas of high flow accumulations for the 1% and 3.3% AEP surface water maps. The areas of ponding or accumulation are between 100 and 5000 metres squared and have been tagged where they fall on an area of slope steeper than 6% as gully blocking opportunities

3.10.7 Defra have produced a Woodland Constraints dataset which refines potential locations for WWNP, taking into account roads, rail, urban areas, existing woodland, peat, and water bodies.

3.10.8 As well as reducing the causes and impacts of flooding, WWNP has a number of environmental, social, and cultural benefits, including water quality, habitat, climate regulations, health access, air quality, aesthetic quality, and cultural activity.

³⁰ Working with Natural Processes datasets
<https://environment.data.gov.uk/searchresults;query=wwnp;searchtype=All;page=1;pagesize=20;orderby=Relevancy>

- 3.10.9 Although WWNP methods have very promising benefits, they are relatively new concepts, and more research is required to gain a greater understanding of their impacts in different conditions and representation in models.
- 3.10.10 The WWNP data does not provide information on design, which may need to consider issues such as drain-down between flood events. It is important to note that land ownership and change to flood risk have not been considered. Locations identified may have more recent building or land use than available data indicates.

Southern Water Drainage and Wastewater Management Plan (DWMP)

- 3.10.11 Water and sewerage companies must produce Drainage and Wastewater Management Plans (DWMPs) covering a minimum of 25 years, setting out how they intend to improve and maintain a robust and resilient drainage and wastewater system in the face of risks to the network such as climate change and population growth. Companies will need to produce final plans in 2023 and the production of plans will be made statutory through the Environment Act.
- 3.10.12 Southern Water has developed 11 DWMPs across their entire operational region³². The DWMPs relevant to the PfSH SFRA study area are: East Hampshire catchment, Test and Itchen catchment, New Forest catchment, and the eastern part of the Arun and Western Streams catchment. These are described in more detail for each LPA in Parts 2-10.
- 3.10.13 The following points were extracted from the regional DWMP, detailing how Southern Water will assess and manage issues related to flood risk and drainage across its system over the next 25 years:
- Submission and review of Infiltration Reduction Plans in order to measure and reduce the rate of groundwater infiltration into Southern Water's sewer systems, as these have the potential to cause internal flooding.
 - Investment of £35 million between 2020 and 2025 to create smarter sewer networks and install 20,000 sewer level monitors, so pre-emptive actions and maintenance can be undertaken to reduce the number of flooding incidents by approximately 60 per annum.
 - Tree root ingress surveys, and clearance, and conditions, in order to reduce the number of floods by 30 incidents per annum.
 - Southern Water will undertake modelling to better understand and demonstrate the risk of sewer flooding across their network during both the 1 in 30 year storm and the 1 in 50 year storm.
 - Southern Water will conduct a network-wide risk assessment in collaboration with LLFAs, internal drainage boards, other councils, and the Environment Agency, to identify the locations where the management of surface water flood needs to be improved, with a particular focus on the adoption of sustainable measures such as rainwater separation as opposed to traditional practices such as increasing the flow capacity of pipes.

3.11 Managing residual risks

Flood Warning Areas

- 3.11.1 The Environment Agency provide a flood warning service for many areas at risk of flooding from rivers and the sea³³. In some parts of England, the Environment Agency may be able to provide warnings when flooding from groundwater is possible.
- 3.11.2 Flood warnings are issued to homes and businesses when flooding is expected. Upon receipt of a flood warning, occupants should take immediate action.

³² Southern Water, Drainage and Wastewater Management Plans <https://www.southernwater.co.uk/dwmp>

³³ Environment Agency, March 2022 Flood Alerts and Warnings <https://check-for-flooding.service.gov.uk/alerts-and-warnings>