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# **Eastleigh Hydrological Sensitivity Study Conceptual Surface Water Drainage Strategy**

**Final Report**

**May 2018**



**EASTLEIGH**  
BOROUGH COUNCIL

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## Contract

This report describes work commissioned by Eastleigh Borough Council. Eastleigh Borough Council's representative for the contract was Debbie Salmon.

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## Abbreviations

BOD .....	Biochemical Oxygen Demand
CDM.....	Construction (Design and Management) Regulations 2015
CFMP.....	Catchment Flood Management Plan
EA .....	Environment Agency
EBC.....	Eastleigh Borough Council
ESWMP.....	Eastleigh Surface Water Management Plan
FEH.....	Flood Estimation Handbook
FRA.....	Flood Risk Assessment
ha .....	hectares
HAWRAT .....	Highway Agency Water Risk Assessment Tool
IDB .....	Internal Drainage Board
JBA .....	Jeremy Benn Associates
km .....	kilometres
LLFA .....	Lead Local Flood Authority
LiDAR.....	Light Detection and Ranging
LPA .....	Local Planning Authority
LTS .....	Long Term Storage
m .....	metres
mm.....	millimetres
m AOD .....	metres Above Ordnance Datum (Newlyn)
NBLR.....	North of Bishopstoke link road
RWH .....	Rain Water Harvesting
SAAR .....	Seasonal Average Annual Rainfall
SAC.....	Special Area of Conservation
SFRA .....	Strategic Flood Risk Assessment
SPR.....	Standard Percentage Runoff
SSSI.....	Site of Special Scientific Interest
SuDS.....	Sustainable Drainage Systems
WwTW .....	Waste Water Treatment Works

# 1 Introduction

## 1.1 Background

JBA Consulting was commissioned by Eastleigh Borough Council (EBC) to undertake a study comprising the following tasks:

- Task 1 - to identify the hydrological sensitivities within the north of the borough by relevant environmental assessments and hydraulic modelling;
- Task 2 – to advise on the alignment of the proposed North Bishopstoke link road (NBLR) to ensure the impacts on the existing streams are minimised;
- Task 3 – to recommend sustainable management of post-development surface water runoff from the future developments and roads to minimise the impact on the water quality and quantity of the local watercourses.

The EBC Local Plan includes strategic development of housing and associated transport infrastructure within the northern portion of the borough.

The assessment areas are located in rural setting with numerous headwaters in close proximity of the River Itchen Special Area of Conservation (SAC), which imposes an ecological and hydrological constraint to the development. Any changes in hydrology and chemical composition of runoff resulting from the developments and new road infrastructure could have an adverse impact on the water quality and quantity within the catchment and potentially cause a significant impact on the River Itchen SAC.

This report has been prepared to address Task 3 of the study. It summarises existing information gathered to date and presents recommendations in relation to management of the post-development surface water runoff arising from the proposed developments and the transport links. It also highlights any constraints that may affect the future location/ layout of the development parcels and the roads.

## 1.2 Local policy review

The area of land to the north and east of Bishopstoke and Fair Oak is allocated as a strategic location for two new communities in the draft Emerging Eastleigh Borough Local Plan 2011-2036, dated July 2017.

The development will be in accordance with the principles of development set out in the aforementioned document, the North of Bishopstoke and Fair Oak Supplementary Planning Document and a detailed masterplan approved by the Council. The development will include new homes, employment space, retail and community facilities, open spaces and a new link road to the north of Bishopstoke and Fair Oak.

The key points of strategic policies S1, S5 and S6 relevant to this study are summarised below:

- new development in the Borough should have regard to the potential impacts of climate change and restrict developments in areas at risk from flooding;
- development will not be permitted unless it is demonstrated through Habitats Regulations Assessment that it will not adversely affect the integrity of the River Itchen Special Area of Conservation or any other European Sites. Development will be required to protect headwater ecosystems (a buffer of approximately 20m will be required) and hydrological flows and preserve existing flood zones;
- development will appropriately manage the risk of flooding to the new communities and not increase the risk of flooding to existing communities. Development will include sustainable drainage systems which are appropriate to the overall design of the new communities, and preserve the water quality and flows in the Itchen and its tributaries and other flood risk management measures as required;
- the proposed road link should not adversely impact the integrity of the River Itchen Special Area of Conservation or any other European sites. This will include the provision of appropriately designed bridges across the river and its tributaries and measures to manage hydrology;

- the development should not increase flood risk in the wider area and if possible reduce existing flood risk.

Furthermore, the Policy DM6 'Sustainable surface water management and watercourse management' states the following:

- a). new development in areas at risk of flooding that drain into a waterway within the Itchen or Hamble catchment or drain directly to coastal waters will only be permitted if they include Sustainable urban Drainage Systems (SuDS);
- b). all SuDS schemes should:
  - manage surface water runoff as close to its source as possible (ideally by infiltrating directly into the ground) or include at least three forms of naturalised filtration within the treatment train wherever feasible. Discharge hierarchy should be obeyed;
  - be designed in accordance with the CIRIA C697 SuDS Manual or equivalent national or local guidance;
  - ensure that discharges mirror greenfield rates and natural hydrological pathways before development;
  - where discharge is to a wetland or wet woodland habitat, flows off site must mirror the natural hydrological pathways;
  - 10% of the site should be reserved for natural SuDS. Naturalised forms of filtration include, green roofs, vegetated swales, attenuation areas and basins, ponds, rain gardens and wetlands. Other more mechanised forms can be used to drain the urban area on the larger sites providing the three naturalised forms are present at the end of the treatment train.
  - include arrangements for whole life management and maintenance.
- c). where a watercourse is present on a development site, it should be retained or restored into a natural state and enhanced where possible. The culverting of any watercourse will not be permitted (clear span bridges should be used where possible), and development should wherever possible remove any existing culverts and increase on-site flood storage;
- d). well-designed naturalised SuDS will have wider benefits for flood risk management, water quality protection, biodiversity, health, recreation and water resource management;
- e). development should be laid out to enable maintenance of the watercourse. No gardens should back on to the watercourse and there should be no development within distance of at least 8 metres from the top of the bank. Wider buffer strips may be appropriate for larger watercourses. Such buffer strips should form part of the landscape framework for the site, and arrangements should be made for their long-term management and maintenance;
- f). where development drains into a waterway connected to the Natura 2000 or Ramsar network a Construction Environment Plan must be prepared before construction providing details of safe storage of fuels and chemicals.

## 1.3 Review of existing documents

### 1.3.1 Strategic Flood Risk Assessment (SFRA), Atkins, December 2007

The SFRA states that while there is little in the historic record that refers to the assessment area, the hydraulic modelling suggests that there is significant flood risk to Bishopstoke and Eastleigh. Proposed development in Eastleigh and more intense storms in the future due to climate change, have the potential to increase flood risk. Furthermore, the SFRA identifies that it is necessary to better understand the flood risk in the Lower Itchen area in order to put in place measures to mitigate against the increased risk from climate change.

### 1.3.2 Test and Itchen Catchment Flood Management Plan (CFMP), Environment Agency, December 2009

The CFMP provides an overview of current flood risk within the Itchen catchment, and considers all sources of flooding including river, surface water, groundwater and sewer flooding. There are over 3,500 properties in the catchment with 1% chance of flooding in any one year.

There was extensive flooding in the winter of 2000/01 in the Test and Itchen catchment affecting up to 300 properties. Groundwater flooding of properties was experienced throughout the catchment during this time, while river flooding was located in places such as Winchester.

Historically flood risk management within the Test and Itchen CFMP area has been relatively limited, in a large part to preserve the rich natural environment of the river corridors. Schemes completed have been largely related to the creation of culverted channels, and some limited raising of defences, that have often been closely integrated to ongoing urban development.

Approaches to managing current and future flood risk vary across the Itchen catchment. The assessment area, located largely in the lower Itchen catchment is shown as an area in which flood risk is considered to be managed effectively but where there may need to be further actions taken in the future to keep pace with climate change.

### 1.3.3 Eastleigh Surface Water Management Plan (ESWMP), Hampshire County Council, December 2012

The ESWMP provides an overview of historic, existing and future flood risk issues across parishes in the Eastleigh district. The parishes of the greatest relevance to this study are Bishopstoke and Fair Oak and Horton Heath.

The ESWMP states the following in relation to flooding:

*'Flooding in the borough is fairly sporadic and there are relatively few substantial surface water flooding incidents... The most significant flooding incidents within the borough can be attributed to fluvial issues.'*

The ESWMP also identifies existing and potential flooding hotspot areas within the region. These include:

- Fair Oak Road in Bishopstoke - where flooding incidents have been addressed by improving the capacity of drainage ditches;
- The area south of Templecombe Road in Bishopstoke - where there are issues with the capacity of the local land drainage and watercourses due to insufficient maintenance;
- The Itchen floodplain (Shawford to Bishopstoke) which is largely undeveloped but with the potential to impact properties along the edge of the floodplain; and
- The Bow Lake main river line, which is largely undeveloped;

For Fair Oak and Horton Heath the hotspots include:

- Allington Lane, Fir Tree Lane, Summerlands Road and Botley Road - suffering from regular siltation and damage to existing drainage ditches or blocked culverts and insufficient maintenance;
- Surface water flooding in the Fair Oak area is associated with the presence of tributaries of the River Itchen and Ford Lake.

The ESWMP recommends that appropriate maintenance of local drains and culverts is required to minimise flood risk and that any future developments should account for potential flood risk and should not increase runoff rates within the above areas.

## 1.4 Consultations

The Environment Agency (EA) was consulted as part of the larger commission.

The key issues identified by the EA in relation to the potential impacts of the development on the water environment are as follows:

- Any crossing of the floodplain and thus associated floodplain storage compensation;
- Any impacts on conveyance and flow routes of flood and surface water;
- Potential surface water disposal methods such as SuDS; and
- Water quality and pollution prevention methods.

It is also understood that the EA have commented on the development plans presented in the Eastleigh Borough Council's draft local plan and their requirements are accounted for within the plan.

A preliminary consultation was also carried out with Southern Water, the sewerage undertaker for the area, in relation to any existing surface/foul water flooding, sewer capacity issues and particular requirements for future surface water management within the developments.

Considering the strategic character of the development, Southern Water could not comment on any of the above topics. This will have to be dealt with at the planning stage for the relevant development plots via pre-development enquiries.

## 2 Existing site characteristics

### 2.1.1 Site location and topography

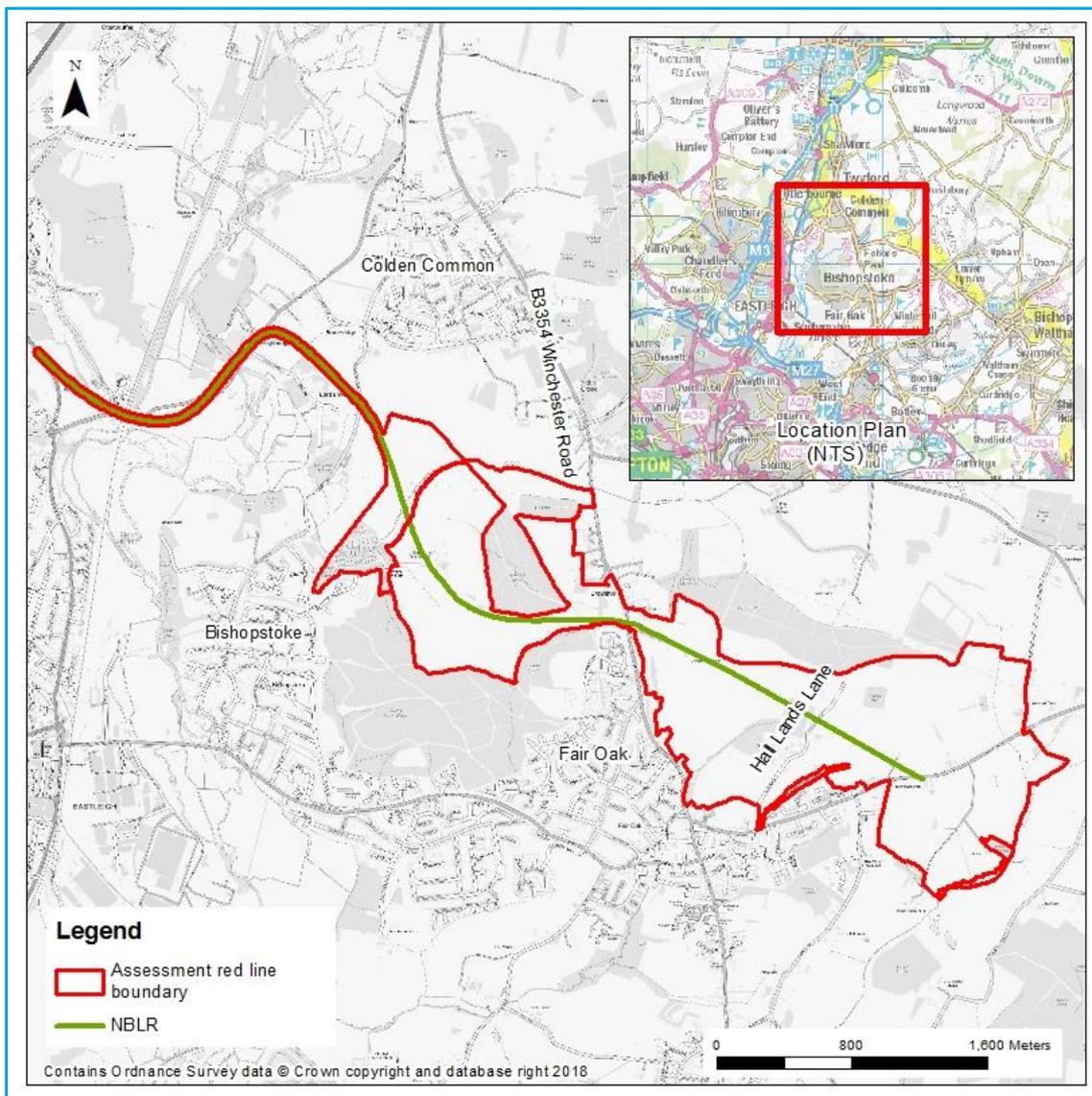
#### 2.1.1.1 Development parcel

The land designated for future development assessed as part of this study is located immediately north of the Bishopstoke and Fair Oak settlements, in Hampshire. It is approximately 380ha in size.

The land is located within rural area, occupied mainly by agricultural land and woodland and dissected by local roads. Sparsely positioned individual farms are located within the study area.

The indicative area of the site, including the proposed North of Bishopstoke link road (NBLR) referred to as 'an assessment area' throughout this report is shown in Figure 2-1.

Figure 2-1: Site location

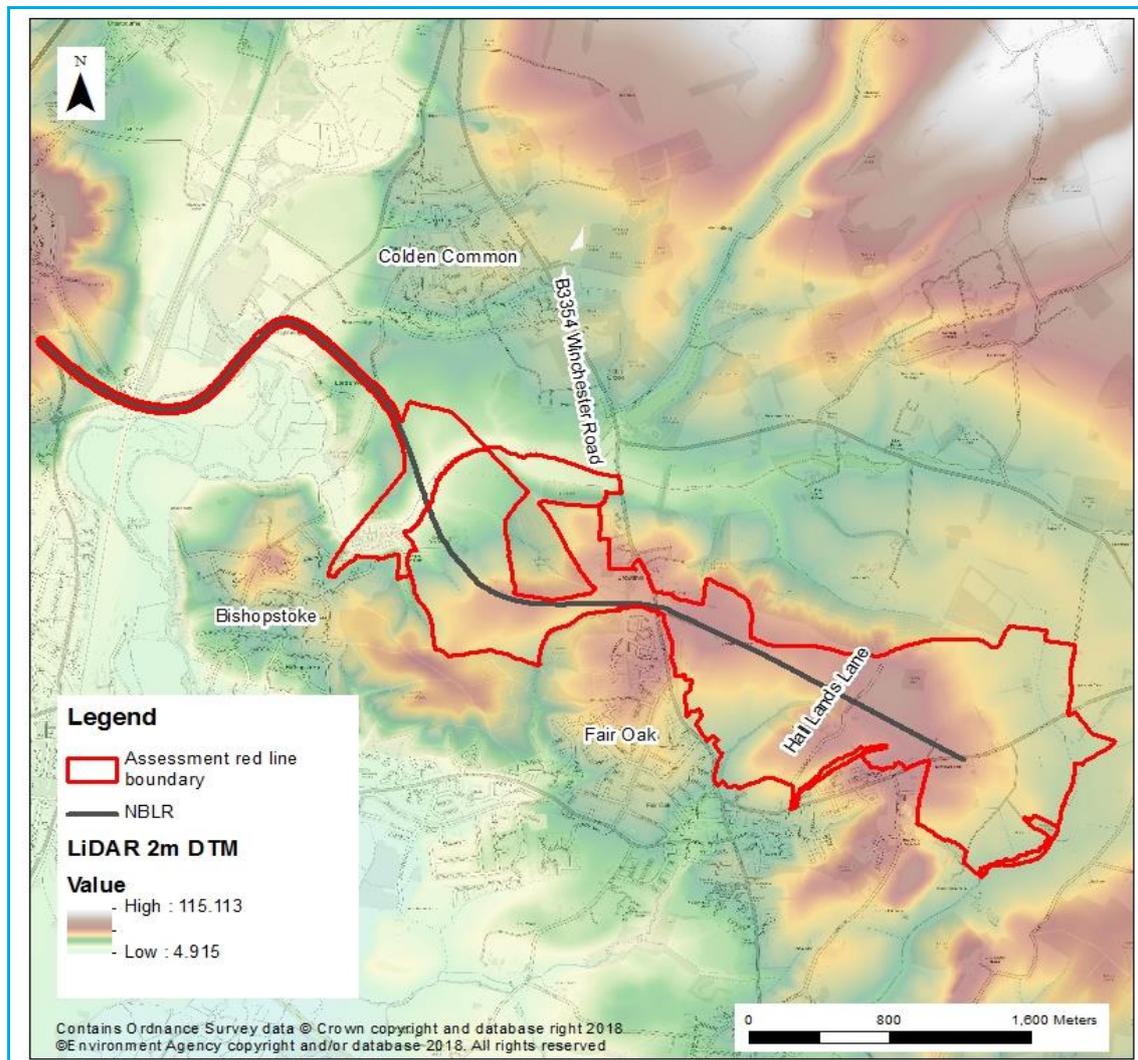


No topographical survey of the assessment area has been undertaken to date. The topography of the various parts of the land has therefore been appraised based on 2m LiDAR data available from the Open Data source. The topography of the various parts of the site is as follows:

- an area to the west of the B3354 Winchester Road - it generally falls in a north-westerly direction from ~56.00mAOD in the south-eastern part to ~19.30mAOD in the westerly corner near the Bow Lake watercourse (the location of Bow Lake watercourse is illustrated in Figure 2-3). Except for a small part of the site located along the right bank of the Bow Lake, where the topography falls in a westerly direction towards the watercourse from ~37.00mAOD to approximately ~18.50mAOD;
- an area between the B3354 and Tippers Copse - the topography within this area falls generally towards an unnamed watercourse flowing in a south-westerly direction from ~63.00mAOD near Jamesmead Farm and ~67.80mAOD near Tippers Copse to ~31.50mAOD in the most southern corner of this area. The most northern part of this area falls in a northerly direction from Jamesmead Farm and Tippers Copse to ~55.00mAOD along the northern boundary of the site. A small area between Halls Land Lane and Mortimers Lane is falling towards another unnamed watercourse in Gore Copse;
- an area between Tippers Copse and the eastern site boundary - the majority of this area falls in an easterly direction towards an unnamed watercourse present along the eastern site boundary from ~67.80mAOD in the west and 37.00mAOD in the south. A part of the site located along the left bank of the watercourse falls from ~ 43.00mAOD towards the said watercourse.

The general topography of the site is illustrated in Figure 2-2 and on drawing 2017s6220-001 included in Appendix A.

Figure 2-2: Site topography



### 2.1.1.2 Road infrastructure

The North of Bishopstoke link road (NBLR) is currently being considered by the EBC and its indicative location is shown in Figure 2-2.

The NBLR is located between Allbrook Way in the west at ~47.00mAOD and B3037 Mortimers Lane in the east at ~56.00mAOD. The route runs through areas with varying topography with the maximum elevation of ~63.00mAOD near Tippers Copse and the minimum elevation of ~16.00mAOD at the River Itchen crossing.

## 2.1.2 Climatic conditions

No rainfall gauges are located within the assessment area. The Flood Estimation Handbook (FEH) shows the long-term average rainfall data for the area, as the Standard Annual Average Rainfall (SAAR), ranging between ~800 and 830 mm/year.

Based on the FEH, the Standard Percentage Runoff (SPR) for the assessment area is approximately 30-40%. However, this varies across the site, with SPR values within Stoke Park Wood around ~30%, increasing up to 50% near the Horton Heath Stream. These values are indicative of normal runoff associated with the low permeability underlying soils.

## 2.1.3 Site geology

### 2.1.3.1 Bedrock and superficial deposits

No intrusive ground investigation has been carried out to date within the assessment area and the information on the ground and groundwater conditions have been assessed using publicly available information.

In line with the British Geological Survey soil maps and available historic borehole data, the majority of the assessment area is underlain by London Clay Formation. Isolated outcrops of Whitecliff Sand Member (sandy silt and clay, with lenticular bodies of sand) and Durley Sand Member (sandy clay and sandy silt) are present within the assessment area.

No superficial deposits are recorded except for the River Itchen and Bow Lake valleys which are overlain by Alluvium deposits.

### 2.1.3.2 Soils

Soils mapping indicates that much of the assessment area is underlain by soils of the Windsor Association. They are characterised as slowly permeable, seasonally waterlogged clayey soils. Also present are some fine loamy or fine silty over clayey soils and, locally on slopes, clayey soils with only slightly seasonal waterlogging. The main risks to water environment in areas with such soils are associated with overland flow from compacted or poached fields carrying organic slurry, dirty fertilisers, pathogens and fine sediments.

Soils around the eastern end of Fair Oak are of the Burlesdon Association and comprise deep fine loamy soils with slowly permeable subsoils and slight seasonal waterlogging associated with deep, coarse, loamy soils variably affected by groundwater. Some slowly permeable, seasonally waterlogged, loamy over clayey soils are also present. Irregular terrain and local landslips are characteristic of this soil type. Surface capping can trigger erosion of fine sediment. Drained farm land can carry pollutants and cause rapid through-flow to local watercourses.

Soils of the Fyfield 4 Association are present within the Stoke Park Wood. They comprise deep well drained and often stoneless, coarse loamy and sandy soils as well as loamy soils with slowly permeable subsoils and slight seasonal waterlogging and some slowly permeable seasonally water logged fine loamy over clayey soils.

The low permeability soils correspond well with the identified SPR values.

## 2.1.4 Site hydrogeology

### 2.1.4.1 Groundwater levels

There has been no site-specific groundwater level monitoring undertaken on site to date.

The groundwater table levels within the assessment area are likely to vary with topography and geology.

The assessment area lies primarily in the Lower Itchen catchment and Horton Heath Stream catchment over the London Clay Formation. It is therefore considered as an area of 'rocks with essentially no groundwater'. However, the outcrops of the Whitecliff Sand Member and Durley Sand Member are considered to be a Secondary A aquifer consisting of permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of baseflow to rivers.

Superficial deposits comprising a Secondary A aquifer are also occurring primarily along the main River Itchen and Bow Lake. Secondary (undifferentiated) deposits exist where river terrace deposits occur.

The EA has two groundwater monitoring boreholes close to the assessment area, which monitor Chalk groundwater level, in an area overlain by London Clay Formation.

It is understood from the EA that six groundwater abstraction licences (all for agriculture) exist to the north of the assessment area in Chalk. There is also one potential abstraction between Fisher's Pond and Stoke Park Farm, used for fisheries. It is uncertain if this abstraction is from the deeper Chalk or alluvium deposits at that location.

#### 2.1.4.2 Groundwater quality

The assessment area is not located within a Groundwater Protection Zone according to the EA mapping.

Two groundwater bodies with the following classifications are located adjacent to the assessment area:

- Hants Central Bracklesham Group - underlies Bishopstoke and Fair Oak and has overall Good status; and
- Hants South East Bracklesham Group - in the south-eastern part of the assessment area. It has overall Poor status with Good Quantitative status and Poor Chemical status due to industry pressures.

The northern part of the assessment area, underlain by the London Clay Formation, is not classified as a groundwater body.

#### 2.1.5 Site hydrology and existing drainage conditions

The assessment area is currently greenfield land with sparsely located individual farms and local roads. It drains via a combination of natural infiltration to the ground and overland flows within the following respective natural catchments:

- River Itchen

The majority of the assessment area is located in the Lower River Itchen catchment (Figure 2-3). The River Itchen flows in a southerly direction some 700m to the west of the most western extent of the assessment area to its confluence with Southampton Water. The most northern part of the site is drained via Bow Lake, the tributary of the River Itchen, and its small tributaries. The southern part of the site is drained into the River Itchen via small unnamed tributaries.

Numerous fish farm ponds are located within the Bow Lake catchment.

The NBLR link road is also located within the Bow Lake/ the River Itchen catchment, with the exception of a small eastern section, which is located within the Horton Heath Stream's catchment.

The lower Itchen flows through a heavily urbanised area, making it more prone to flash flooding from surface water runoff and overwhelmed drainage systems.

- River Hamble

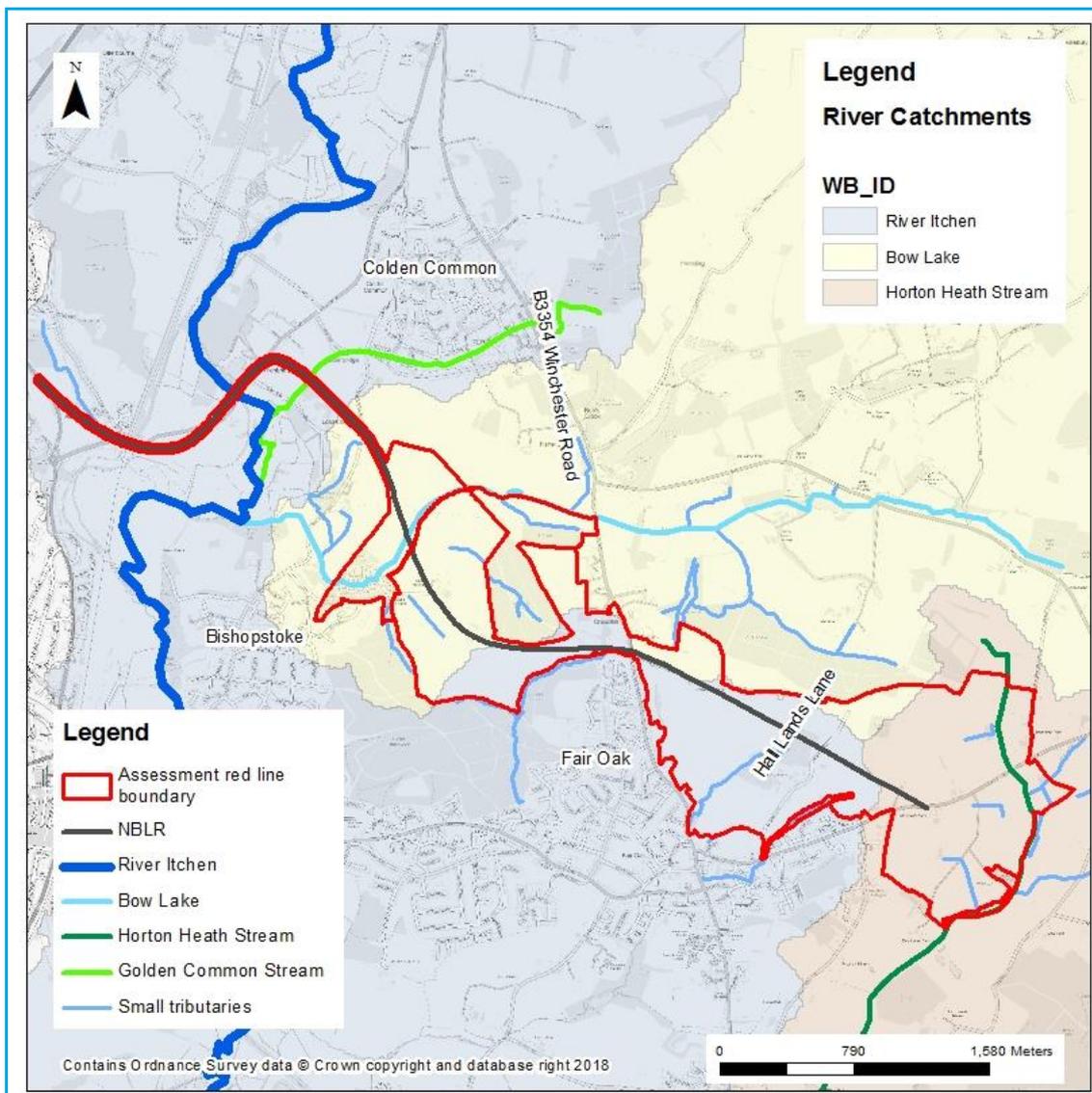
Only the most eastern part of the assessment area is located in the catchment of the River Hamble. The River Hamble flows in a south westerly direction some 4km south of the most eastern extent of the assessment area to its confluence with Southampton Water. The site drains via Horton Heath Stream/ Ford Lake, the tributaries of the River Hamble, and their small tributaries (Figure 2-3).

The geology, topography and mainly vegetated land cover within the assessment area contribute to the current natural management of the runoff and biodiversity within the relevant sub-catchments.

A review of the OS mapping shows some of the small tributaries being orphaned without the visual connection with the larger watercourses. This may be due to the culverts present, especially within the urban areas and/or arable fields, or limitation of the mapping. The connectivity of the small tributaries has not been confirmed on site as part of this study. It is assumed however that, based on the topography such connectivities exist.

The natural watercourse catchment boundaries are shown in Figure 2-3.

Figure 2-3: Natural catchment boundaries



### 2.1.5.1 Flood risk

The Environment Agency (EA) flood map indicates that the assessment area is largely located outside Flood Zones 2 and 3, except the most western section of the NBLR link road which crosses the River Itchen's/ Bow Lake's floodplain. It should be noted however that due to the rural location and small sizes of the watercourses within the assessment area they don't have public flood risk classification.

A 1D-2D hydraulic modelling of the larger watercourses and 2D modelling of the smaller tributaries has been undertaken as part of the larger study to refine the EA's flood extents and classify the smaller watercourses in terms of flood zones.

Further information about the hydraulic modelling study is included in a Technical Note entitled 'Hydraulic Modelling', by JBA Consulting, May 2018.

The EA surface water flood map does not identify any surface water flooding hot spots within the assessment area. The flow paths shown on the flood map coincide largely with the numerous streams present in the area. Some areas at risk of surface water flooding are however identified within the settlements of Bishopstoke and Fair Oak. This is consistent with the findings of the ESWMP.

#### 2.1.5.2 Water quality

The River Basin Management Plan (RBMP) for South East river basin district shows the following current ecological status of the watercourses downstream of the assessment area:

- River Itchen - Overall Good status with Good Chemical status and Good Ecological status in 2016;
- Bow Lake - Overall Bad status with Good Chemical status and Bad Ecological status in 2016 due to pressures relating to commercial fisheries;
- River Hamble - Overall Moderate status with Moderate Ecological and Good Chemical status in 2016; and
- Horton Heath Stream - Overall Good status with Good Ecological and Good Chemical status in 2016.

Both, the River Itchen and the River Hamble are designated as Special Areas of Conservation (SAC) and Sites of Special Scientific Interest (SSSI). They both drain into the Solent and Southampton Special Protection Area (SPA) and Ramsar, or the Solent Maritime SAC.

Although the small tributaries of the main rivers are not classified in terms of water quality, based on their character, location and contribution to the designated water bodies, they are considered of qualities similar to the respective receiving watercourses and therefore vulnerable to pollution.

The assessment area lies within a Nitrate Vulnerable Zone (2017 designation).

Historically, water quality in the Itchen was poorest in Eastleigh area, particularly for ammonia, Biochemical Oxygen Demand (BOD) and phosphorus. This was due to discharges from two major wastewater treatment works (WwTW) (Chickenhall Lane WwTW and Harestock WwTW). These inputs have been reduced to acceptable levels following introduction of discharge consenting by the EA.

#### 2.1.5.3 Headwaters

Headwaters of the lower Itchen tributaries are primarily located on London Clay outcrops in drift-free areas. Some headwaters however arise over the Whitecliff Sand Member.

Headwaters are closely linked to the overall health of the larger downstream water bodies, like streams, rivers and lakes. Primary headwater streams provide functions of retention of sediment, water and organic matter, nutrient reduction and corridors for wildlife dispersal.

A site visit undertaken by JBA's hydrogeologist in June 2017 concluded the following:

- most of the headwater locations had no flowing water but the gully base remained damp. The dampness was associated with surface water runoff or perched water within pockets of granular material rather than deep groundwater;
- the water quality in the headwaters is considered to be moderate;
- runoff proportions may be lower than predicted due to the extent of wooded area where floor leaf cover may act to effectively attenuate runoff;
- none of the Itchen SAC qualifying flora and fauna are observed within the headwaters or the lower Itchen tributaries.
- given the low or absent flows in the headwater streams during parts of the year, these waters are unlikely to be making a significant contribution to the conditions required by the SAC River Itchen.

Further information is contained in the 'Eastleigh Hydrological Sensitivity Study, Task 1' report by JBA Consulting, May 2018.

The existing water features within and in the immediate vicinity of the site and associated constraints are shown on drawing 2017s6220-001 included in Appendix A.

## 2.1.6 Risks to existing drainage patterns due to development

### 2.1.6.1 Risk during construction stage

Construction activities, including topsoil strip and use of heavy construction machines can impact the local runoff storage depressions, evapotranspiration losses and infiltration potential of the underlying soils. This in turn can affect the natural drainage pattern of the development area. Furthermore, the risk of pollution to the local water environment, due to sediment loading and on-site fuel/ chemical storage, is increased.

### 2.1.6.2 Risk during operation stage

Considering the size of the proposed development long term adverse impacts to the drainage patterns and water quality parameters in the individual sub-catchments and subsequently in the larger River Itchen and River Hamble catchments can occur at the operational stage of the development, if mitigation measures are not introduced into the design. The main risks are as follows:

- The proposed roads crossing watercourses could impact the existing hydraulic conditions in the respective watercourses leading to increased flood risk elsewhere;
- The water quality of the watercourses receiving the new road drainage could be adversely impacted by the routine runoff and the emergency spillages. Same applies to the remaining development area;
- The development could block off the existing overland surface water pathways conveying water to local streams and also alter the natural runoff chemistry;
- The natural infiltration of surface water into the ground, feeding locally the shallow perched water across the assessment area, can be significantly reduced.

## 3 Surface water drainage concept

Development of sites and creation of impervious surfaces can increase both the rate and volume of surface water runoff compared with the 'greenfield' conditions. These increases can exacerbate existing flooding problems or create new surface water flood risks downstream of the site and also cause pollution of the water environment. These impacts can be mitigated by introduction of appropriate sustainable drainage techniques (SuDS).

A conceptual drainage strategy outlining the required post-development surface water management principles has been produced for the assessment area. The proposed surface water management will aim to provide flood risk mitigation to new developments and protect the downstream environment against increased flood risk. It will also provide opportunities for water quality treatment, enhanced ecology and amenity benefits to the site and its surroundings.

### 3.1 Design guidance

The conceptual surface water drainage strategy has been developed in line with the following guidance documents advising on best practice for managing runoff from development sites:

- 'Surface Water and Sustainable Drainage, Guidance for Developers, Designers and Planners, v1.0', Hampshire County Council, undated;
- CIRIA 753 'The SUDS Manual', November 2015;
- 'Flood risk assessments: climate change allowances', Environment Agency, February 2016 (updated February 2017)

#### 3.1.1 Runoff quantity

Peak rate of runoff can be readily managed and reduced using flow control and attenuation techniques. The reduction of runoff volume can however be more difficult to achieve as it relies upon infiltration, evapo-transpiration or re-use. Where these techniques are not viable then the alternative is to provide appropriate attenuation in over ground storage facilities (e.g. detention basins, retention ponds, swales) and/or underground facilities (e.g. oversized pipes, tanks) by restricting the runoff rates to the greenfield equivalent.

To mitigate against increasing downstream flooding due to the additional volume of runoff the following alternative approaches should be considered in line with CIRIA 753 The SuDS Manual:

- Segregation of the Long-Term Storage Volume (LTS), the difference between the pre- and post-development runoff volumes from the main peak flow attenuation. The LTS is then discharged at very low rates (less than 2l/s/ha) and the remaining peak flow attenuation can be discharged at equivalent greenfield runoff rates with suitable deductions made for the discharge from the LTS. In practice, this arrangement is complex and depends on catchment size, site layout, topography, number of outfalls and viable runoff management options.
- Restricting discharges for all return period storms up to the 100-year plus climate change storm event to the pre-development QBAR or 1-year flow rate. Effectively, surface water is managed collectively and discharged at low rates to extend the runoff hydrograph from the site.

The greenfield runoff rates should be derived from monitored field data. If such data is not available, the pre-development QBAR or 1-year flow rate calculated using appropriate method based on characteristics of a relevant catchment (e.g. Institute of Hydrology Report 124, FEH, ReFH) should be used - subject to agreement with Hampshire County Council.

### 3.1.2 Climate change

The future impacts of climate change on rainfall should be accounted for within the design of the post-development surface water management schemes in line with the Environment Agency's guidance. The recommended climate change allowances are shown in Table 3-1.

Table 3-1: Peak rainfall intensity allowance in small and urban catchments

	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 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

The guidance recommends both, the central and upper end allowances, to be assessed to understand the range of impacts.

Considering the sensitive and 'flashy' character of the assessed area it is recommended to use the upper end climate change allowances for the design event based on the predicted life span of the development.

### 3.1.3 Runoff quality

To mitigate against adverse impacts on water quality in the receiving water environment CIRIA 753 "The SuDS Manual" recommends the following steps to determine the required water quality management for discharges to surface waters and groundwaters:

- Plan land use to prevent runoff and associated pollutants for most rainfall events up to 5mm in depth;
- Identify the pollution hazard level associated with the given type of development;
- Select risk assessment approach based on receiving water environment and the pollution hazard level;
- Carry out the risk assessment for each outfall taking into account the pollution hazard level, the status of the receiving water environment and effectiveness of the proposed SuDS techniques.

Residential roofs are noted as having very low pollution hazard level and require removal of gross solids and sediments only.

Commercial/ industrial roofs, residential car parks and low traffic roads and non-residential roads with infrequent change (e.g. offices, schools) present low pollution level and require application of simple index approach. Commercial yards, non-residential parking with frequent change (e.g. retail, hospital) and all roads, except low traffic roads and trunk roads/ motorways, present medium pollution hazard risk and simple index approach is also applicable. Extra measures may however be required, if the proposed discharges are to protected resources.

Industrial estates with heavy pollution potential present high pollution hazard level and will require site-specific risk assessment prior to selection of appropriate mitigation measures. The discharges may require environmental permits.

Trunk roads and motorways also present high pollution hazard level and HAWRAT assessments may need to be undertaken in line with the guidance contained in the DMRB Volume 11 Section 3 Part 10 HD 45/09 Road Drainage and the Water Environment to establish appropriate runoff treatment measures.

Considering the sensitive character of the assessed area and numerous headwaters present a more precautionary approach should be adopted in the assessment of the pollution hazard levels and the selection of SuDS treatment train.

## 3.2 Proposed drainage concept

### 3.2.1 Discharge hierarchy

The following discharge hierarchy, in order of preference, has been considered during the conceptual design process:

- Discharge to ground: Based on the available information of the assessment area being 'poorly draining', the discharge of surface water runoff via infiltration to ground may not be viable. This option will however require to be revisited at planning stage for relevant development plots when ground investigation becomes available. Localised areas with increased permeability may be found and a degree of infiltration is encouraged to help replenishing shallow groundwater, especially in the immediate areas to headwaters;
- Discharge to watercourses in respective catchments: As the site is located within natural catchments of the Bow Lake, Horton Heath Stream and their tributaries it is anticipated that the existing drainage regime will be maintained and the post-development runoff from the development parcels and the link road will discharge into these watercourse, respecting the natural catchment boundaries;
- Discharge to public surface water sewer: direct discharges to public surface water sewers should be avoided. This option cannot however be discounted at this stage;
- Discharge to public combined sewer: direct discharges to public surface water sewers should be avoided. This option cannot however be discounted at this stage.

Considering the topography of the assessed area it is envisaged that the new drainage systems will be gravity based. A need for pumped systems cannot however be discounted at this stage.

### 3.2.2 Runoff rate and volume control

To provide collective management of the rate and volume of the surface water runoff from the assessment area it is envisaged that the post-development runoff in all storm events up to and including the 100-year plus upper end allowance for climate change storm event will be restricted to the pre-development QBAR or 1-year flow rate - subject to agreement with Hampshire County Council, the Lead Local Flood Authority (LLFA) for the area. Alternatively, if the Long-Term Storage Volume could be managed separately, then like-for-like discharges would be permitted (e.g. 1-year post-development rate restricted to the 1-year pre-development runoff rate, 100-year post-development rate restricted to the 100-year pre-development runoff rate, etc.).

The resulting attenuation storage would be provided within the boundaries of respective development plots. Utilisation of vegetated over ground SuDS facilities should be maximised to create a combination of blue and green corridors across the sites contributing to their ecological enhancement. Furthermore, incorporation of green roofs, rain gardens and permeable paving within the plots should be encouraged to provide surface water management at source and reduce the runoff rates and volumes leading to reduced attenuation storage requirements.

The use of underground storage facilities should be kept to minimum.

The existing ground levels should be retained as much as practicable and incorporation of open spaces/ landscape areas should be maximised throughout the development to mimic the existing conditions and natural drainage patterns. Dense concentrations of development (e.g. roofs and hardstanding) should be avoided.

Water re-use such as rain water harvesting (RWH) can be used to reduce the consumption of mains water and reduce the annual volume of water discharged from a development. However, it is recognised that RWH provides limited storm water attenuation because storage volume cannot be guaranteed to be available for a particular storm event (e.g. depends on water consumption by the development). Furthermore, as RWH usually requires pumping it adds to the operational cost of the system and increases the whole life carbon footprint of the drainage system. The application of RWH should therefore be considered on a site by site basis, following economic and environmental assessment of the system.

The runoff conveyance system should give precedence to swales and filter trenches over traditional pipework.

### 3.2.3 Runoff treatment

The water quality treatment and biodiversity potential of the surface water management train will be of high importance considering the sensitivity of the River Itchen and River Hamble catchments. It is envisaged that the runoff treatment train within the assessed site will comprise the following measures:

- Prevention of the 'first flush' leaving the site;
- Controlling runoff quality at source by utilising green roofs, permeable paving and filter strips;
- Conveying, storing and treating water within a network of SuDS components such as swales, filter trenches and detention basins (site control);
- Providing final polishing of runoff quality within regional controls such as retention ponds and wetlands.

Depending on the phasing of the development plots the latter two may be used in combination.

If the site-specific risk assessment reveals elevated pollution hazard levels which could not be managed by the 'green' drainage infrastructure, proprietary surface water treatment systems (e.g. oil interceptor, downstream defenders, etc) may require to be utilised.

### 3.2.4 Amenity and biodiversity

All the existing watercourses within the development plots should be retained as open water habitats. Culverting of watercourses should be avoided and opening up of existing culverts to be incorporated, if practicable. If watercourses need to be crossed (e.g. by roads), clear span bridges with sufficient freeboards to accommodate flood flows should be used. The bridges should cross the watercourses at the narrowest floodplain extents. Positioning of piers within the floodplain should be kept to minimum.

Considering the above, the route of the NBLR as shown in Figure 2-2 would not be the optimum road route considering its required span over the significant floodplain of the River Itchen.

Connectivity between the existing watercourses and the proposed above ground SuDS features should be provided to increase the potential for habitat corridors.

The SuDS features should be designed as part of the landscaping scheme to provide a triple function, namely surface runoff quantity management, amenity, and biodiversity benefits for the area.

Where green roofs are incorporated into new buildings, these could be used to compensate for the loss of arable habitat.

### 3.2.5 Design for exceedance

Overland flow routes following the roads and public spaces will be required to convey the flood waters in a safe manner in the event of a blockage or exceedance of the drainage system capacity.

The flood waters should be routed away from the buildings and towards the downstream drainage systems and open spaces.

The finished floor levels of the proposed units on site should be positioned no lower than 150mm above the surrounding ground levels, 600mm above the predicted 100-year+CC fluvial flood levels in the adjacent watercourses and 300mm above the design water levels in the overground SuDS facilities to protect the properties against flooding from fluvial and surface water sources.

The site level setting and landscaping should also ensure that creation of low-lying areas and depressions is avoided to mitigate against surface water ponding during rainfall events. Furthermore, positioning the buildings in natural or man-made ground depressions and within the existing overland flow routes should be avoided.

### 3.2.6 Runoff from higher ground

Ground through the development should be profiled to facilitate natural drainage (overland flow) of the runoff from the higher ground beyond the development. If that proves difficult a perimeter drain should be installed around the development to intercept any runoff arising from higher ground prior to entering the proposed development site. The flows should ideally be discharged directly into the respective watercourses.

### 3.2.7 Construction stage management

Environmental Management Plan will require to be prepared prior to construction stage of the development parcels/ roads to minimise the risk of flooding and pollution during that phase, but also to minimise the long-term impact on the catchment hydrology.

### 3.2.8 Operational stage management

The design of surface water drainage and associated SuDS components should be targeted at minimising ongoing management costs and planning should ensure that funds are available for long-term management.

Drainage systems and associated SuDS facilities will require regular planned maintenance and monitoring to ensure operational effectiveness at all times. Lack of maintenance will lead to reduced efficiency in terms of pollution removal and attenuation storage. Furthermore, inadequate maintenance will result in decreasing the amenity value of the assets.

Long term management plan will require to be prepared for the development /it's individual parcels and roads and maintenance responsibilities established prior to commencement of the operational stage of the development.

### 3.2.9 Consents

The surface water discharges from the site will unlikely require formal consents - subject to type of developments proposed. However, any works within and in the immediate vicinity of the ordinary watercourses which may impact the flow in the channel (e.g. culverting, realigning and construction of drainage outfalls) will require ordinary watercourse consents under the Land Drainage Act 1991. The consenting authority for this area is Hampshire County Council, the LLFA. Any similar works within main rivers and their floodplains will require environmental permits from the Environment Agency.

## 4 CDM compliance

Under the Construction (Design and Management) Regulations 2015 (CDM 2015) it is the designer's duty to:

- eliminate foreseeable health and safety risks to anyone affected by the project;
- take steps to reduce or control any risks that cannot be eliminated;
- communicate, cooperate and coordinate with the client, other designers and contractors involved in the project so that designs are compatible and health and safety risks are accounted for during construction of the project and beyond.

The following hazards which may potentially impact the construction, operation and maintenance of any future surface water drainage systems, have been identified during the preliminary site assessment. The findings are summarised in Table 4-1.

Table 4-1: Preliminary CDM Design Risk Assessment

Project element	Hazard	Risk	Control measures
Health and Safety Considerations			
Plant/material delivery	Limited access to the assessment area via single lanes leading to individual properties	1. Collisions and injury/damage to people/vehicles 2. Denied access	Access agreements to be reached with relevant third parties for use of existing/ construction of new roads to facilitate the development.  Traffic management to be prepared prior to construction activities commencing.  Public to be notified of construction activities to take place.
Excavations	1. Services - public and private overground and underground services  2. Ground conditions  3. Groundwater conditions - locally shallow perched water  4. UXO	1. Service strikes/ injury/death, damage to infrastructure.  2. Falls into excavations/ overturning plant, trench collapse, confined space, injury, damage/ill health; pollution to surface water  3. Inundation  4. Low bomb risk in the Hampshire region in line with <a href="http://www.zetica.com">www.zetica.com</a> website	1. Detailed utility survey to be carried out prior to construction commencing to confirm the location and details of the existing services and check for any unidentified services. Care to be taken when excavating around existing services to minimise the risk of structural damage. Location of electrical cables to be confirmed using detection equipment before any excavation takes place.  2. Site specific ground investigation to be undertaken (including testing of geotechnical properties of soils and testing for ground and groundwater contamination, soakaway testing)) prior to design and construction work.  3. Long term (seasonal) groundwater monitoring

Construction of outfalls to watercourses	Water, working at height	Inundation, pollution, falls/ drowning	Work to be carried out during low flow conditions adhering to relevant pollution prevention measures.
Maintenance of drainage systems	Water, working at height/ confined spaces/ inundation	Drowning, injury, suffocation.	Maintenance work to be undertaken during low flow conditions in the system. Non-man entry inspection chambers should be used, where possible, to eliminate confined space entry.
Failure of drainage systems due to blockage or capacity exceedance	Water/ backing up flow	Site inundation	Site / building levels to be set appropriately and long-term maintenance regime implemented.
General construction activities	Noise, dust, construction traffic	Impact on existing residents in the currently rural area. Impact on current agricultural activities.	Environmental management plan to be prepared prior to construction activities commencing and adhered to during construction
<b>Environmental Considerations</b>			
Excavations/ topsoil strip and general construction activities	Sediment and other contaminants release	Pollution to water resources, including River Itchen and River Hamble SACs	Environmental management plan to be prepared prior to construction activities commencing and adhered to during construction
General construction activities	Existing woodlands/ trees	Loss of habitat due to trees and other natural vegetation removal. Increased runoff rates leading to erosion in the receiving watercourses	Removal of wooded areas should be minimised. Loss of existing trees/ green spaces to be compensated for as part of the development.
Culverting of watercourses	Environmental quality reduction	Increased flood risk, impact on hydrogeomorphological conditions	Culverting should be avoided, clear span bridges with sufficient freeboard to accommodate flood flows to be used for watercourse crossings.
Operational stage	1.Flood risk and surface water / groundwater quality  2.Headwater's health	Adverse impact on water flows and water chemistry in the existing streams	Site specific ground investigations/ hydrological assessments to be undertaken to allow for design of drainage systems to mimic existing conditions as much as practicable.

It should be noted that the above indicate potential significant hazards on and in the vicinity of the site based on a desk study of available information. This list therefore should not be considered as exhaustive and a detailed site/services survey should be undertaken prior to commencing construction activities on site.

## 5 Conclusions and recommendations

Considering the scale of the proposed development there is a potential for the existing water quality and quantity in the local watercourse network to be adversely affected.

It is assumed that the development would be phased over a number of years and more detailed analysis of each affected catchment would be undertaken at the time. However, the following generic recommendations are made in relation to the water environment and surface water runoff management for the developments within the assessment area to mitigate, as much as practicable, the impacts of the development on the natural water environment:

- Locate the proposed development outside the predicted 1000-year flood extents to mitigate against floodplain storage loss. Any developments within the said floodplain will require provision of a 'level' for 'level' compensation scheme;
- Retain the existing watercourses as open channels throughout the developments. Removal / opening up of existing culverts should be championed throughout the development to restore the natural conditions;
- If watercourse crossings are required (e.g. for road crossings) clear span bridges with sufficient freeboard to accommodate design flood events should be used. The roads should cross watercourses at the narrowest floodplain extent. Positioning of bridge piers should be avoided;
- Culverting of watercourses should be avoided. If not practicable the culverts should be designed with natural beds and sufficient freeboard to accommodate design flood events;
- No developments other than roads should be constructed over existing / new culverts;
- If any works to the watercourse channels are proposed (e.g. realignment, culverting, etc.) the impact of the works on the existing flood extents should be assessed by undertaking hydraulic modelling of the proposed changes;
- Existing drainage ditches/ culverts especially within the areas prone to flooding/ having history of flooding should be checked for capacity/ improved as required and long-term management established prior to any surface water drainage connections from the new development area are permitted;
- Minimum 20m buffer to be provided to all affected headwaters to maintain the existing hydrological conditions as much as practicable;
- Minimum 8m strip to be left free of development along other affected watercourses. Furthermore, the maintenance access to these areas should be facilitated;
- Incorporate Sustainable Drainage Systems (SuDS) across the development to manage the quality and quantity of the surface water runoff but also to contribute to the biodiversity and amenity value of the site. Ensure sufficient flexibility within the open space area is available for provision of surface water attenuation storage above ground to minimise the need for underground storage. The land allocation for SuDS should be considered at the early stage of the planning process;
- Any SuDS features should be positioned outside the identified 1000-year floodplain areas to minimise the impact of the development on the local flood risk and contribute to the effective surface water runoff management at all times;
- Runoff management to be undertaken respecting natural catchment boundaries - no transfer of water between catchments should be permitted. Existing drainage pathways to be retained, as much as practicable, to maintain existing conditions supporting the Itchen and Hamble SAC;
- Provide connectivity between the blue and green corridors to aid habitat creation and wildlife migration;
- Infiltration to ground should be encouraged, if local geological and hydrogeological conditions permit, to maintain the existing drainage pattern by replenishing the shallow perched groundwater in the area;
- If infiltration techniques are not viable the post-development runoff in the 100-year including upper end climate change allowance (depending on the lifespan of the development) should be restricted to the greenfield runoff rates derived from monitored field data. If such data is not available, the pre-development QBAR or 1-year flow rate

calculated using appropriate method for a relevant catchment should be used - subject to agreement with Hampshire County Council;

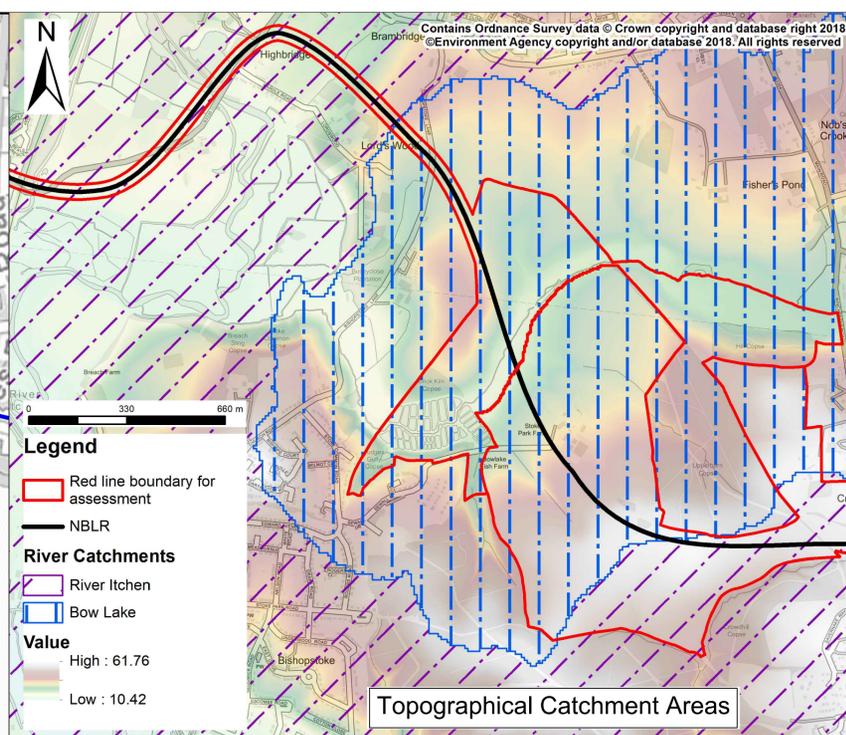
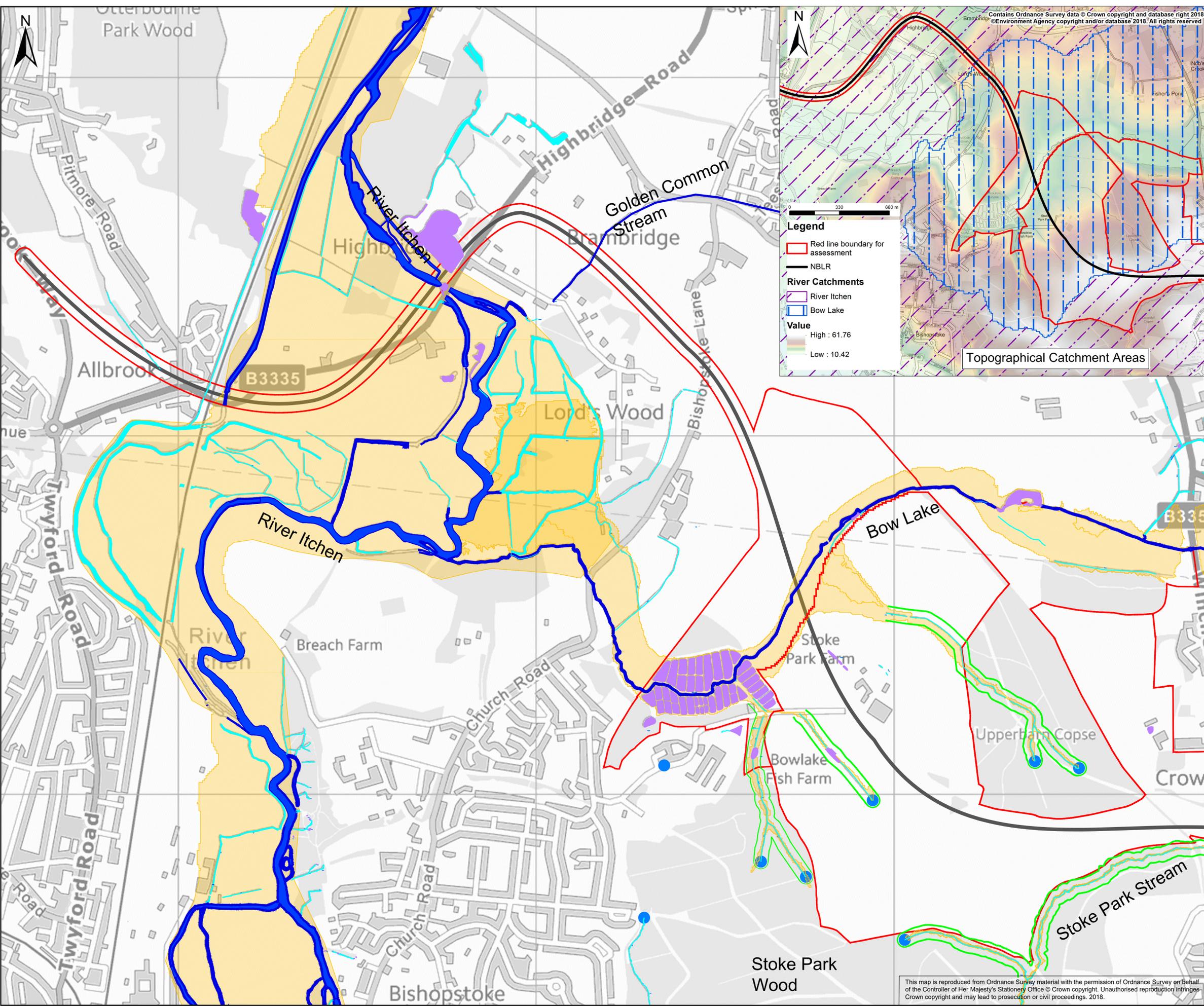
- Considering the sensitive and 'flashy' character of the assessed area it is recommended to use the upper end climate change allowances, based on the predicted life span of the development, for surface water drainage design;
- Minimum allowance of 10% for future urban creep should be accounted for when calculating the required attenuation storage for development parcels (mainly residential areas);
- Direct drainage connections at the top of headwaters should be avoided. The connections should be made further downstream, into more defined channels;
- Use of natural materials should be prioritised when constructing outfalls to watercourses (e.g. Rootlok solutions) to minimise the impact on the local hydrogeomorphology and visual impacts;
- Reinststate or divert as appropriate any field drains affected by the proposed development. Blocking off the flow paths of the existing field drains should be avoided;
- Maintain the existing drainage conditions in the relevant catchments by avoiding blocking off the preferential pathways, both over- and underground, to minimise the impact on the Itchen and Hamble SAC conditions. Location of densely concentrated build-up zones should be avoided;
- The areas of existing woodlands within the assessment area should be maintained/ removal of existing trees should be avoided, where possible;
- Long term management plan will require to be prepared for the development /it's individual parcels and roads and maintenance and funding responsibilities established prior to commencement of the operational stage of the development.
- Environmental Management Plan will require to be prepared prior to construction stages of the development parcels/ roads and adhered to in order to minimise the risk of flooding and pollution during that phase.

The following further studies are also recommended to enhance the knowledge of the catchment characteristics within the assessment area and make informed decisions in relation to the best post-development surface water management techniques in the relevant catchments and protection of the water environment during construction stage:

- Topographical survey confirming the exact locations of all water features in the area and identifying their physical parameters. The connectivity of the small streams (currently shown as orphaned on OS mapping) should be confirmed at the planning stages of the individual parcels prior to proposing any drainage connections to the said watercourses;
- Flow monitoring over full calendar year (to allow for seasonal variations) and some sampling and testing of water from the streams within the assessment area. The monitoring should continue during construction stages and into the operational stage of the development;
- Ground investigation to obtain more site-specific data regarding the nature of the underlying geology, overlying soils, their permeability and groundwater conditions (both levels and chemistry);
- Mapping of likely surface/groundwater flow pathways in relevant catchments to facilitate production of development masterplans aligning with the existing drainage conditions/ pathways as much as practicable;
- The route of the currently proposed NBLR link road should be re-assessed to minimise the impact of the new crossing on the River Itchen floodplain.

## Appendix A

2017s6220-001 Water Environment Constraints Plan (Sheet 1 and Sheet 2)



- General Notes**
1. All dimensions shown are in metres unless otherwise stated and levels in metres to Ordnance Datum.
  2. Do not scale from this drawing. All dimensions must be checked/verified on site.
  3. Any discrepancies noted on site are to be reported to the Engineer immediately.
  4. This drawing is based on Master map received from the Client in March 2018.
  5. All works affecting flood defences, main watercourses and/or ordinary watercourses will be subject to land drainage or environmental permits for Permanent and Temporary Works under the Land Drainage Act 1991.
  6. This drawing has been prepared for illustrative purposes only.
  7. The floodplain extents of the small tributaries shown are based on the hydraulic modeling study undertaken as part of the larger commission. Whereas the floodplain extents associated with the River Itchen have been derived from the Environment Agency's Flood Maps. These flood extents will be superseded upon completion of the hydraulic modeling study of the River Itchen undertaken as part of the larger commission.

**KEY**

- Assessment red line boundary
- North of Bishopstoke Link Road (NBLR)
- Large watercourse
- Small tributary
- Other water feature (e.g. pond)
- Headwater
- 20m buffer to headwater
- 1000-year flood extent

**Legend**

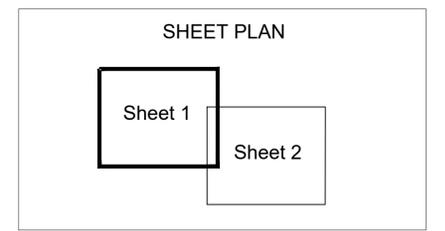
- Red line boundary for assessment
- NBLR

**River Catchments**

- River Itchen
- Bow Lake

**Value**

High : 61.76  
Low : 10.42



Rev.	Modifications	Date	Drawn	Designed	Checked	Approved
A	Assessment red line boundary revised. Inset added.	03/05/18	EL	MLJ	MLJ	DK

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for

**EASTLEIGH BOROUGH COUNCIL**  
EASTLEIGH HYDROLOGICAL SENSITIVITY STUDY  
WATER ENVIRONMENT CONSTRAINTS PLAN

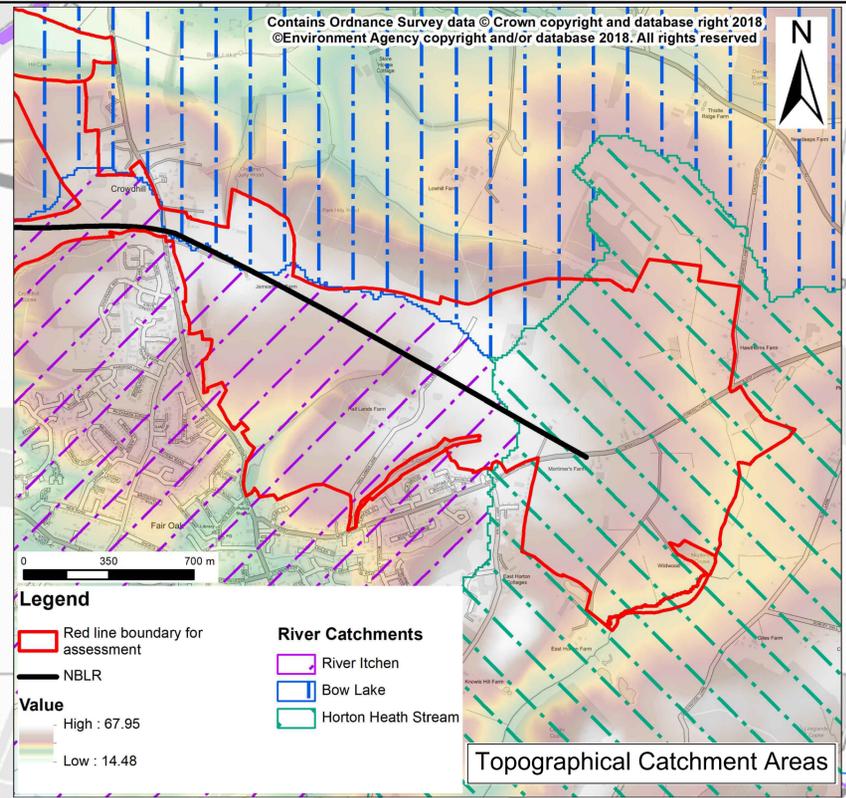
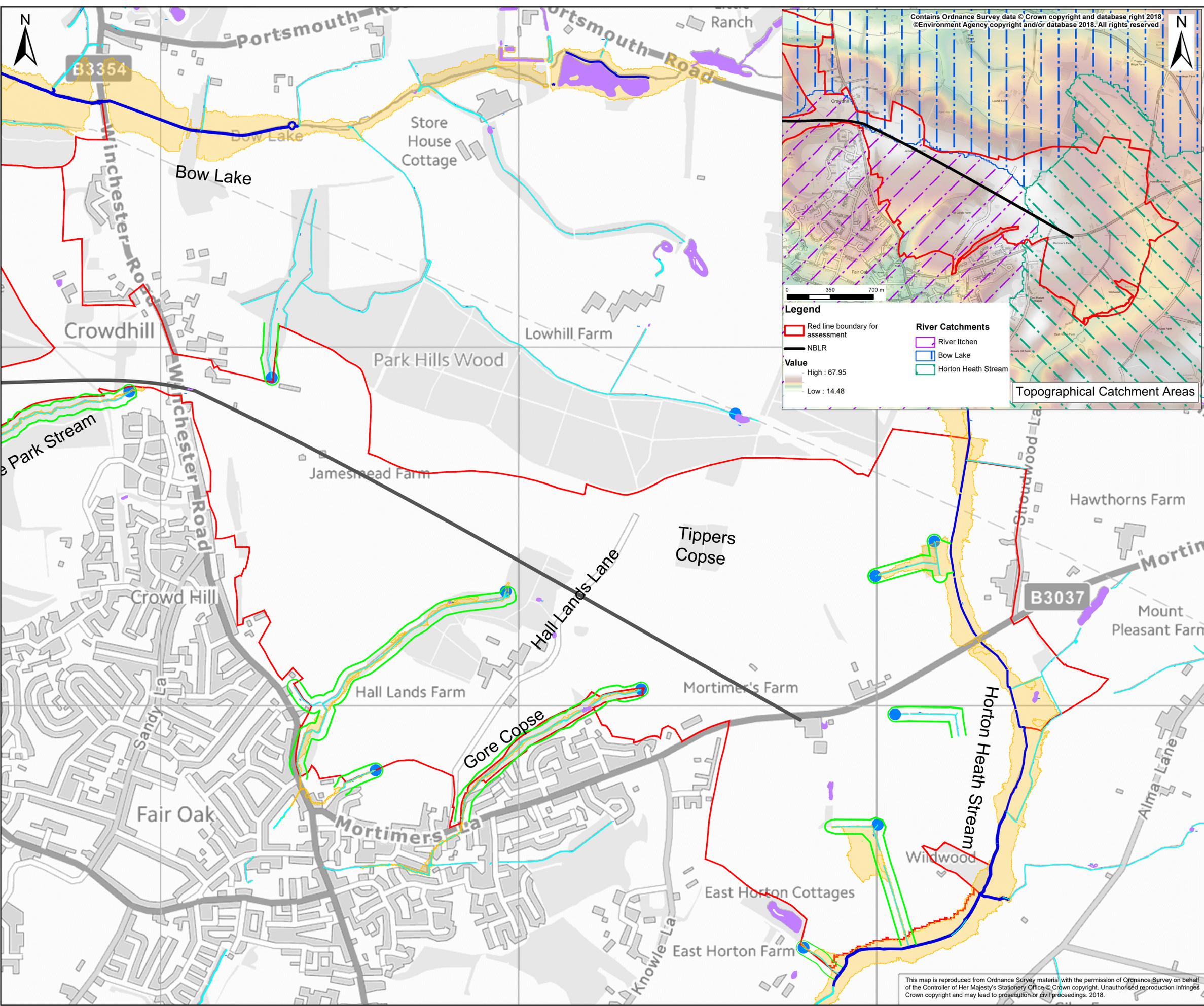
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		Checked:	M. Lubiejewska-Jones	23/02/18
		Approved:		

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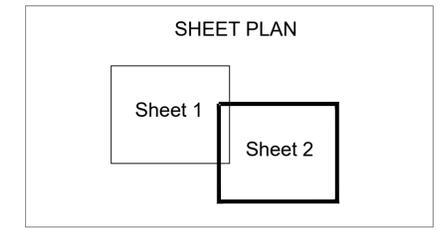
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  6. This drawing has been prepared for illustrative purposes only.
  7. The floodplain extents shown are based on the hydraulic modeling study undertaken as part of the larger commission. Whereas the floodplain extents associated with the River Itchen have been derived from the Environment Agency's Flood Zone 2. These flood extents will be superseded upon completion of the hydraulic modeling study of the River Itchen undertaken as part of the larger commission.

**KEY**

- Assessment red line boundary
- North of Bishopstoke Link Road (NBLR)
- Large watercourse
- Small tributary
- Other water feature (e.g. pond)
- Headwater
- 20m buffer to headwater
- 1000-year flood extent

**Legend**

- Red line boundary for assessment
- NBLR
- Value: High: 67.95, Low: 14.48
- River Catchments: River Itchen, Bow Lake, Horton Heath Stream



Rev.	Modifications	Date	Drawn	Designed	Checked	Approved
A	Assessment red line boundary revised. Inset added.	03/05/18	EL	MLJ	MLJ	DK

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**EASTLEIGH BOROUGH COUNCIL**  
EASTLEIGH HYDROLOGICAL SENSITIVITY STUDY  
WATER ENVIRONMENT CONSTRAINTS PLAN

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	Checked:	M.Lubiejewska-Jones	23/02/18
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