West Sussex County Council

# A29 REALIGNMENT PHASE 1

## Environmental Statement - Chapter 11

VERSION 2
MAY 2021

PUBLIC

West Sussex County Council

# A29 REALIGNMENT PHASE 1

## Environmental Statement - Chapter 11

**TYPE OF DOCUMENT (VERSION) PUBLIC**

**PROJECT NO. 70079718**

**OUR REF. NO. VERSION 2**

**DATE: MAY 2021**

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# 11 WATER RESOURCES AND FLOOD RISK

## 11.1 INTRODUCTION

11.1.1. This chapter reports the outcome of the assessment of likely significant effects arising from the Scheme upon water resources, flood risk and drainage in the context of the baseline conditions at and within the vicinity of the Site. Where appropriate, this chapter also identifies proposed mitigation measures to prevent, minimise or control likely negative effects arising from the Proposed Development and the subsequent anticipated residual effects.

11.1.2. The remainder of the chapter describes the assessment methodology and the baseline conditions relevant to the assessment, which have been used to reach these conclusions, as well as a summary of the likely significant effects leading to the secondary mitigation measures required to avoid, prevent, reduce or, if possible, offset any likely significant adverse effects, and the likely residual effects and any required monitoring after these measures have been employed.

11.1.3. This chapter (and its associated figures and appendices) is intended to be read as part of the wider ES, with particular reference to **Chapters 3 Description of the Scheme**, **Chapter 12 Geology and Soils** and **Chapter 14 Cumulative Effects** and the Flood Risk Assessment (FRA) (**Appendix 11.1**) and the Surface Water Drainage Strategy (A29-CAP-HDG-00-DR-C-0047 S0-P11) that accompany the planning application.

## 11.2 LEGISLATIVE FRAMEWORK, POLICY AND GUIDANCE

### LEGISLATIVE FRAMEWORK

11.2.1. The applicable legislative framework is summarised in **Table 11-1** below.

**Table 11-1 - Water Resources and Flood Risk: Summary of Legislation**

| Legislation | Summary | Chapter Reference |
|---|---|---|
| *Floods Directive 2007 (2007/60/EC) (Ref. 11.1)* | *Sets out the duties of the EA and LLFA in terms of Preliminary Flood Risk Assessments and flood mapping. Following these assessments, the authorities must identify areas which are at significant risk of flooding. The assessments and decisions of areas at significant risk must be reviewed at least every six years.*<br>*The Floods Directive is implemented in England and Wales through the Flood Risk Regulations 2009.* | *This Chapter uses flood risk documents produced by the LLFA and EA to inform the FRA.* |
| *The Water Resources Act 1991 (Ref. 11.2)* | *Regulates water resources, pollution, water quality and flood defence. The Act aims to prevent and minimise pollution of water. Currently, the EA is responsible for the policing of this Act. Under the Act, it is an offence to cause or knowingly permit any poisonous, noxious or polluting material, or any solid waste to enter any controlled water.*<br>*The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 allow the enforcement of powers to protect and remediate deleterious* | *This Chapter considers water resources, pollution, water quality and flood defence in accordance with the applicable legislative framework to flood risk and water resources in the UK.* |

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| | *effects on water bodies. These effects can be caused by either damage to hydro-morphological elements which affect water control, such as river erosion, or general pollution.* | |
| *Land Drainage Act 1994 (Ref. 11.3)* | *Local Authorities and Internal Drainage Boards have duties and powers associated with the management of flood risk under the Land Drainage Act 1991. As the Land Drainage Authorities, consent must be given for any permanent or temporary works that could affect the flow within an ordinary watercourse under their jurisdiction to ensure that local flood risk is not increased. The Land Drainage Act also sets out the maintenance responsibilities riparian owners have to reduce local flood risks. Riparian owners, who are landowners with a watercourse either running through their land or adjacent to, have the responsibility to ensure that the free flow of water is not impeded by any obstruction or build-up of material within the watercourse.*<br><br>*The 1994 amendment adds new environmental duties to the Land Drainage Act 1991. It requires the Internal Drainage Board and Local Authorities to further the conservation and enhancement of natural beauty, and to conserve flora, fauna and geological or physiographical features of special interest, as well as taking account of any effects which the proposals may have on the beauty or amenity of any rural or urban area, or on any such flora, fauna or features.* | *This Chapter, including the appended FRA, has been prepared in consultation with the LLFA who are the relevant Land Drainage Authority for this area.* |
| *Water Framework Directive (WFD) 2000 (Ref. 11.4)* | *Aims to improve and integrate the way waterbodies are managed throughout Europe. In order to address the requirements of the Directive, the EA has produced river basin management plans, which develop new ways of protecting and improving the water environment. The main aims of the WFD are to ensure that all surface water and groundwater bodies reach 'good' status (in terms of ecological and chemical quality and water quantity, as appropriate). The WFD also contains provisions for controlling discharges of dangerous substances to surface waters and groundwater.*<br><br>*The WFD is implemented in England and Wales through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.* | *This Chapter has considered the potential effects of the Scheme on the objectives of the WFD.*<br><br>*This Chapter uses the information included in the EA Catchment Data Explorer online which provides information regarding the relevant water bodies and their classifications under the Water Framework Directive 2000.*<br><br>*The EA Catchment Explorer Data is available under the Open Government Licence v3.0.* |
| *Groundwater Directive (2006/118/EC) 2006 (Ref. 11.5)* | *Establishes specific measures to prevent and control groundwater pollution. In particular; (a) criteria for the assessment of good groundwater chemical status; and (b) criteria for the identification and reversal of significant and sustained upward trends and for the definition of starting points for trend reversals. The Directive also aims to prevent the deterioration of the status of all bodies of groundwater.* | *This Chapter assessed the potential impacts on groundwater in accordance with this legislation.* |

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| | *The Directive has been developed in response to the requirements of Article 17 of the WFD, specifically the assessment of the chemical status of groundwater and objectives to achieve 'good' status.*<br><br>*The Groundwater Directive is implemented in England and Wales through the Groundwater (England and Wales) Regulations 2009.* | |
| *Flood and Water Management Act 2010 (Ref. 11.6)* | *Revises and consolidates legislation relating to flooding, land drainage, coastal erosion and reservoir safety. The Act gave new responsibilities to unitary and county councils to manage local flood risk. The Act also includes provisions regarding flood risk management assets, sustainable drainage, powers to undertake environmental works, reservoir safety and a number of alterations to water and sewerage provision.* | *The FRA is appended to this Chapter and it has been prepared in consultation with the LLFA and EA.*<br><br>*The available drainage design documents prepared by Capita Jackson have been appended to the FRA.* |
| *The Environmental Damage (Prevention and Remediation) (England) Regulations 2015 (Ref. 11.7)* | *Provides guidance for imminent threats of 'environmental damage' or actual 'environmental damage', related to surface water and groundwater. Guidance is provided to ensure appropriate mitigation measures, such as easements when working near water, is allowed for. In addition, it recommends remediation measures, should there be significant effects to cause a change in surface water and groundwater.* | *This Chapter assesses the potential impact on the water environment which includes surface water and groundwater impacts and describes how the potential significant effects would be managed in accordance with the relevant legislative framework.* |
| *The Environmental Permitting (England and Wales) Regulations 2016 (Ref. 11.8)* | *The Regulations replaced the Water Resources Act 1991 as the key legislation for water pollution in the UK. Under the Regulations it is an offence to cause or knowingly permit a water discharge activity, including the discharge of polluting materials to freshwater, coastal waters, relevant territorial waters or groundwater, unless complying with an exemption or an environmental permit. An environmental permit is obtained from the EA. The EA sets conditions which may control volumes and concentrations of particular substances or impose broader controls on the nature of the effluent, taking into account any relevant water quality standards from the relevant EU Directives.*<br><br>*The Regulations also assist in the management of flood risk and, as of 6 April 2016, any activity which has the potential to impact on a main river will require a Flood Risk Activities Permit (FRAP) (previously referred to as Flood Defence Consent) to be granted by the EA and specifies the appropriate conditions to ensure works do not increase flood risk or damage flood defences.* | *The FRA is appended to this Chapter and it references that a FRAP would be required from the EA.* |

## POLICY

11.2.2. The applicable policy framework is summarised in **Table 11-2** below.

**Table 11-2 - Water Resources and Flood Risk: Summary of Policy**

| Policy | Summary | Chapter Reference |
|---|---|---|
| *National Planning Policy Framework (NPPF) 2019 (Ref. 11.9)* | *The NPPF, published in March 2012 and updated on 16 June 2019, sets out the Government's planning policies for England and how these should be applied.*<br>*Section 10 – 'Meeting the challenge of climate change, flooding and coastal change of the NPPF' requires an FRA to be prepared to assess the potential impacts of flooding on and as a result of the scheme and ensure that the scheme is sequentially appropriate which may involve passing the exception test if required.*<br>*The NPPF is supported by the National Planning Practice Guidance (PPG). The PPG for Flood Risk and Coastal Change was published in March 2014 and is updated regularly to respond to changes in guidance and best practice.* | *A FRA has been prepared in accordance with the NPPF to assess the risks of flooding to and from the Scheme. The assessment also details how climate change has been taken into account.* |
| *Arun Local Plan 2011-2031 (Ref. 11.10)* | *The Arun Local Plan was adopted in 2018 and includes three policies that apply to this assessment:*<br>*Policies W SP1, W DM1 and W DM2 require that developments maintain/enhance water quality, improve efficiency and reduce flooding risk.* | *This Chapter has assessed the potential effects of the Scheme on water quality.*<br>*A FRA has been prepared to assess the risks of flooding to and from the Scheme.*<br>*A drainage design has been developed by Capita Jackson as part of the Scheme to manage potential increase in flood risk and risks to water quality. The latest drainage proposals are appended to the FRA for reference.* |

## GUIDANCE

11.2.3. The applicable guidance documents are summarised in **Table 11-3** below.

**Table 11-3 - Water Resources and Flood Risk: Summary of Guidance**

| Policy | Summary | Chapter Reference |
|---|---|---|
| *Flood Risk Assessments: Climate Change Allowances (2019) (Ref. 11.11)* | *The Environment Agency has produced this guidance for the use of climate change allowances in flood risk assessments and strategic flood risk assessments* | *The FRA uses the latest climate change allowances in accordance with this guidance.* |
| *Environment Agency Flood Risk Assessment: Standing Advice (2017) (Ref. 11.12)* | *This advice sets out the expected content of a Flood Risk Assessment and provides standard information on whether a development is likely to be considered suitable with regards to flood risk.* | *The FRA has been prepared in accordance with the EA Flood Risk Assessment Standard Advice. This Chapter uses the information presented in the FRA.* |

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| *Arun District Council Strategic Flood Risk Assessment 2016 (Ref. 11.13)* | *The SFRA summarises the flood risk from all sources throughout the district and provides recommendations for development control policies for new development within the district, including the sustainable management of surface water runoff for flood risk control and water treatment.* | *The SFRA establishes flood risk within Arun District at a strategic level. It does not specifically assess flood risk to the Site but gives an overview of the flood risk within the area. It provides advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff* |
| *West Sussex Local Flood Risk Management Strategy (LFRMS) 2014 (Ref. 11.14)* | *The West Sussex LFRMS (2013 – 2018) sets out how West Sussex County Council carries out its flood risk responsibilities that are a statutory requirement of the Flood and Water Management Act 2010.*<br>*The Strategy states that all new development near areas of flood risk needs to be appropriate and requires building design and drainage to be scrutinised to ensure risk is managed acceptably. Development should not be granted permission if proposals will increase flood risk to others.* | *This Chapter includes a FRA. Drainage design documents were also produced by Capita / Jackson. The latest drainage proposals are appended to the FRA for reference.* |
| *The SuDS Manual, CIRIA C753 (2015) (Ref. 11.15)* | *The SuDS Manual offers guidance for the planning, construction and maintenance of Sustainable Drainage Systems (SuDS), ensuring their effective implementation in order to manage flood risk, water quality, and maximising biodiversity benefits.* | *The proposed drainage design appended to the FRA has taken the recommendations of the SuDS Manual into account and also applied the Simple Index Approach promoted by the SuDS Manual to assess risks to water quality.* |
| *Design Manual for Roads and Bridges (DMRB) LA113 Road Drainage and the Water Environment, Revision 1, 2019 (Ref. 11.16)* | *The DMRB LA113 Road Drainage and the Water Environment discusses the requirements for the assessment and management of the impacts that road projects may have on water environments and flood risk. The guidance is specifically relevant to the strategic road network (managed by Highways England in England) although the same principles can be applied to any road project.* | *This chapter adopted the principles of the DMRB for the assessment of effects to the water environment and flood risk. HEWRAT[1] have been applied to assess the risks to water quality.* |
| *Site handbook for the construction of SuDS, CIRIA C698 (2007) (Ref. 11.17)* | *This CIRIA document offers guidance on the construction of Sustainable Drainage Systems (SuDS) to facilitate their effective implementation within developments.* | *Guidance has been taken into account for mitigation in the construction phase* |
| *The Environment Agency's Approach to Groundwater Protection (2018) (Ref. 11.18)* | *The Environment Agency's Approach to Groundwater Protection provides information about the Environment Agency's approach to managing and protecting groundwater resources, detailing how they deliver government policy for groundwater.* | *The groundwater sensitive receptors have been assessed in accordance with the EA guidance.* |

[1] Highways England Water Risk Assessment Tool

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| *CG 501 Design of Highway Drainage Systems, Revision 2 (Ref. 11.19)* | *This document sets out requirements and provides recommendations on the design of drainage for the UK motorway and all-purpose trunk roads. It describes the various alternative drainage solutions that are available, including their potential to control pollution and flooding, as well as detailed design factors to be taken into account.* | *This chapter uses information of pollution control measures in drainage in Table 8.6.4N3. Table 8.6.4N3 presents potential treatment efficiencies for the various pollution control measure types for different contaminants.* |

## 11.3 CONSULTATION, SCOPE, METHODOLOGY AND SIGNIFICANCE CRITERIA

### CONSULTATION UNDERTAKEN TO DATE

11.3.1. **Table 11-4** provides a summary of the consultation activities undertaken in support of the preparation of this chapter.

**Table 11-4 - Water Resources and Flood Risk: Summary of Consultation Undertaken**

| Body / organisation | Individual / stat body / organisation | Meeting dates and other forms of consultation | Summary of outcome of discussions |
|---|---|---|---|
| *Environment Agency (Ref. 11.24)* | *Customers and Engagement Team.* | *16/12/2019 - Product 4 Flood risk, drainage and groundwater enquiry.* | *03/01/2020 Product 4 provided and included in the FRA.* |
| *Environment Agency (Ref. 11.24)* | *Customers and Engagement Team.* | *29/04/2020 – Email requesting data on records of licenced ground and surface water abstractions and consented discharges within 1 km of the Site.* | *06/05/2020 Response provided.*<br>*EA confirmed that there are seven discharge permits and two abstraction licences within the vicinity of the Site.* |
| *Southern Water (Ref. 11.26)* | *Developer Services.* | *04/05/2020 - Pre-Development enquiry request.* | *21/05/20 Asset Location Plans provided*<br>*22/05/20 Sewer flooding history provided.*<br>*SW confirmed that they have records of flood events within the Site's vicinity which are mainly related to foul sewers. Correspondence/data included in the FRA.* |
| *West Sussex County Council (LLFA) / Arun District Council (Ref. 11.25)* | *Flood and Water Management Team.* | *29/04/2020 – Pre-development enquiry request.* | *30/04/2020 – Pre-development enquiry provided.* |

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| | | | *Arun District Council and the LLFA confirmed that there were past surface water flood events at Fontwell Avenue, Chantry Mead and Eastergate Lane. They confirmed that they do not hold any record of unlicensed private water abstractions. Correspondence/data included in the FRA.* |

## SCOPE OF THE ASSESSMENT

11.3.2. The scope of this chapter has been established through an ongoing scoping process. Further information can be found in **Chapter 5: Approach to EIA**.

11.3.3. The original Scoping Report scoped out water resources and flood risk, however, correspondence with the EA, WSCC and ADC determined that these issues needed to be considered with in the ES due to high seasonal groundwater, presence of a Source Protection Zone within the chalk and surface water flood risk.

### ELEMENTS SCOPED OUT OF THE ASSESSMENT

11.3.4. The hydro-morphological characteristics of the watercourses are not likely to change as the Scheme does not cross any watercourses, is not within a river floodplain and the only potential impact would be because of the drainage outfalls. However, this potential effect has been scoped out as the proposed drainage design incorporates SuDS to control outflow rates to minimise in-channel erosion. The watercourses that will receive this discharge (Barnham Lan Ditch and School Ditch) are likely to be ephemeral and their hydro-morphological quality is not likely to be affected by the construction of an outfall.

11.3.5. Groundwater Dependent Terrestrial Ecosystems (GWDTE) were not identified at the Site based on a high level desk study, and, therefore these were not included in this assessment. The potential impacts on the ecology is assessed separately within Chapter 9: Ecology and Nature Conservation.

### ELEMENTS SCOPED INTO THE ASSESSMENT

#### Construction Phase

11.3.6. The following elements are considered to have the potential to give rise to likely significant effects during construction of the Scheme and have therefore been considered within the ES:

- Short-term increase in flood risk due to construction activities;
- Potential effects on the water quality of surface water and groundwater resources due to construction activities or accidental leaks and spillages; and
- Potential increase in physical contamination (i.e. sedimentation) of surface water bodies due to ground disturbance.

#### Operation Phase

11.3.7. The following elements are considered to have the potential to give rise to likely significant effects during operation of the Scheme and have therefore been considered within the ES:

- Potential increase in on and off-site flood risk, due to an increase in impermeable surface areas, interception of overland surface water flows and the disturbance of groundwater flow paths; and
- Potential effects on the water quality of water resources associated with routine runoff and spillage, including watercourses and groundwater. This effect includes both potential chemical and physical contamination).

## EXTENT OF THE STUDY AREA

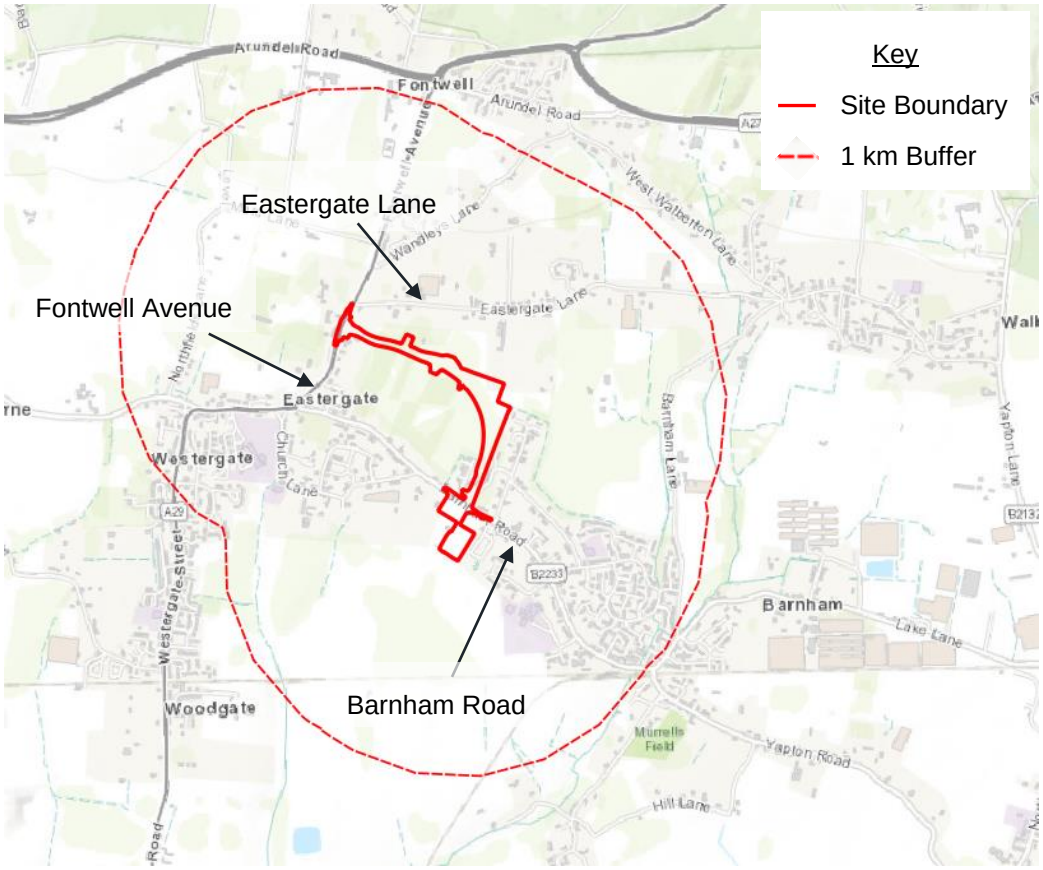


***Figure 11-1:*** *Extent of study area.*

11.3.8. The scheme is located approximately 1.4 km south of the South Downs National Park, within a transitional landscape, and to the north of the coastal town of Bognor Regis within the upper coastal plains. Around the periphery of the Site are the settlements of Barnham, Eastergate, Fontwell and Walberton. The Barnham residential estate is adjacent to the east of the site. The existing A29 Fontwell Avenue near its crossing with Eastergate Lane is situated to the west of the Site. Agricultural fields are located to the north and to the south of the Site, as shown of **Figure 11-1** above.

11.3.9. Features that are in hydraulic connectivity with the Scheme have been considered, including downstream watercourses. Based on professional judgement and current knowledge of the area, features located up to 1 km from the red line boundary has been considered.

11.3.10. The baseline conditions studied in this chapter will be within 1 km of the red line boundary of the Scheme.

## METHOD OF BASELINE DATA COLLATION

### DESK STUDY

11.3.11. To investigate baseline conditions and to consider potential effects of the proposed Scheme with respect to surface water and groundwater quality, drainage and flood risk, a review of available desk-based information has taken place.

11.3.12. This desk study assessment has included the review of the following available datasets and reports:

- EA Flood Mapping (Ref. 11.20);
- BGS Geoindex Onshore mapping 1:50,000 scale (Ref. 11.21);
- DEFRA Magic Map (Ref. 11.22);
- EA Catchment Data Explorer (Ref. 11.23);
- EA correspondence, including Product 4 and abstraction licence data (Ref. 11.24);
- LLFA and ADC correspondence and flood risk data provided (Ref. 11.25);
- Southern Water – history of flooding and Asset location plans (Ref. 11.26);
- WSP Flood Risk Assessment included in **Appendix 11.1**; and
- Drainage design documents provided by Capita / Jackson on 03 August 2020 - appended to the above FRA (Ref. 11.27).

### SURVEYS

11.3.13. This Chapter uses the following survey data undertaken for the A29 or surrounding areas, all of which have been appended to the FRA:

- Geotechnics (2019) – A29 Realignment, Eastergate. Factual Report – ground investigation to inform the A29 Realignment Transport Business Case (Ref. 11.28);
- Land Science (2020) – ground investigations subsequent groundwater level monitoring undertaken to inform the A29 realignment Phase 1 (Ref. 11.39);
- Wilson Bailey 2018, 2019 and 2020 – ground investigations undertaken on behalf of Barratts (Ref. 11.30);
- 3D Engineering Surveys Limited 2019 – topographic survey (Ref. 11.31);
- Geomatic Surveyors 2018 – topographic survey (Ref. 11.32); and
- Pellfrishman 2018 – topographic survey (Ref. 11.33).

### ASSESSMENT METHODOLOGY

11.3.14. This Chapter provides an assessment of the potential effects of the Scheme on the water environment and flood risk. The assessment methodology used in this chapter is based on the DMRB guidance LA 113 Road Drainage and the Water Environment (Ref. 11.16).

### SIGNIFICANCE CRITERIA

11.3.15. The significance level attributed to each effect has been assessed based on the sensitivity/value of the affected receptor(s) and the magnitude of change arising from the Scheme, as well as a number of other factors that are outlined in more detail in **Chapter 5: Approach to EIA**. The sensitivity of the affected receptor is assessed on a scale of very high, high, medium and low, and the magnitude of change is assessed on a scale of major, moderate, minor, negligible and no change, as set out in **Chapter 5: Approach to EIA**.

## EFFECT SIGNIFICANCE

*Assessing the sensitivity / value of receptors*

11.3.16. **Table 11-5** specifies the general criteria used in qualitatively assessing the sensitivity of surface water and flood risk receptors using professional judgement based on the information presented within this ES. The sensitivity of the receptors is based on Table 3.70 from LA113 Road Drainage and the Water Environment (Ref. 11.16).

**Table 11-5 –Sensitivity/ Value of Water Resource Receptor**

| Sensitivity/ Value | Criteria | Example |
|---|---|---|
| Very High | Nationally significant attribute of high importance | **Surface water**<br>Watercourse having a WFD classification shown in a River Basin Management Plan (RBMP) and Q95 ≥ 1.0 m3/s.<br>Site protected/designated under EC or UK legislation (SAC, SPA, SSSI, Ramsar site, salmonid water)/Species protected by EC legislation LA108.<br><br>**Groundwater**<br>Principal aquifer providing a regionally important resource and/or supporting a site protected under EC and UK legislation LA 108;<br>Groundwater locally supports GWDTE.<br>SPZ1.<br><br>**Flood Risk**<br>Essential infrastructure or highly vulnerable development. |
| High | Locally significant attribute of high importance | **Surface water**<br>Watercourse having a WFD classification shown in a RBMP and Q95<1.0m3/s.<br>Species protected under EC or UK legislation LA 108<br><br>**Groundwater**<br>Principal aquifer providing locally important resource or supporting a river ecosystem.<br>Groundwater supports a GWDTE.<br>SPZ2<br><br>**Flood Risk**<br>More vulnerable development. |
| Medium | Of moderate quality and rarity | **Surface water**<br>Watercourses not having a WFD classification shown in a RBMP and Q95 >0.001m3/s.<br><br>**Groundwater**<br>Aquifer providing water for agricultural or industrial use with limited connection to surface water.<br>SPZ3 |

| | | |
|---|---|---|
| | | **Flood Risk**<br>Less vulnerable development |
| Low | Lower quality | **Surface water**<br>Watercourses not having a WFD classification shown in a RBMP and Q95 ≤0.001m3/s.<br><br>**Groundwater**<br>Unproductive Strata<br><br>**Flood Risk**<br>Water compatible development |

*Assessing the magnitude of impact / change*

11.3.17. The likely magnitude or extent of an impact (or change) on a receptor is established by assessing the degree of the impact relative to the nature and extent of the Scheme (see **Table 11-6** – Magnitude of Change Criteria). Potential effects can be both adverse and beneficial. The derivation of magnitude is carried out independently of the sensitivity / value of the water resource receptor.

## Table 11-6 – Magnitude of Impact / Change Criteria

| Magnitude of Change | Criteria | Example |
|---|---|---|
| Major | Results in loss of attribute and/or quality and integrity of the attribute, or results in major improvement of attribute quality. | **Surface Water**<br>*Adverse*<br>Failure of both acute-soluble and chronic-sediment related pollutants in HEWRAT but compliance with Environmental Quality Standard (EQS) values.<br>Calculated risk of pollution from spillages ≥1% annually and <2% annually.<br>Partial loss in productivity of a fishery.<br>Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies.<br>Contribution to reduction in water body WFD classification.<br>*Beneficial*<br>Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring to a watercourse.<br>Improvement in water body WFD classification.<br>**Groundwater**<br>*Adverse*<br>Partial loss or change to an aquifer.<br>Degradation of regionally important public water supply or loss of significant commercial/ industrial/ agricultural supplies.<br>Potential medium risk of pollution to groundwater from routine runoff - risk score 150-250.<br>Calculated risk of pollution from spillages ≥1% annually and <2% annually.<br>Partial loss of the integrity of GWDTE.<br>Contribution to reduction in water body WFD classification.<br>Damage to major structures through subsidence or similar effects or loss of minor structures.<br>*Beneficial*<br>Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring.<br>Recharge of an aquifer.<br>Improvement in water body WFD classification.<br>**Flood Risk**<br>*Adverse*<br>Increase in peak flood level (> 100mm).<br>*Beneficial*<br>Creation of flood storage and decrease in peak flood level (> 100mm). |
| Moderate | Results in impact on integrity of attribute or loss of part of attribute, or results in moderate improvement of attribute quality. | **Surface Water**<br>*Adverse*<br>Failure of both acute-soluble and chronic-sediment related pollutants in HEWRAT but compliance with EQS values.<br>Calculated risk of pollution from spillages ≥1% annually and <2% annually.<br>Partial loss in productivity of a fishery.<br>Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies.<br>Contribution to reduction in water body WFD classification.<br>*Beneficial*<br>HEWRAT assessment of both acute-soluble and chronic-sediment related pollutants becomes pass from an existing site where the baseline was a fail condition.<br>Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually).<br>Contribution to improvement in water body WFD classification. |

| | | |
|---|---|---|
| | | **Groundwater**<br>*Adverse*<br>Partial loss or change to an aquifer.<br>Degradation of regionally important public water supply or loss of significant commercial/ industrial/ agricultural supplies.<br>Potential medium risk of pollution to groundwater from routine runoff - risk score 150-250.<br>Calculated risk of pollution from spillages ≥1% annually and <2% annually.<br>Partial loss of the integrity of GWDTE.<br>Contribution to reduction in water body WFD classification.<br>Damage to major structures through subsidence or similar effects or loss of minor structures.<br><br>*Beneficial*<br>Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually).<br>Contribution to improvement in water body WFD classification.<br>Improvement in water body catchment abstraction management Strategy (CAMS) (or equivalent) classification.<br>Support to significant improvements in damaged GWDTE.<br><br>**Floor Risk**<br>*Adverse*<br>Increase in peak flood level (> 50mm).<br><br>*Beneficial*<br>Creation of flood storage and decrease in peak flood level1 (>50mm). |
| Minor | Results in some measurable change in attributes, quality or vulnerability, or results in some beneficial effect on attribute or a reduced risk of negative effect occurring. | **Surface Water**<br>*Adverse*<br>Failure of either acute soluble or chronic sediment related pollutants in HEWRAT.<br>Calculated risk of pollution from spillages ≥0.5% annually and <1% annually.<br>Minor effects on water supplies.<br><br>*Beneficial*<br>HEWRAT assessment of either acute soluble or chronic-sediment related pollutants becomes pass from an existing site where the baseline was a fail condition.<br>Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually).<br><br>**Groundwater**<br>*Adverse*<br>Potential low risk of pollution to groundwater from routine runoff - risk score <150.<br>Calculated risk of pollution from spillages ≥0.5% annually and <1% annually.<br>Minor effects on an aquifer, GWDTEs, abstractions and structures.<br><br>*Beneficial*<br>Calculated reduction in existing spillage risk by 50% or more to an aquifer (when existing spillage risk <1% annually).<br>Reduction of groundwater hazards to existing structures.<br>Reductions in waterlogging and groundwater flooding.<br><br>**Flood Risk**<br>*Adverse*<br>Increase in peak flood level (> 10mm).<br><br>*Beneficial*<br>Creation of flood storage and decrease in peak flood level (> 10mm). |

| | | |
|---|---|---|
| Negligible | Results in an impact on attribute but of insignificant magnitude to affect the use / integrity. | The proposed project is unlikely to affect the integrity of the water environment.<br>**Surface Water**<br>No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants).<br>Risk of pollution from spillages <0.5%.<br>**Groundwater**<br>No measurable impact upon an aquifer and/or groundwater receptors and risk of pollution from spillages <0.5%.<br>**Flood Risk**<br>Negligible change to peak flood level (≤ +/- 10mm). |
| No Change | No change or impact in the use/integrity | No loss or alteration of characteristics, features or elements; no observable impact in either direction. |

*Assessing the classification of effect / significance criteria*

11.3.18. Once the sensitivity / value of the water resource (receptor) and the magnitude of the impact / change are both established, the potential effect can then be derived by combining the two assessments in a simple matrix as set out in **Table 11-7**.

**Table 11-7 – Classification of Effect**

| | | Magnitude of impact (degree of change) | | | | |
|---|---|---|---|---|---|---|
| **Environmental value (sensitivity)** | | No change | Negligible | Minor | Moderate | Major |
| | Very High | Neutral | Slight | **Moderate or Large** | **Large or Very Large** | **Very Large** |
| | High | Neutral | Slight | Slight or **Moderate** | **Moderate or Large** | **Large or Very Large** |
| | Medium | Neutral | Neutral or Slight | Slight | **Moderate** | **Moderate or Large** |
| | Low | Neutral | Neutral or Slight | Neutral or Slight | Slight | Slight or **Moderate** |

11.3.19. The following terms have been used to define the significance of the effects identified and apply to both beneficial and adverse effects:

- **Very Large** where the Scheme are likely to have a substantial improvement or deterioration on receptors;
- **Large effect**: where the Scheme could be expected to have a substantial improvement or deterioration on receptors;
- **Moderate effect**: where the Scheme could be expected to have a noticeable improvement or deterioration on receptors;
- **Slight effect**: where the Scheme could be expected to result in a perceptible improvement or deterioration on receptors; and
- **Neutral effect**: where no discernible improvement or deterioration is expected as a result of the Scheme on receptors, including instances where no change is confirmed.

11.3.20. As set out in **Chapter 5: Approach to EIA**, effects that are classified as **moderate or above** are considered to be **significant**. Effects classified as minor or below are considered to be **not significant**.

## 11.4 BASELINE CONDITIONS

11.4.1. This Section summarises information on the baseline conditions of water resources and related receptors that have the potential to be influenced by the Scheme.

**TOPOGRAPHY**

11.4.2. The topography survey completed by 3D Engineering Surveys Limited (Ref. 11.31), Geomatic Surveyors (Ref. 11.32), and Pell Frischmann (Ref. 11.33), show that the Site slopes gently down towards the south-east and south. Ground levels range between approximately 8 and 16 metres above ordnance datum (m AOD). Further information can be found within the accompanying FRA.

**SURFACE WATER BODIES**

11.4.3. All surface water bodies identified within the area of study are included in Figure 60799-LOC-002 in **Appendix 11.3**.

11.4.4. Lidsey Rife, an EA designated Main River, is located approximately 0.5 km south-west of the Site. Review of the Magic Map indicates that the watercourse issues close to the junction of Fontwell Avenue and Nyton Road and flows south through Eastergate and agricultural land to ultimately discharge to the sea at Bognor Regis approximately 6.3km to the south. The Lidsey Rife is monitored against the objectives of the WFD. The current WFD status (Cycle 2, 2016) of the Lidsey Rife water body (GB107041012010) is Moderate, with Moderate ecological quality and Good chemical quality. The waterbody is expected to reach Good status by 2027. The watercourse is not designated as artificial or heavily modified, however the stretch closest to the Site appears to be artificially straightened to align with Church Lane. The catchment of the watercourse (from source to sea) is stated on the EA Catchment Data Explorer to be 36km$^2$. The Q95 low flow is unknown but is likely to be less than 1.0m$^3$/s. Review of FEH data indicates the watercourse's catchment close to the Site is only approximately 1.4km$^2$ and therefore the Q95 low flow may be less than 0.001m$^3$/s close to the Site. The waterbody is considered to be of High sensitivity in accordance with **Table 11-5** due to the waterbody's WFD designation.

11.4.5. Barnham Lane Ditch, an EA designated Main River, is located immediately adjacent to the eastern site boundary. The watercourse flows in an easterly direction along the northern periphery of West Barnham to confluence with Barnham Rife approximately 0.8km downstream of the Site. The Barnham Lane Ditch is not monitored against the objectives of the WFD but is likely to be an ephemeral ditch with very low flow and heavily modified. EA LiDAR data indicates that the watercourse's catchment upstream of to the Site is only 0.3km$^2$ and therefore the Q95 low flow is approximately 0.001m$^3$/s close to the Site. This waterbody is therefore considered to have Low sensitivity in accordance with **Table 11-5**.

11.4.6. Barnham Rife is also an EA designated Main River located approximately 0.7km east of the Site. The watercourse flows in a south-westerly direction to confluence with the Lidsey Rife approximately 2.5km downstream of the watercourse's connection with the Barnham Lane Ditch. The watercourse is not monitored against the objectives of the WFD although given the similar characteristics with the Lidsey Rife it is considered appropriate to apply the same indicative WFD status classifications. Review of FEH data indicates the watercourse's catchment at its confluence with the Lidsey Rife is approximately 10.3km$^2$. The Q95 low flow is unknown but is likely to be less than 1.0m$^3$/s. Immediately downstream of the Site the catchment is approximately 2.1km$^2$. This waterbody is therefore considered to have Medium sensitivity in accordance with **Table 11-5**.

11.4.7. Westergate Stream is also an EA designated Main River situated approximately 0.7 km west of the Site. The watercourse flows in a south-westerly direction and confluences with the Aldingbourne Rife approximately 2.5km downstream of the Site. The Scheme is not located in the drainage catchment of the Westergate Stream and there is no known hydraulic link between the Scheme and the watercourse. The Scheme is therefore not thought to have an impact upon this watercourse and therefore Westergate Stream has not been further assessed within this ES Chapter.

11.4.8. School Ditch, and Ordinary Watercourse under the jurisdiction of the LLFA, is located adjacent to the south of the Scheme. The watercourse is thought to be culverted further to the south. This watercourse has been determined to be of Low sensitivity due to its local scale.

11.4.9. Several small ordinary watercourses are also present within 1km from the Site. These watercourses are included as "Unnamed Ordinary Watercourses" on Figure 60799-LOC-002 in **Appendix 11.3**. The Scheme is not located in the drainage catchment of the unnamed watercourses and there are no known hydraulic links between the Scheme and the unnamed watercourses. The Scheme is therefore not considered to have an e upon these watercourses and therefore the "Unnamed Ordinary Watercourses" have not been further assessed within this ES Chapter.

**GROUNDWATER BODIES**

11.4.10. BGS online mapping (Ref. 11.21) indicates that the Site is underlain by Head (gravel, sand, silt and clay) and River Terrace Deposits (sand, silt and clay). Available site investigation data indicate that the main lithology is sand and gravel. The bedrock geology which underlies the Head and River Terrace Deposits is the London Clay Formation which is classed as "Unproductive Strata" by the EA. Geology figures can be found in Appendix A of the FRA. Based on the BGS mapping (Ref. 11.21) the bedrock under the London Clay Formation is formed by the Lambeth Group which is then underlain by Chalk at the Site.

11.4.11. The geology which directly underlays the Site comprises of Superficial Deposits only (Head and River Terrace Deposits). The EA classifies the superficial deposits as a "Secondary A" aquifer and therefore are considered of Medium sensitivity.

11.4.12. The Lambeth Group and the Chalk are aquifers of national importance as they support large groundwater abstractions. However, at the Site, they are present under the London Clay Formation which acts as a confining layer and the Lambeth Group and the Chalk are therefore protected from potential impacts resulting from the Scheme and are not considered further in this assessment.

11.4.13. The EA confirmed in correspondence in May 2020 that there are seven licensed discharges within 1 km of the Site: five to surface water and two to groundwater. The EA also confirmed the presence of 15 discharge exceptions, mainly related to discharges to ground. None of the discharges are within the red line boundary of the proposed Scheme.

11.4.14. The EA confirmed there are two licensed groundwater abstractions which are from the Chalk within 1 km of the Site. These are held by Portsmouth Water and Fuente. The Portsmouth Water abstraction is used for public water supply and is abstracting from the underlying confined aquifer as the SPZ is shown as subsurface source protection zone on Magic Map (Ref. 11.22). The daily abstraction licence limit is 41,000m$^3$/day. The Fuente abstraction is used for irrigation for agricultural land and the abstraction licence limit is 102 m$^3$/day.

11.4.15. **Table 11-8** below lists the groundwater abstraction data provided by the EA on 1 July 2020. As discussed above it is considered that the Scheme will not have an impact on the Chalk and therefore no further consideration has been given to potential impacts to these licensed abstractions.

**Table 11-8 – Groundwater abstraction data within 1km of the Site**

| | **EASTERGATE PUMPING STATION (Portsmouth Water)** | **STONEYFIELDS NURSERIES, EASTERGATE LANE, WALBERTON (Fuente)** |
|---|---|---|
| LIC_NO | 10/41/542108 | 10/41/542211 |
| START_DATE | 01/04/2016 00:00 | 31/03/2016 00:00 |
| LH_NAME | Portsmouth Water Ltd | Fuente |
| ADDR_LINE2 | West Street | Eastergate Lane |
| POSTCODE | PO9 1LG | PO20 6SL |
| SUBPURPOSE | Public Water Supply | General Agriculture |
| USE | Potable Water Supply - Direct | Spray Irrigation - Direct |
| SOURCE | Southern Region Groundwater | Southern Region Groundwater |
| NGR | SU9406 | SU95590592 |
| CART1EAST | 494 | 495590 |
| CART1NORTH | 106 | 105920 |
| AQUIFR_TYP | H5CH Chichester Chalk / UGS | H5CH Chichester Chalk / UGS |
| Daily Licence Limit (m$^3$/d) | 41000 | 102 |
| Annual Licence Limit (m$^3$/year) | 10357800 | 9092 |

*Source: Environment Agency data provided in July 2020 - Open Government Licence v3.0*

**DESIGNATIONS**

11.4.16. DEFRA's online Magic Map application indicates that the Site is located within a designated Nitrate Vulnerable Zone. The zones indicate areas where waterbodies may be at risk from agricultural nitrate pollution. If soils are mobilised this may impact the water resources receptors.

11.4.17. There are no other statutory designated sites within 1 km of the Site.

**EXISTING SEWER AND DRAINAGE INFRASTRUCTURE**

11.4.18. Information regarding the existing sewer and drainage infrastructure within the vicinity of the Scheme has been discussed in the supporting FRA.

11.4.19. Topographic surveys and data provided by ADC (included in the FRA) indicate that highway drains are located along Barnham Road and Fontwell Avenue. Existing sewer and drainage infrastructure would be maintained. In addition, along Barnham Road, additional gullies would be provided at the low points if the existing highway drainage has insufficient capacity, subject to the CCTV survey. These were carried out in July, September and October 2020.

**FLOOD RISK RECEPTORS**

11.4.20. This section outlines the baseline flood risk from all sources as defined under the NPPF. The importance of receptors relates to the NPPF vulnerability classification for land uses potentially affected by the Scheme. Potential receptors can therefore be occupiers or users of the Scheme, as well as users or occupiers of land outside of the Site boundary and the construction workers that could be affected by changes to flood risk as a result of the Scheme.

11.4.21. The sensitivity of residents / users of the surrounding areas is considered to be High as the surrounding land use is predominantly residential and relates to a "more vulnerable" use base on the NPPF vulnerability classification.

11.4.22. The sensitivity of the scheme and future users of the Scheme is considered to be Very High as the Scheme would be classified as "Essential infrastructure" in accordance with NPPF, as it would provide an important transport link that should remain operational in times of flooding.

11.4.23. Flooding may affect construction workers and construction plant. Their sensitivity is considered to be Medium considering the flexibility of the works and limited time of exposure to risks during working hours.

11.4.24. The FRA provided an assessment of flood risk from all sources of flooding as listed below:

- Flooding from coastal and tidal sources;
- Flooding from fluvial sources;
- Flooding from pluvial / overland flow sources;
- Flooding from groundwater;
- Flooding from sewer and drainage infrastructure; and,
- Artificial sources of flooding.

11.4.25. The main sources of flooding identified in the FRA are from surface water, groundwater and fluvial sources. No other prominent sources of flooding have been identified as affecting the area.

## FUTURE BASELINE

11.4.26. Should the Scheme not proceed, it is considered that the future baseline conditions in relation to flooding, hydrology and water resources at the Site would remain relatively unchanged.

11.4.27. The volume and intensity of precipitation falling on the Site could increase due to climate change, leading to increased pluvial flood risk and increased pressure on sewerage infrastructure. Climate change could also result in a higher fluctuation of groundwater levels due to prolonged rainfall events. However, this is predicted to be relatively insignificant in the Site due to the high permeability of the underlying gravel (and ability to remove high volumes of water quickly).

11.4.28. Climate change may also cause prolonged periods of lower rainfall and drought conditions which, in turn, could also affect the ecological and chemical quality of watercourses in the vicinity of the Site. This stresses the need to maintain baseflow during low flow conditions, promote groundwater recharge and provide robust treatment of surface water runoff.

11.4.29. Residential developments are proposed in the surrounding areas which could impact on the identified sensitive receptors. However, under the NPPF, these developments should also demonstrate that they are implementing appropriate mitigation measures to ensure that there are no significant impacts on the sensitive receptors in the area.

# SENSITIVE RECEPTORS

11.4.30. **Table 11-9** below summarises the identified sensitive water resources and flood risk receptors that could be impacted by the Scheme.

**Table 11-9 – Sensitive Receptors**

| Water Resource Receptor | Sensitivity |
|---|---|
| **Surface Water Bodies** | |
| Barnham Lane Ditch (Main River) | Low |
| Barnham Rife (Main River) | Medium |
| Lidsey Rife (Main River) | High |
| School Ditch (Ordinary watercourse) | Low |
| **Flood Risk receptors** | |
| Future users of the Scheme (Essential Infrastructure) | Very High |
| Residents / users of the surrounding areas (More Vulnerable) | High |
| Construction worker (Less Vulnerable) | Medium |
| **Groundwater** | |
| Superficial Deposits (Secondary aquifer) | Medium |

## 11.5 ASSESSMENT OF EFFECTS, MITIGATION AND RESIDUAL EFFECTS

### CONSTRUCTION PHASE

11.5.1. Best practice recommendations for the prevention of contamination, management of flood risk and sediment control will be outlined in more detail in a Construction Environment Management Plan (CEMP) or equivalent and agreed with relevant statutory consultees prior to commencement of construction works. This will include measures to comply with relevant legislation, guidance and best practice measures, in line with the Considerate Contractors Scheme and Site handbook for the construction of SuDS (CIRIA C698) (Ref. 11.15).

11.5.2. The following potential construction impacts have been assessed within the chapter and are presented in the tables below:

- Short-term increase in flood risk due to construction activities;
- Potential effects on the water quality of surface water and groundwater resources due to construction activities or accidental leaks and spillages; and
- Potential increase in physical contamination (i.e. sedimentation) of surface water bodies due to ground disturbance.

**Table 11-9 – Short-term increase in flood risk due to construction activities (Construction)**

| Assessment Component | Commentary |
|---|---|
| **Short-term increase in flood risk due to construction activities** | The construction of the Scheme has the potential to increase flood risk within the Scheme area and within the vicinity of the Scheme due to the introduction of new impermeable areas leading to increased rates and volumes of surface water runoff.<br>Fluvial flooding is possible at the east of the Scheme near the access road and proposed attenuation pond 3 associated with Barnham Lane Ditch. However, the proposed site compounds, access roads and permanent works are not located within areas identified to be at risk from surface water or fluvial sources and therefore the works are not predicted to pose flood risk to construction workers or increase flood risk elsewhere during construction. Description and location of the construction elements are provided in Chapter 3.<br>Groundwater flooding is possible as excavation is proposed for the drainage ponds and road alignment from CH 15 to CH 100. This may pose risk to the stability of excavations that would require consideration but is not expected to pose flood risk to construction workers or increase flood risk elsewhere.<br>The sensitivity of the residents / users of the surrounding areas is considered to be High and the sensitivity of the construction workers is considered to be Medium. The magnitude of change prior to mitigation is considered to be Minor associated with a potential increase in flood risk associated with uncontrolled surface water runoff from impermeable areas. Therefore, there is likely to be a direct, temporary, short-term **slight adverse** effect on the flood risk receptors (**not significant**) prior to the implementation of mitigation measures. |
| **Secondary Mitigation** | Refer to the environmental mitigations listed in the CEMP in Appendix 3.4. The main mitigation measures are summarised below: |

| | |
|---|---|
| | ▪ Implement a construction-phase drainage strategy to intercept, capture and attenuate surface water runoff and adopt a phased approach to the construction of the operational drainage system to ensure impermeable areas are appropriately drained and attenuated prior to discharge. The construction-phase drainage strategy could include the provision of a bund along the lowest perimeters of the site to prevent uncontrolled runoff towards existing properties. Operational-phase drainage systems must be protected from ingress of sediment and debris and cleaned on completion of construction works.<br>▪ Storage of material and construction plant should be set back from the Barnham Lane Ditch and away from areas that may be at risk of flooding or existing overland flow routes described in the FRA.<br>▪ To minimise groundwater seepage into the areas of excavation/cutting, deep excavations should be constructed during the summer months as far as practicable and groundwater levels should ideally be monitored during construction. |
| **Residual Effects and Monitoring** | The magnitude of change following the implementation of secondary mitigation is considered to be negligible. Therefore, there is likely to be a direct, temporary, short-term **neutral to slight adverse** residual effect on the flood risk receptors (**not significant**) following the implementation of mitigation measures. |

**Table 11-10 – Potential effects on the water quality of water resources due to accidental leaks and spillages (Construction)**

| Assessment Component | Commentary |
|---|---|
| **Potential effects on the water quality of water resources due to construction activities and accidental leaks and spillages** | The construction of the Scheme has the potential to adversely impact on the water quality of water resources as a result of construction activities that cause accidental leaks and spillages or harmful substances. Sensitive water resources receptors that could be impacted by pollution are surface water bodies (Barnham Lane Ditch, Barnham Rife, Lidsey Rife and School Ditch) and groundwater bodies (Superficial Deposits). During the construction phase, the risk is primarily posed by materials being stored on site, such as oils, fuels and other chemicals.<br><br>The sensitivity of Barnham Lane Ditch is considered to be Low and the magnitude of change prior to mitigation is considered to be Moderate given the watercourse's close proximity to the construction works. Therefore, there is likely to be a direct, temporary, short-term **slight adverse** effect on Banham Lane Ditch (**not significant**) prior to the implementation of mitigation measures.<br><br>The sensitivity of Barnham Rife is considered to be Medium and the magnitude of change prior to mitigation is considered to be Negligible as pollutants are likely to be trapped or diluted within the Barnham Lane Ditch prior to reaching the Barnham Rife. Therefore, there is likely to be a **neutral** effect on Barnham Rife (**not significant**) prior to the implementation of mitigation measures.<br><br>The sensitivity of Lidsey Rife is considered to be High and the magnitude of change prior to mitigation is considered to be Negligible given the majority of the Scheme is not within the direct catchment of Lidsey Rife. Therefore, there is likely to be an indirect, temporary, short-term **slight adverse** effect on Lidsey Rife (**not significant**) prior to the implementation of mitigation measures. |

| | |
|---|---|
| | The sensitivity of School Ditch is considered to be Low and the magnitude of change prior to mitigation is considered to be Moderate given the watercourses' proximity to the construction works. Therefore, there is likely to be a direct, temporary, short-term **slight adverse** effect on the School Ditch (**not significant**) prior to the implementation of mitigation measures.<br><br>The sensitivity of the Superficial Deposits is considered to be Medium and the magnitude of change prior to mitigation is considered to be Moderate as there will be excavation / cuttings as part of the construction activities. Therefore, there is likely to be an indirect, temporary, short-term **moderate adverse** effect on the Superficial Deposits (**significant**) prior to the implementation of mitigation measures. |
| **Secondary Mitigation** | Refer to the environmental mitigations listed in the CEMP in Appendix 3.4. The main mitigation measures are summarised below:<br>▪ Surface water run-off from within the Site should be managed to prevent uncontrolled migration of pollutants to waterbodies. This could include temporary bunding and settlement ponds.<br>▪ Preparation of incident response plans, prior to construction, which should be present on-site throughout construction to inform contractors of required actions in the event of a pollution incident.<br>▪ Spillages and leaks would be immediately contained in line with the incident response plan.<br>▪ On-site availability of oil spill clean-up equipment including absorbent material and inflatable booms for use in the event of an oil spill or leak.<br>▪ Wherever possible, plant and machinery would be kept away from the drainage system and watercourses.<br>▪ Use of drip trays under mobile plant.<br>▪ Oil, fuels and other harmful substances should be stored on an impermeable surface with appropriate drainage or containment.<br>▪ Construction materials brought to the Site should be free of any contaminated material, so as to avoid any possible contamination of watercourses.<br>▪ Care should be taken to ensure that wet cement does not come into contact with surface water or near the watercourses and drainage ditches. Cement should be poured in dry conditions and consideration should be given to use fast drying cement.<br>▪ If ground contamination is encountered during construction works, work would stop immediately and measures would be taken to prevent disturbance and mobilisation of contaminants, until the contamination has been treated in-situ or removed for off-site treatment. |
| **Residual Effects and Monitoring** | The magnitude of change following the implementation of secondary mitigation is considered to be negligible. Therefore, there is likely to be a direct, temporary, short-term **neutral to slight adverse** residual effect on the Superficial Deposits (**not significant**) following the implementation of mitigation measures. The potential residual effect to Barnham Lane Ditch, Barnham Rife, Lidsey Rife and School Ditch is considered to be **neutral** (**not significant**). |

**Table 11-11 – Potential increase in physical contamination (i.e. sedimentation) of surface water bodies due to ground disturbance (Construction)**

| Assessment Component | Commentary |
|---|---|
| **Potential increase in physical contamination (i.e. sedimentation) of surface water bodies due to ground disturbance** | During the construction phase there would be a number of activities which could reduce surface water quality with respect to physical contaminants. These include site clearance; excavations; groundwater dewatering; localised ground remediation (if required); and materials handling, storage, stockpiling, spillage and disposal. In addition, during periods of heavy rainfall, vehicle movements associated with construction activities may result in damage to soil structure that may generate increased sedimentation within surface run-off.<br><br>Sensitive water resources receptors that could be impacted by pollution are Barnham Lane Ditch, Barnham Rife, Lidsey Rife and School Ditch.<br><br>The sensitivity of Barnham Lane Ditch is considered to be Low and the magnitude of change prior to mitigation is considered to be Moderate given the proximity of the watercourse to the construction works. Therefore, there is likely to be a direct, temporary, short-term **slight adverse** effect on Banham Lane Ditch (**not significant**) prior to the implementation of mitigation measures.<br><br>The sensitivity of Barnham Rife is considered to be Medium and the magnitude of change prior to mitigation is considered to be No change as sediments are likely to settle within the Barnham Lane Ditch prior to reaching the Barnham Rife. Therefore, there is likely to be a **neutral** effect on Barnham Rife (**not significant**) prior to the implementation of mitigation measures.<br><br>The sensitivity of Lidsey Rife is considered to be High and the magnitude of change prior to mitigation is considered to be Negligible given the majority of the Scheme is not within the direct catchment of Lidsey Rife. Therefore, there is likely to be an indirect, temporary, short-term **slight adverse** effect on Lidsey Rife (**not significant**) prior to the implementation of mitigation measures.<br><br>The sensitivity of School Ditch is considered to be Low and the magnitude of change prior to mitigation is considered to be Moderate, given the proximity of the watercourse to the construction works. Therefore, there is likely to be a direct, temporary, short-term **slight adverse** effect on the School Ditch (**not significant**) prior to the implementation of mitigation measures. |
| **Secondary Mitigation** | Refer to the environmental mitigations listed in the CEMP in Appendix 3.4. The main mitigation measures are summarised below:<br>▪ Working areas shall be clearly defined to ensure the disturbance of soils is minimised, where possible.<br>▪ The cleaning of vehicle wheels prior to leaving Site.<br>▪ Dust Management Plan (i.e. damping down) with subsequent consideration given to the management of surface water run-off.<br>▪ Installation of systems such as perimeter bunds, silt traps and swales designed to trap silty water including adequate maintenance and monitoring of these to ensure effectiveness, particularly after adverse weather conditions.<br>▪ The implementation of a temporary drainage strategy to prevent uncontrolled runoff.<br>▪ Locating stockpiles and materials storage a minimum of 10m from any watercourses or drainage lines. |

| | |
|---|---|
| | ▪ If perched groundwater is encountered within the made ground or superficial deposits at the Site, during the establishment of the foundations, dewatering may be required. The most appropriate method of dewatering would be chosen at this stage, which may include the enclosure of the excavation by sheet piling. Piezometers could be used outside of the sheet-pile to monitor groundwater levels. Damp proof membranes will be incorporated during construction to prevent the ingress of shallow groundwater.<br>▪ If dewatering is required, water should be passed through an appropriate sediment control system prior to discharge. |
| **Residual Effects and Monitoring** | The magnitude of change to Barnham Lane Ditch and School Ditch following mitigation is considered to be Minor. Therefore, there is likely to be a direct, temporary, short-term **slight adverse** effect on Barnham Lane Ditch and School Ditch (**not significant**) following the implementation of mitigation measures.<br><br>The magnitude of change to Lidsey Rife and Barham Rife following mitigation is considered to be No Change. Therefore, there is likely to be a **neutral** effect on Lidsey Rife and Barham Rife (**not significant**) following the implementation of mitigation measures. |

## OPERATIONAL PHASE

11.5.3. The following potential operational impacts have been assessed within the chapter and are presented in the tables below:

- Potential increase in on and off-site flood risk, due to an increase in impermeable surface areas, interception of overland surface water flows and the disturbance of groundwater flow paths; and
- Potential effects on the water quality (physical and chemical) of water resources associated with routine runoff and spillages, including watercourses and groundwater.

**Table 11-12 – Potential increase in flood risk, due to an increase in impermeable surface areas and the disturbance of surface water and groundwater flow paths (Operation)**

| Assessment Component | Commentary |
|---|---|
| **Potential increase in flood risk, due to an increase in impermeable surface areas and the disturbance of surface water and groundwater flow paths** | The Scheme has the potential to increase flood risk within the Scheme area and within the vicinity of the Scheme due to the introduction of new impermeable areas leading to increased rates and volumes of surface water runoff.<br><br>The introduction of new impermeable areas may also intercept and displace overland flows, posing an increased flood risk. Analysis of the Environment Agency's Risk of Flooding from Surface Water map indicates that the interception of overland flows could result in an increase in flood risk as the Scheme crosses existing flow routes (refer to the FRA). The Scheme has the potential to intercept the groundwater table through the installation of below-ground features (i.e. cuttings/excavations) resulting in reduced capacity of attenuation features. Infiltration to ground could also result in changes to the groundwater flows and potentially increase groundwater flood risk elsewhere.<br><br>The Scheme is located entirely within Flood Zone 1 and therefore the fluvial flood risk has not been assessed for the operational phase. |

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|---|---|
| | The potential increase in flood risk associated with surface water run-off from new impermeable areas would be managed though the implementation of the drainage design which was undertaken by Capita / Jackson and in consultation with WSCC (LLFA), ADC and the EA. For more details on flood risk mitigation measure refer to the FRA. In summary, the drainage design proposes the infiltration of runoff to ground for the (approximate) western half of the Scheme, and the controlled discharge to Barham Lane Ditch and School Ditch for the (approximate) eastern half of the Scheme. The drainage proposals are designed to control runoff up to the 1 in 100-year event plus 40% increase due to climate change. The proposed discharge rate into the Barnham Lane Ditch is 1.8l/s which is a significant reduction of 14.6l/s in greenfield runoff for up to the 1 in 100 year plus 40% climate change event. A practicable minimum limit on the discharge rate of 5l/s will be applied to the discharge to School Ditch. The controlled discharge rates have been agreed with the LLFA and ADC.<br><br>Groundwater monitoring (as detailed in the FRA) within the Site and surrounding areas indicates that groundwater levels are shallow (circa or less than 2m below ground level) in the western portion of the Site, are very shallow (up to approximately 0.5m below ground level) in the eastern and southern portions of the Site. The drainage design includes lined attenuation ponds in the eastern and southern portions as primary mitigation measures to prevent groundwater ingress into the drainage system. In the western part, the groundwater monitoring indicates that groundwater levels could rise above the base of the proposed soakaways which would limit the storage capacity of the drainage system. ~~The groundwater monitoring locations however were not located within the area of the proposed soakaways and therefore the drainage design has not considered these as representative.~~<br><br>Additional groundwater monitoring (as detailed in the FRA) was undertaken in February 2021. Three trial pits were excavated at the location of the proposed storage installations in the vicinity of the proposed roundabout at Fontwell Avenue. Groundwater was encountered at 2.5-2.7m bgl (below ground level) in two trial pits, and no groundwater was encountered in the third Trial Pit.<br><br>The sensitivity of the future users of the Scheme is considered to be Very High and the magnitude of change prior to secondary mitigation is considered to be Minor, as although the proposed drainage system is designed to account for the 1 in 100 year plus 40% increase due to climate change event, there are uncertainties regarding groundwater levels in the western end of the scheme. Therefore, there is likely to be a direct, permanent, long-term, **moderate adverse** effect on future site users of the Scheme (**significant**) prior to the implementation of secondary mitigation measures.<br><br>The Scheme ties into Fontwell Avenue and Barnham Road where two overland flow routes are present along those roads. However, to mitigate the potential increase in surface water flood risk to others from blockage of the overland flow routes, the Scheme design proposes to keep the current road drainage systems along these roads. In addition, the Scheme incorporates additional gullies at low points. This has been consulted on and agreed with the LLFA and ADC. CCTV surveys were carried out in July, September and October 2020 (as detailed in the FRA), along Barnham Road and Fontwell Avenue. ~~A CCTV condition survey along Barnham Road will be required to confirm the final road design/mitigation measures at the proposed roundabout with Barnham Road~~ |

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| | The sensitivity of the residents / users of the surrounding areas is considered to be High and the magnitude of change prior to secondary mitigation is considered to be Minor, as the secondary mitigation measures to maintain the overland flow route along Barnham Road would need to be confirmed by a CCTV condition survey of the existing drainage prior to construction. Therefore, there is likely to be a direct, permanent, long-term, **moderate adverse** effect on residents / users of the surrounding areas (**significant**) prior to the implementation of secondary mitigation measures. |
| **Secondary Mitigation** | The proposed operational surface water drainage system has been taken into account in the assessment of potential effects. Secondary mitigation includes:<br>▪ Additional groundwater monitoring, which was completed in February 2021, fed into the revised drainage strategy design. ~~And~~ The ~~, if required,~~ amendment to the drainage design prior to construction of the Scheme ~~as~~ was suggested by WSCC (LLFA) and ADC in their correspondence dated 6 August 2020 and is included in the FRA. The results showed that, while the distance between the invert of the tanks and the ground water level is less than expected the infiltration rates are still sufficient to enable the 100yr + 40% event to be fully managed within the proposed system.<br>▪ CCTV condition surveys were carried out along Barnham Road and Fontwell Avenue, as outlined in the FRA, ~~will be required~~ to confirm the final road design / mitigation measures at the proposed roundabout with Barnham Road ~~prior to construction~~. This ~~has~~ was ~~been~~ agreed with WSCC (LLFA) and ADC in their correspondence dated 6 August 2020 and included in the FRA. |
| **Residual effects and monitoring** | The magnitude of change following secondary mitigation is considered to be Negligible. Therefore, there is likely to be a direct, permanent, long-term, **slight adverse** effect on the future users of the Scheme and residents / users of the surrounding areas (**not significant**) following the implementation of secondary mitigation measures. |

**Table 11-13 – Potential effects on the water quality (physical and chemical) of water resources, including water courses and groundwater (Operation)**

| Assessment Component | Commentary |
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| **Potential effects on the water quality of water (physical and chemical) resources, including watercourses and groundwater** | During the operational phase, untreated routine surface runoff from impermeable areas and accidental spillages could be mobilised into the surface water drainage system, and this contaminated surface water could be discharged to the surface water or groundwater receptors via the proposed drainage system.<br>The quality of surface water run-off from new impermeable areas would be managed though the implementation of the drainage design which was undertaken by Capita / Jackson and in consultation with WSCC (LLFA), ADC and the EA. For more details on the drainage strategy refer to the FRA. In summary, the drainage design proposes the infiltration of surface runoff to ground for the (approximate) western half of the Scheme, and the controlled discharge to Barham Lane Ditch and School Ditch for the (approximate) eastern half of the Scheme. Treatment measures will include a combination of SuDS features as detailed below:<br>▪ By-pass oil/petrol interceptors upstream of cellular units for groundwater protection in the western end of the Scheme. |

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| | ▪ Infiltration through the base of swales and infiltration pond for the northern portion of the Scheme;<br>▪ Swales and a lined attenuation pond for the eastern portion of the scheme (runoff will discharge to Barnham Lane Ditch).<br>▪ A lined attenuation pond and a by-pass oil/petrol interceptor for the eastern portion of the scheme (runoff will discharge to School Ditch).<br><br>Water quality has been assessed using the Simple Index Approach in accordance with CIRIA C753 (Ref. 11.15), in consultation with the LLFA and ADC (refer to FRA Ref. 11.27), as well as a HEWRAT assessment in accordance with DMRB LA113 Revision 1 (Ref. 11.16). The Simple Index Approach is included in Appendix F2 of the FRA. The FRA and HEWRAT assessment are included in Appendix 11.1 and Appendix 11.2 respectively.<br><br>Sensitive water resources receptors that could be impacted by pollution are surface water bodies (Barnham Lane Ditch, Barnham Rife and School Ditch) and groundwater bodies (Superficial Deposits). Lidsey Rife is not proposed to receive discharge form the Scheme and therefore no impacts are expected.<br><br>The sensitivity of Barnham Lane Ditch is considered to be Low and the magnitude of change prior to secondary mitigation is considered to be Negligible as the proposed surface water drainage system would provide sufficient treatment based on the results of the HEWRAT and CIRIA C753 Simple index Approach assessments considering the treatment measures within the proposed drainage design. The HEWRAT results, after considering the proposed drainage design, indicate that the annual average concentration is 0.21µg/l for copper and 0.77µg/l for zinc which passes the acute impacts of soluble pollutants. The HEWRAT assessment for the chronic impacts of sediment-bound pollutants is also passed. The assessment of long-term pollution impacts considers the annual average pollutant concentrations associated with the Scheme against the EQS threshold values set out in the WFD. The annual average concentrations for both copper and zinc are well below the EQS thresholds when considering the proposed drainage design and go beyond the minimum standards required to pass the HEWRAT assessment. Therefore, there is likely to be a **neutral** effect on the water quality of Barnham Lane Ditch (**not significant**) prior to the implementation of secondary mitigation measures.<br><br>Discharge to the Barnham Ditch will migrate to the Barham Rife located approximately 0.8km downstream. Pollutants are expected to settle or be diluted prior to reaching Barnham Rife and therefore the magnitude of change prior to secondary mitigation is considered to be Negligible. Therefore, there is likely to be a **neutral** effect on the water quality of Barnham Rife (**not significant**) prior to the implementation of secondary mitigation measures. |

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| | The southern extent of the Scheme is proposed to discharge into School Ditch. The sensitivity of School Ditch is considered to be Low and the magnitude of change prior to secondary mitigation, is considered to be Negligible as the proposed surface water drainage system would provide sufficient treatment based on the results of the HEWRAT and CIRIA C753 Simple index Approach assessments considering the drainage design. Due to the low Q95 for this watercourse, School Ditch was assessed as a groundwater "shallow linear" feature. The HEWRAT results before primary mitigation was Medium Risk however, the drainage design incorporates swales and a lined attenuation pond which would provide sufficient treatment of at least 50% removal for dissolved copper, zinc and 80% removal for Total Suspended Solids (TSS) as per table 8.6.4N3 in CG501 (Ref. 11.19). Therefore, there is likely to be a **neutral** effect on the water quality of School Ditch (**not significant**) prior to the implementation of secondary mitigation measures.<br><br>Infiltration to ground will be within the underlying Superficial Deposits and potentially pollute groundwater resources if present. The sensitivity of the Superficial Deposits is considered to be Medium and the magnitude of change prior to secondary mitigation is considered to be Moderate based on the HEWRAT assessment (Appendix 11.2). It should be noted that the HEWRAT assessment does not consider the mitigation measures embedded into the drainage design of the Scheme. The proposed swales would reduce the risk of soluble contaminants by at least 50% as per table 8.6.4N3 in CG501 (Ref. 11.19), in addition, an infiltration pond would further facilitate the removal of dissolved metals and solids (Ref. 11.19). It should be noted however that the roundabout which connects the Scheme to Fontwell Avenue does not incorporate sufficient mitigation prior to discharge to ground (Superficial Deposits) as petrol interceptors are not given a value within table 8.6.4N3 in CG501 (Ref. 11.19). According to the treatment technical note provided by Capita (2020) (Ref. 11.27) where the Simple index Approach was applied, the proposed oil/petrol interceptors would provide sufficient treatment. The proposed treatment was presented and agreed with the LLFA and ADC. As the Fontwell Avenue roundabout is only ~0.18ha in area and the Simple index Approach does not take area into consideration within the assessment, the overall magnitude of change for the Superficial Deposits therefore is considered to be Negligible. Therefore, there is likely to be a **neutral** effect on the groundwater quality in the Superficial Deposits (**not significant**) prior to the implementation of secondary mitigation measures. |
| **Secondary Mitigation** | Not required. |
| **Residual effects and monitoring** | The magnitude of change to Barnham Lane Ditch, Barnham Rife, Lidsey Rife, School Ditch and the Superficial Deposits is considered to be Negligible. Therefore, there is likely to be a **Neutral** residual effect on the water quality to these features (**not significant**) and mitigation measures would not be required. |

## ASSESSMENT AGAINST FUTURE BASELINE

11.5.5. In the longer term, the risk of fluvial and surface water flooding at the Site and in the vicinity may increase with the effects of climate change due to an increase in the volume and intensity of precipitation falling on the Scheme and in the surrounding area. This could have a corresponding effect on flood risk associated with the drains and watercourses onsite and in the vicinity of the Scheme, including potentially more frequent surcharging of the road drainage.

11.5.6. Maximum groundwater levels in the southern part of the Site are very shallow and even if the road is protected surrounding land will not be raised as part of the Scheme. For the groundwater monitoring and maximum levels refer to the FRA. Other developments in the area have to develop drainage strategies and it is important that cumulative impacts on groundwater levels are considered, i.e. avoiding an increase in groundwater recharge during prolonged wet conditions.

## 11.6 CUMULATIVE EFFECTS

11.6.1. The Scheme has been designed to account for the potential increase in flood risk by including climate change allowance in the drainage design as required by the NPPF. Residential developments are proposed in the surrounding areas which could impact on the identified sensitive receptors. However, under the NPPF, these developments should also demonstrate that they are implementing appropriate mitigation measures to ensure that there are no significant impacts on the sensitive receptors in the area. Therefore, the cumulative impacts on flood risk and the water environment arising from the Scheme and the future developments would not be significant.

11.6.2. Water and flood risk receptors were considered within 1km of the Scheme, as any development beyond this distance would not be expected to have an impact on water resources.

11.6.3. As set out in **Chapter 14: Cumulative Effects** (Table 14-1) committed developments with the potential for inter-project (in-combination) effects have been identified. Construction activities associated with Land east of Fontwell Avenue (2), Land at former Eastergate Fruit Farm (4), Pollards Nursery Lane (5), Land west of Fontwell Avenue (16), Arun District Strategic Housing Allocation (SD5) (17) and Barratts Development “Adjacent Proposed Scheme “ (19) would increase the regional area of construction works, and the subsequent risk of flood risk. The nature of these activities would likely be similar in nature and as a result have similar residual effects associated with them such as accidental leaks and spillages to surface water. These effects are not anticipated to increase the significance of residual effects beyond the Scheme in isolation. As a result, Neutral (not significant) in-combination effects are anticipated.

11.6.4. The operational committed Land east of Fontwell Avenue and the Barratts Development will see increased vehicle traffic and numbers as well as an increased impermeable surface with implications on flood risk. As a result of the scale of the committed development, these effects are anticipated to result in a Slight Adverse (not significant) in-combination effect.

11.6.5. The operational committed Land at former Eastergate Fruit Farm, Pollards Nursery Lane, Land west of Fontwell Avenue and Arun District Strategic Housing Allocation (SD5) will see increased vehicle traffic and numbers as well as an increased impermeable surface with implications on flood risk. The drainage strategy for the Scheme has been developed in consultation with the Southern Consortium and amendments have been made to Pond 4 since submission of the ES as detailed in Chapter 3, to align with their emerging designs and to prevent sterilisation or impact upon future development south of Barnham Road. The effects are of a nature and scale to not result in a significant increase

in residual effects compared to the Scheme in isolation. As such, a Neutral (not significant) in-combination effect in anticipated.

11.6.6. Other developments in the area will have to develop drainage strategies and it is important that cumulative impacts on groundwater levels are considered during their planning process, i.e. avoiding an increase in groundwater recharge during prolonged wet conditions.

## 11.7 LIMITATIONS AND ASSUMPTIONS

11.7.1. The description of the proposed Scheme, including construction activities, is as confirmed in **Chapter 3 - Description of Scheme**.

11.7.2. In addition, it is assumed that the mitigation measures listed as part of the CEMP are correctly implemented and best practice is adopted at all times. It is also assumed that the flood mitigation measures included in the drainage design would be functional and able to successfully mitigate the potential impacts during the operation phase.

11.7.3. Drainage designs and additional mitigation measures are as provided by Capita / Jackson and included in the FRA (**Appendix 11.1**).

## 11.8 SUMMARY

11.8.1. The following table provides a summary of the findings of the assessment.

## Table 11-15 - Summary of Effects Table for Water Resources and Flood Risk

| Description of Effects | Receptor | Significance and Nature of Effects Prior to Secondary Mitigation | Summary of Secondary Mitigation | Significance and Nature of Residual Effects |
|---|---|---|---|---|
| **Construction Phase** | | | | |
| Short-term increase in flood risk due to construction activities | Residents / users of the surrounding areas | Slight<br>- / T /D / ST | ▪ Implement a construction-phase drainage strategy to intercept, capture and attenuate surface water runoff and adopt a phased approach to the construction of the operational drainage system to ensure impermeable areas are appropriately drained and attenuated prior to discharge. The construction-phase drainage strategy could include the provision of a bund along the lowest perimeters of the site to prevent uncontrolled runoff towards existing properties. Operational-phase drainage systems must be protected from ingress of sediment and debris and cleaned on completion of construction works.<br>▪ Storage of material and construction plant should be set back from the Barnham Lane Ditch and away from areas that may be at risk of flooding or existing overland flow routes described in the FRA.<br>▪ To minimise groundwater seepage into the areas of excavation/cutting, deep excavations should be constructed during the summer months as far as practicable and groundwater levels should ideally be monitored during construction. | Neutral to Slight<br>- / T /D / ST |
| | Construction workers | Slight<br>- / T /D / ST | | Neutral to Slight<br>- / T /D / ST |
| Potential effects on the water quality of water resources due to construction activities and accidental leaks and spillages | Barnham Lane Ditch | Slight<br>- / T /D / ST | ▪ Surface water run-off from within the Site should be managed to prevent uncontrolled migration of pollutants to waterbodies. This could include temporary bunding and settlement ponds. | Neutral |

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| | Barnham Rife | Slight<br>-/ T /D / ST | ▪ Preparation of incident response plans, prior to construction, which should be present on-site throughout construction to inform contractors of required actions in the event of a pollution incident.<br>▪ Spillages and leaks would be immediately contained in line with the incident response plan.<br>▪ On-site availability of oil spill clean-up equipment including absorbent material and inflatable booms for use in the event of an oil spill or leak.<br>▪ Wherever possible, plant and machinery would be kept away from the drainage system and watercourses.<br>▪ Use of drip trays under mobile plant.<br>▪ Oil, fuels and other harmful substances should be stored on an impermeable surface with appropriate drainage or containment.<br>▪ Construction materials brought to the Site should be free of any contaminated material, so as to avoid any possible contamination of watercourses.<br>▪ Care should be taken to ensure that wet cement does not come into contact with surface water or near the watercourses and drainage ditches. Cement should be poured in dry conditions and consideration should be given to use fast drying cement.<br>▪ If ground contamination is encountered during construction works, work would stop immediately and measures would be taken to prevent disturbance and mobilisation of contaminants, until the contamination has been treated in-situ or removed for off-site treatment. | Neutral |
| | Lidsey Rife | Slight<br>- / T /I / ST | | Neutral |
| | School Ditch | Slight<br>- / T /D / ST | | Neutral |
| | Superficial Deposits | Moderate<br>- / T /I / ST | | Slight<br>- / T /I / ST |
| Potential increase in physical contamination (i.e. sedimentation) of surface water bodies due to ground disturbance | Barnham Lane Ditch | Slight<br>- / T /D / ST | ▪ Working areas shall be clearly defined to ensure the disturbance of soils is minimised, where possible.<br>▪ The cleaning of vehicle wheels prior to leaving Site.<br>▪ Dust Management Plan (i.e. damping down) with subsequent consideration given to the management of surface water run-off.<br>▪ Installation of systems such as perimeter bunds, silt traps and swales designed to trap silty water including adequate maintenance and monitoring of these to ensure effectiveness, particularly after adverse weather conditions.<br>▪ The implementation of a temporary drainage strategy to prevent uncontrolled runoff.<br>▪ Locating stockpiles and materials storage a minimum of 10m from any watercourses or drainage lines. | Slight<br>- / T /D / ST |
| | Barnham Rife | Neutral | | Neutral |

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| | Lidsey Rife | Slight<br>- / T /I / ST | ▪ If perched groundwater is encountered within the made ground or superficial deposits at the Site, during the establishment of the foundations, dewatering may be required. The most appropriate method of dewatering would be chosen at this stage, which may include the enclosure of the excavation by sheet piling. Piezometers could be used outside of the sheet-pile to monitor groundwater levels. Damp proof membranes will be incorporated during construction to prevent the ingress of shallow groundwater.<br>▪ If dewatering is required, water should be passed through an appropriate sediment control system prior to discharge. | Neutral |
| | School Ditch | Slight<br>- / T /D / ST | | Slight<br>- / T /D / ST |
| **Operational Phase** | | | | |
| Potential increase in flood risk, due to an increase in impermeable surface areas and the disturbance of surface water and groundwater flow paths | Future site users of the Scheme | Moderate<br>- / P /D / LT | The proposed operational surface water drainage system has been taken into account in the assessment of potential effects. Secondary mitigation includes:<br>▪ Additional groundwater monitoring, <u>which was completed in February 2021</u>, and~~, if required~~ amendment to the drainage design prior to construction of the Scheme as suggested by WSCC (LLFA) and ADC in their correspondence dated 6 August 2020 and included in the FRA. The results showed that, while the distance between the invert of the tanks and the ground water level is less than expected the infiltration rates are still sufficient to enable the 100yr + 40% event to be fully managed within the proposed system.<br>▪ <u>CCTV condition surveys were carried out along Barnham Road and Fontwell Avenue, as outlined in the FRA, to confirm the final road design / mitigation measures at the proposed roundabout with Barnham Road. This was agreed with WSCC (LLFA) and ADC in their correspondence dated 6 August 2020 and included in the FRA.</u> ~~CCTV condition survey along Barnham Road will be required to confirm the final road design / mitigation measures at the proposed roundabout with Barnham Road prior to construction. This has been agreed with WSCC (LLFA) and ADC in their correspondence dated 6 August 2020 and included in the FRA.~~ | Slight<br>- / P /D / LT |
| | Residents / users of the surrounding areas | Moderate<br>- / P /D / LT | | Slight<br>- / P /D / LT |

| | | | | |
|---|---|---|---|---|
| Potential effects on the water quality of water resources, including water courses and groundwater | Barnham Lane Ditch | Neutral | Not required | Neutral |
| | Barnham Rife | Neutral | | Neutral |
| | Lidsey Rife | Neutral | | Neutral |
| | School Ditch | Neutral | | Neutral |
| | Superficial Deposits | Neutral | | Neutral |

Key to table:

+ / - = Beneficial or Adverse P / T = Permanent or Temporary, D / I = Direct or Indirect, ST / MT / LT = Short Term, Medium Term or Long Term, N/A = Not Applicable

# REFERENCES


- Reference 11.1: Floods Directive 2007 (2007/60/EC)
- Reference 11.2: The Water Resources Act 1991
- Reference 11.3: Land Drainage Act 1994
- Reference 11.4: Water Framework Directive 2000
- Reference 11.5: Groundwater Directive (2006/118/EC) 2006
- Reference 11.6: Flood and Water Management Act 2010
- Reference 11.7: The Environmental Damage (Prevention and Remediation) (England) Regulations 2015
- Reference 11.8: The Environmental Permitting Regulations 2016
- Reference 11.9: National Planning Policy Framework (NPPF) 2019
- Reference 11.10: Adoption Arun Local Plan 2011-2031
- Reference 11.11: Flood Risk Assessments: Climate Change Allowances (2019)
- Reference 11.12: Environment Agency (2017) 'Flood Risk Assessment: Standing Advice'
- Reference 11.13: Arun District Council Strategic Flood Risk Assessment 2016
- Reference 11.14: West Sussex Local Management Strategy (LFRMS) 2014
- Reference 11.15: CIRIA, The SuDS Manual, C753 (2015)
- Reference 11.16: DMRB LA113 Road drainage and the water environment, Revision 1
- Reference 11.17: Site handbook for the construction of SuDS (CIRIA C698) (2007)
- Reference 11.18: The Environment Agency's Approach to Groundwater Protection (2018)
- Reference 11.19: CG 501 Design of Highway Drainage Systems, Revision 2
- Reference 11.20: Environment Agency Flood Mapping
- Reference 11.21: BGS Geoindex Onshore mapping 1:50,000 scale
- Reference 11.22: DEFRA Magic Map
- Reference 11.23: Environment Agency Catchment Data Explorer
- Reference 11.24: Environment Agency correspondence, including Product 4 and abstraction licence data
- Reference 11.25: Lead Local Flood Authority and Arun District Council correspondence and flood risk data provided
- Reference 11.26: Southern Water – history of flooding and Asset location plans
- Reference 11.27: Drainage design documents provided by Capita / Jackson on 03 August 2020 - appended to the above FRA
- Reference 11.28: Geotechnics (2019) – A29 Realignment, Eastergate. Factual Report – ground investigation to inform the A29 Realignment Transport Business Case
- Reference 11.29: Land Science (2020) – ground investigations undertaken to inform the A29 realignment Phase 1
- Reference 11.30: Wilson Bailey 2018, 2019 and 2020 – ground investigations undertaken on behalf of Barratts
- Reference 11.31: 3D Engineering Surveys Limited 2019 – topographic survey
- Reference 11.32: Geomatic Surveyors 2018 – topographic survey and,
- Reference 11.33: Pell Frischmann 2018 – topographic survey

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