MOTT MACDONALD

Informal Habitat Regulations Assessment

Fens Reservoir

November 2022

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Acronyms and abbreviations

Acronym	Definition
AA	Appropriate Assessment
CEMP	Construction and Environmental Management Plan
cSAC	Candidate Special Area of Conservation
CTMP	Construction Traffic Management Plan
DAF	Dissolved Air Floatation
DO	Deployable Output
EA	Environment Agency
ECJ	European Court of Justice
GAC	Granular Activated Carbon
HRA	Habitats Regulations Assessment
INNS	Invasive Non-Native Species
IROPI	Imperative Reasons of Overriding Public Interest
LSE	Likely Significant Effects
Ml/d	Megalitres per day
NLSE	No Likely Significant Effects
NSN	National Site Network
PEAR	Preliminary Environmental Appraisal Report
POM	Programme Of Measures [WFD measures required to improve waterbody status]
PS	Pumping station
pSPA	Proposed Special Protection Area
RAPID	Regulators' Alliance for Progressing Infrastructure Development
RGF	Rapid Gravity Filter
SAC	Special Area of Conservation
SEA	Strategic environmental assessment
SIP	Site Improvement Plan
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
SR	Service Reservoir
SRO	Strategic Resource Option
SSSI	Site of Special Scientific Interest
ToLS	Test of Likely Significance
UKWIR	UK Water Industry Research
WFD	Water Framework Directive
WRMP	Water Resources Management Plan
WRMP19	Water Resources Management Plan 2019
WRMP24	Water Resources Management Plan 2024
WSR	Water Supply Reservoir
WRSE	Water Resources South East

Acronym	Definition
WRC	Water Recycling Centre
WRZ	Water Resource Zone
WSW	Water Supply Works
WTW	Water Treatment Works
ZoI	Zone of Influence

Executive summary

This report presents the results of the informal Habitats Regulations Assessment (HRA) Stage 2 Appropriate Assessment (AA) undertaken for the Fens Reservoir (FR) Strategic Resource Option (SRO) proposed site. This report assesses the potential effects of the proposed scheme on Special Protection Areas (SPAs), Special Conservation Areas (SACs) and Ramsar Sites.

Mott MacDonald Ltd undertook this informal HRA and AA as part of Gate 2 in August 2022, following the methodology in the *Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans (21/WR/02/15)*.

This appendix supports the Environmental Appraisal Report (EAR) that accompanies the Gate 2 submission to Regulators' Alliance for Progressing Infrastructure Development (RAPID).

The HRA Stage 1 Screening concluded that the scheme as proposed by Anglian Water is likely to result in Likely Significant Effects on the following Designated Sites:

- Ouse Washes SPA (UK9008041)
- Ouse Washes Ramsar Site (UK11051)
- Ouse Washes SAC (UK0013011)
- The Wash SPA (UK9008021)
- The Wash Ramsar Site (UK11072)
- The Wash and North Norfolk Coast SAC (UK0017075)

Consequently, the scheme has progressed to Stage 2 AA as several pathways and potential effects were identified at screening. This informal HRA AA, considered that residual effects remain for the Ouse Washes SPA, SAC and Ramsar Site, both during the construction and operational phases of the scheme. Details are outlined as follows:

During construction, the scheme may result in:

- Physical loss during the construction of the pipelines, the reservoir, and their associated built infrastructure. This may also include loss of land functionally linked to the Designated Sites and used by qualifying species with large distribution ranges like birds.
- Physical damage, including habitat degradation as a result of water quality changes in case of pollution events may affect spawning areas for designated fish species.
- Non-physical disturbance caused by noise/visual presence and light pollution leading to the displacement of qualifying bird species from foraging areas.
- Toxic contamination leading to biomass reduction and food web disruptions that may affect the life cycle of qualifying species.
- Non-toxic contamination as a result of changes in water turbidity, sediment loading and silt deposition altering ecosystem processes and food webs; as well as dust effects smothering habitats, affecting photosynthesis and reducing productivity.
- Biological disturbance as a result of changes to habitat availability including functional linked habitat; changes in species abundance or distribution; potential for populations to be displaced from current spawning grounds and feeding areas; changes in natural succession.

During operation this scheme may result in:

- Changes to water levels and flows due to abstraction, storage and emergency discharge drawdown flows leading to fluctuations in water temperature regimes and salinity levels downstream.
- Physical damage as a result of changes in flow velocity and sediment fluxes leading to changes in natural coastal processes; functionally linked habitat degradation as a result of water quality changes in case of pollution events.
- Toxic contamination leading to biomass reduction and food web disruptions that may affect the life cycle of qualifying species.
- Non-toxic contamination as a result of changes in water turbidity, sediment loading and silt deposition altering ecosystem processes and food webs; as well as dust effects smothering habitats, affecting photosynthesis and reducing productivity.
- Biological disturbance including direct mortality, changes to habitat availability including functional linked habitat; changes in species abundance or distribution; potential for populations to be displaced from current spawning grounds and feeding areas; changes in natural succession.

The Wash SPA, Ramsar Site and The Wash and Norfolk Coast SAC are considered to be sufficiently distant from the scheme to exclude light, noise, dust and visual disturbance effects during construction. However, at this stage, it is not possible to exclude adverse effects at The Wash Designated Sites during construction of the reservoir and pipeline and intake structure. Likewise, it is not possible to exclude adverse effects during the operation phase, as the new abstraction and discharge in the River Great Ouse may lead to changes on:

- The extent and distribution of qualifying habitats.
- The structure and function of the qualifying habitats.
- The supporting processes on which habitats of qualifying species rely.

The recommended mitigation measures detailed within this document assume a worst-case scenario at this stage, in the absence of detailed survey data or local records. Mitigation measures have been proposed for both construction and operation phases at all sites.

In addition to good practice measure for construction, the mitigation measures proposed to avoid effects during the construction phase include sensitive timings of works to avoid key periods for overwintering bird populations. It is also recommended that a Construction Environmental Management Plan (CEMP) be put in place that would include the proposed mitigation measures in this AA as well as any other specific measures identified following an HRA undertaken at project level.

At this stage some effects are still uncertain and therefore adverse effects on the Designated sites' integrity cannot be excluded. Further studies are recommended to address uncertainty and would include:

- Hydrodynamic modelling of flows and salinity into The Wash Designated Sites.
- Studies and modelling of the water demand from the River Delph and the River Great Ouse are needed to identify whether the changes in the water levels and flows as a result of the operation of the FR would have an impact on the Designated Sites and their qualifying features. Further modelling of the current nutrient level analysis due to the abstraction is also required to determine the effect of nutrient loading. In addition, potential changes in levels, salinity and sediment transport would also be investigated.
- Additional information about the option, including a further assessment and modelling of the effects of the new discharge and abstraction on the River Great Ouse are needed to reduce uncertainty and determine the effects on the Designated Sites located downstream. A detailed review of the baseline ecological data is also recommended including bird data.

- Finally, the adverse effects identified through this HRA may be compounded through the more frequent and intense effects of climate change, including heat waves, droughts, floods and rising sea levels. Therefore, climate change scenario analysis from simulations with Global Climate Models (GCMs) are also recommended to account for mid and long-term effects on the Designated Sites and functional linked land located downstream of the option.

An in-combination assessment was undertaken with other plans or projects and identified potential effects in-combination with:

- SLR – potential effects on The Wash Ramsar Site and SPA and Wash and North Norfolk Coast SAC.
- Cambridgeshire and Peterborough Mineral and waste development plan - potential effects on the Ouse Washes SAC, Ramsar Site and SPA.
- Land At Coveney Byall Fen Old Lynn Drove Coveney Cambridgeshire - potential effects on the Ouse Washes SAC, Ramsar Site and SPA.

It should be noted that the conclusions contained in this document are based on preliminary, indicative design assumptions available at this time, commensurate with the stage of scheme development the project is at and are primarily informed by available, appropriate desktop information. As the scheme development progresses to inform a future application for development consent, further survey work and assessments would be undertaken to inform and fulfil the regulatory requirements applicable at the time.

1 Introduction

1.1 Background

A new strategic reservoir in Cambridgeshire, referred to as the Fens Reservoir (FR), has been proposed for development as one of several nationally strategic water resource options required to address increasing deficits in public water supply. The scheme is promoted by Anglian Water and Cambridge Water and is being progressed through the fast-tracked delivery framework overseen by the Regulatory Alliance for Progressing Infrastructure Development (RAPID).

The FR has previously progressed through gate one in 2021, the first opportunity to check progress on investigations and development of solutions in the gate process and is now at gate two. Gate two is intended to look at solutions in more detail, with focus on ensuring that funding for continued investigation and development of solutions is aligned to water resources planning.

The FR Habitat Regulations Assessment (HRA) carried out as part of the RAPID gate one submission considered three potential scheme concepts, which were selected from a longer list of potential solutions in consultation with stakeholders. This report includes the informal HRA carried out for the proposed scheme (referred to the scheme in this report) with all its components (reservoir footprint, indicative transfer routes, abstraction points and proposed abstraction.

1.2 Assumptions and limitations

Information provided by third parties, including publicly available information and databases, is considered correct at the time of publication. Due to the dynamic nature of the environment, conditions may change in the period between the preparation of this report, and the undertaking of the proposed works.

Any uncertainties surrounding, and limitations of, the assessment process are acknowledged and highlighted. Recommendations for avoidance and mitigation measures to address the potential adverse effects on the integrity of the Designated Sites identified by this report are also based on the information available at the time of the assessment. It is acknowledged that the requirement for mitigation may change as the design of the Strategic Resource Option (SRO) progresses. This is expected to be through increasing the level of detail available during later stages of scheme development for subsequent gateways if the relevant schemes are progressed.

At this stage in the process the HRA is based on currently available desk-based information and no specific surveys have been undertaken. This is appropriate for the current stage of the process, and the HRA would be updated for the consenting process when further design detail on the scheme and more detailed biological data, which can include data collected on site, is available.

2 Habitats Regulations Assessment process

2.1 Habitats Regulations Assessment process

There is a requirement under the Conservation of Habitats and Species Regulations 2017 (as amended) ("the Habitats Regulations") to determine if a plan or project may have an adverse impact on a site designated under the same (or preceding Regulations) prior to any consent or permission being determined. The process of undertaking this assessment is known as an HRA. The Conservation of Habitats and Species Regulations 2017 (as amended) ('the Habitats Regulations') transpose the Habitats Directive and Wild Birds Directives into English and Welsh law. Regulations 63(1) - (9), 64 and 68 of the Habitats Regulations set out the requirements for assessment of impacts on National Network Sites.

The Habitats Regulations include measures to establish and maintain a network of sites protecting habitats which in themselves are valuable as well as for the species they support. These sites form a network that across Europe historically known as Natura 2000, and domestically now known as the National Site Network (NSN). Within the UK, this network consists of Special Protection Areas (SPAs) and Special Areas of Conservation (SACs), proposed and candidate SPAs and SACs (pSPAs and cSACs). This network also extends to marine environments, with wetland sites of international importance (Ramsar sites) also treated equally within this assessment framework. These sites are collectively referred to in this report as 'Designated Sites'.

The Habitats Regulations are set out in Parts which implement the requirements of the Directives, with Part 2 including provisions for the selection and designation of sites and Part 6 providing provisions to ensure that assessment of plans and projects are fully considered before being granted consent or permission. They also define the nature of and roles of statutory bodies, competent authorities and the appropriate nature conservation body and the requirements for information to be submitted to these bodies to enable them to undertake the required assessments.

Although the Habitats Regulations have been amended by The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019, due to the UK's exit from the EU, the effect of these amendments is largely related to wording and requirements and processes remain the same, as protection levels remain unchanged. As such existing EU guidance[1] and preceding case law from the European Court of Justice (ECJ)[2] [3] [4] remains valid as a source of direction and interpretation of the requirements of the legislation, although it should be noted that much case law has now been incorporated into guidance and/or good practice.

The HRA process consists of four stages, each stage being informed by the one preceding, to ensure an iterative and objective assessment. If the conclusion of Stage 1 Screening is that there would be No Likely Significant Effects (NLSE) on any features of a Designated Site, there is no requirement to undertake further stages. Similarly, if the Stage 2 AA concludes there

[1] European Commission (2018). Managing Natura 2000 Sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/CEE [online] available at: EN_art_6_guide_jun_2019.pdf (europa.eu) (last accessed April 2022).

[2] Landelijke Vereniging tot Behoud van de Waddenzeecase/ Nederlandse Vereniging tot Bescherming van Vogels, European Court of Justice, Case C-127/02 'Waddenzee 2002'

[3] Sweetman et al v An Bord Pleanala, European Court of Justice, Case C-258/11 'Sweetman 2011'

[4] People over Wind/Sweetman v Coiltte Teorante, European Court of Justice Case C-323/17 'People over Wind 2017'

would be no adverse effect on integrity of the Designated Site, then the assessment is concluded. The HRA stages are summarised within Table 2.1.

Table 2.1: HRA Stages

Stage	Description
Screening (Stage One)	This is the process which identifies the potential effects upon the Designated Sites and considers if these are likely to be significant (see definitions below). Screening is an iterative process and before moving to Stage Two it can be repeated if required. Proposals to mitigate any likely significant effects cannot be considered at the screening stage. If the Screening (Stage 1) identifies that the project or plan, alone or in combination, may have likely significant effects on a Designated Site and/or its features of interest, or if there is uncertainty, the competent authority must undertake an Appropriate Assessment (Stage 2) of the implications for that Site in view of that Site's conservation objectives.
Appropriate Assessment (Stage Two)	This stage involves the consideration of the predicted adverse effects of the project or plan either alone, or in combination with other projects or plans, on the integrity of the Designated Site with respect to the Site's structure, function and conservation objectives. Additionally, where mitigation has been proposed to avoid or minimise likely significant effects, this stage includes assessment of the likely effectiveness of any mitigation applied. A key outcome of the Appropriate Assessment is to identify whether the integrity of the Designated Site(s) is likely to be adversely affected by the plan/project.
Assessment of Alternative Solutions (Stage Three)	If the mitigation measures applied and assessed during Appropriate Assessment cannot avoid adverse effects on the integrity of a Designated Site, this stage examines alternative ways of achieving the objectives of the project or plan that avoid adverse effects on the integrity of the Designated Site.
Assessment where no alternative solutions exist and where adverse effects remain (Stage Four)	If no suitable alternative solutions are available, Stage Four requires an assessment of compensatory measures where, in the light of an assessment of Imperative Reasons of Overriding Public Interest ("IROPI"), it is considered that the project or plan should proceed. In making this assessment, it is important to recognise that it would be appropriate to the likely scale, importance and impact of the proposed project. If it is impossible to avoid or mitigate the adverse impact, it must be demonstrated that there is IROPI.

Source: Mott MacDonald, 2022

This assessment has been undertaken in an iterative and objective manner following the above stages, with reference to good practice guidance and relevant case law, notably that provided by the Waddenzee case (ECJ 2002) and Sweetman (ECJ 2011) to inform the interpretation and therefore correct application of the terms 'likelihood, 'significance' and 'in combination'.

Mott MacDonald Ltd undertook this HRA following the methodology in the *Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans (21/WR/02/15)*[5].

[5] UKWIR (2021). Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans (21/WR/02/15), 287p.

2.2 Screening assessment methodology

The initial list of sites for the HRA screening was derived by adopting a distance-based threshold of 10km, whilst including more distant sites subject to longer pathways; this included those sites which were hydrologically connected via surface- or groundwater catchments. This is based on the premise that most significant effects on qualifying features of Designated Sites would occur within a maximum of a 10km radius[6]. This distance of 10km is defined as the Zone of Influence (ZoI) of the FR scheme, which has been extended where appropriate to capture all potential effects on Designated Sites. This distance of 10km is defined as the Zone of Influence (ZoI) of the FR scheme, which has been extended where appropriate to capture all potential effects on Designated Sites.

In undertaking this HRA, a number of steps were undertaken to identify the relevant information to inform the assessment. Information gathered to inform the screening included the identification of:

- Any SPA/SAC/pSPA/cSAC/Ramsar Sites, including any marine or marine elements of these sites within the potential ZoI, and any known areas of land outside the site boundary itself, which plays an important role in supporting the site and its features of interest (functionally linked land), or in hydrological connection with the site;
- Potential effects resulting from the plan or project;
- The ZoI of these effects, noting this may extend some distance from the site and are not confined to activities on or adjacent to the site;
- Any viable pathways for the project (or plan) to the receptor (Designated Sites themselves or functionally linked land);
- The features of interest of the Designated Site(s) in question; and
- The conservation objectives of the Designated Site, including any site sensitivities given within any supplementary advice, site improvement plan, or equivalent document published by the relevant SNCB.

The above information was reviewed in respect of each feature of interest and potential development effect / impact pathway to inform an assessment of any Likely Significant Effects LSE or adverse effects on integrity. Key aspects and terms used in this assessment are defined below:

- Likelihood**:** Where an effect was considered to be potentially significant, then the assessment of its of occurrence was based on the likelihood of it occurring and not certainty that it would occur. Effects are scoped in unless there was evidence to the contrary demonstrating that they would not occur, e.g., there being no valid pathway, or the absence of the species in that area, at that time.
- Significance: The significance of any effect is considered objectively, against the scale and nature of the impact in relation to those of that particular feature or condition and in relation to the extent of that feature or condition over the entire Designated Site. A significant effect within this assessment is one which, if it occurred, would lead to a decline in the quality or status of the habitats or distribution, abundance, etc. of feature(s) of interest.
- In-combination: The assessment of in-combination effects considers those projects or plans which:
  - Are currently in operation; and
  - and those which are actually proposed – defined by being a valid live planning application, or any referenced with a local plan where there is a strong likelihood of them being undertaken within a reasonable time period, specified within that plan.

In line with relevant case law, this assessment is undertaken in the absence of mitigation (including measures embedded into the SRO where these are intended for the avoidance of effects).

Where likely significant effects were identified the assessment has taken these effects through to Stage 2 AA.

2.3 Appropriate Assessment approach and methodology

2.3.1 Approach

Where a plan or project is likely to, or has the potential to, give rise to LSE upon a Designated Site, an assessment must be made of the implications on the integrity of that site in view of that site's structure, function and conservation objectives and taking into account any site-specific supplementary advice or site improvement plan.

Where mitigation measures are to be applied to eliminate or reduce any effects identified in screening, these may be considered within the AA.

Potential effects may be direct or indirect and are dependent on the relationship between the source (proposed scheme actions) and the receptor (the qualifying features of the Designated Site(s)). The significance of an impact is relative to the sensitivity, existing condition and conservation status of the qualifying features of the site and the scale of the impact in space and time.

Potential effects on the qualifying features of the Designated Site(s) are evaluated with respect to the scale, extent and nature of the impact, for example the area of habitat affected, changes in hydrodynamics, potential changes in species distribution, and the duration of the impact. Given the high-level nature of the assessment at this plan stage it is not always possible to determine the exact scale and extent of the impact, when this is the case, a precautionary approach is taken when evaluating the significance of the impact.

This HRA Stage 2 AA has been formulated using the following approach:

- Review the sites identified at Stage 1 and confirm any additions or exclusions;
- Assessment of the construction and operation effects of the SRO;
- Assessment of the Designated Sites' characteristics and identification of their conservation objectives[6]; and
- Identification of the aspects of the proposed scheme that would significantly impact the conservation objectives of the Designated Site(s)[7].

This assessment has been undertaken in accordance with the following guidance:

- GOV.UK (2019) Appropriate Assessment - Guidance on the use of Habitats Regulations Assessment. Published 22 July 2019[8]
- UK Water Industry Research (UKWIR, 2021)[9]

[6] Habitats Sites descriptions, qualifying features and conservation objectives are given in Appendix A.

[7] This is the Appropriate Assessment given and tabulated in Sections 4, 5 and 7.

[8] UK Government (2019). Guidance on the use of Habitats Regulations Assessment [online] available at: Appropriate assessment - GOV.UK (www.gov.uk) (last accessed April 2022).

[9] UKWIR (2021). Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans (21/WR/02/15), 287p

- European Commission (EU, 2018) Managing Natura 2000 sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC[10]

2.3.2 Potential effects considered as part of the HRA

Following UKWIR (2021) guidance and given the nature of the selected scheme, the potential effects considered in this assessment are summarised in Table 2.2. Proposed distances are also provided following the same guidance to ascertain if, where a pathway has been identified, the impact is likely to affect the habitats or species for which the Designated Site(s) are designated.

Table 2.2: Potential effects and proposed Zone of Influence

Broad categories of potential effects on Designated Sites	Examples of activities resulting in effects and proposed ZoI
Physical loss Destruction (including offsite effects) e.g. foraging habitat, smothering	Development of built infrastructure associated with the schemes, e.g., reservoir embankments and access routes[11]. Physical loss is only likely to be significant where the boundary of the Scheme extends within the boundary of the Designated Site, or within an offsite area of known foraging, roosting, breeding habitat (that supports species for which a Designated Site is designated or where natural processes link the Scheme to the site, such as through hydrological connectivity downstream, or the scheme effects the linking habitat).
Physical damage Habitat degradation Erosion Trampling Fragmentation Severance/barrier effects Edge effects	Development of built infrastructure associated with the schemes, e.g., reservoir embankments and access routes. Physical loss is only likely to be significant where the boundary of the Scheme extends within the boundary of the Designated Site, or within an offsite area of known foraging, roosting, breeding habitat (that supports species for which a Designated Site is designated or where natural processes link the Scheme to the site, such as through hydrological connectivity downstream, or the scheme effects the linking habitat).
Non-physical disturbance Noise Visual presence Light pollution	**Noise from construction activities.** Taking into consideration the noise level generated from general building activity (c. 122dB(A)) and considering the lowest noise level identified in guidance as likely to cause disturbance to waterbird species (although this guidance is designed primarily for estuarine birds it was considered appropriate to use for this plan), it is concluded that noise effects could be significant up to **1km** from the boundary of the Designated Site. **Noise from vehicular traffic during construction of the scheme** Noise from construction traffic is only likely to be significant where the transport route to and from the scheme is within **500m** of the boundary of the Designated Site(s). **Plant and personnel involved in operation of the Scheme** These effects (noise, visual/human presence) are only likely to be significant where the boundary of the scheme extends within or is adjacent to an offsite area of known foraging, roosting, breeding habitat that support species for which a Designated Site is designated. **Scheme that might include artificial lighting,** e.g., for security around a temporary pumping station. Effects from light pollution are more likely to be significant where the boundary of the scheme is within **500m** of the boundary of the Designated Site
Water table/ availability Drying	Change to water levels and flows due to water abstraction, storage and drainage interception associated with inland Scheme.

[10] European Commission (2018). Managing Natura 2000 Sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/CEE [online] available at: EN_art_6_guide_jun_2019.pdf (europa.eu) (last accessed April 2022).

[11] It is acknowledged that infrastructure associated with the construction of the reservoirs may have an impact on Habitats Sites. However, for the purposes of this informal HRA, only the construction footprint of the reservoir itself has been used to determine the potential for significant effects.

Broad categories of potential effects on Designated Sites	Examples of activities resulting in effects and proposed ZoI
Flooding/storm water Changes to surface water levels and flows Changes to groundwater level and flows	These effects are only likely to be significant where the boundary of the scheme extends within the same ground or surface water catchment as the Designated Site. However, these effects are dependent on hydrological continuity between the scheme and the Designated Site and whether the scheme is up or downstream from the Designated Site.
Toxic contamination Water pollution Soil contamination Air pollution	**Reduced dilution in downstream or receiving waterbodies due to changes in abstraction or reduced compensation flow releases to river systems.** These effects are only likely to be significant where the boundary of the scheme extends within the same ground or surface water catchment as the Designated Site. However, these effects are dependent on hydrological continuity between the scheme and the Designated Site, and sometimes whether the scheme is up or downstream from that site. Air emissions associated with plant and vehicular traffic during construction and operation of the scheme. The effect of dust is only likely to be significant where site is within or in close proximity to the boundary of a Designated Site. Without mitigation, dust and onto the public road network and then deposited/spread by vehicles on roads up to **500m from large sites**, **200m from medium sites**, and **50m from small sites** as measured from the site exit. Effects of road traffic emissions from the transport route to be taken by the scheme traffic are only likely to be significant where the Designated Site falls within **200 metres** of the edge of a road affected.
Non-toxic contamination Nutrient enrichment (e.g., of soils and water) Algal blooms Changes in turbidity Changes in sedimentation/silting Air pollution (dust)	**Changes to water salinity, nutrient levels, turbidity, thermal regime due to increased water abstraction, discharges, storage, or reduced compensation flow releases to river systems.** These effects are only likely to be significant where the boundary of the scheme extends within the same ground or surface water catchment as the Designated Site. However, these effects are dependent on hydrological continuity between the scheme and the Designated Site, and sometimes whether the scheme is up or downstream from that site. Emissions of dust during the earthworks, construction of plant and tunnel/pipeline construction associated with scheme.
Biological Disturbances Direct mortality Changes to habitat availability Changes in species abundance or distribution Out-competition by non-native species Introduction of disease Introduction of invasive species	**Killing or injury due to construction activity.** Likely to be a risk where the boundary of the scheme extends within or is directly adjacent to the boundary of the Designated Site, or within/adjacent to an offsite area of known foraging, roosting, breeding habitat (that supports species for which a Designated Site is designated). **Changes in habitat availability, such as reductions in wetted width of rivers from abstraction or reduced compensation flow.** These effects are only likely to be significant where the boundary of the scheme extends within the same ground or surface water catchment as the Designated Site. However, these effects are dependent on hydrological continuity between the scheme and the Designated Site, and sometimes whether the scheme is up or downstream from that site. **Creation of new pathway for spread of non-native invasive species.** This effect is only likely to be significant where the scheme is situated within the Designated Site or an upstream tributary of the Designated Site, but also for inter-catchment water transfers.

Source: Adapted from: UK Water Industry Research (2021)[12].

[12] UK Water Industry Research (UKWIR, 2021). *Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans (21/WR/02/15).*

2.3.3 Assumptions and standard best-practice mitigation measures

2.3.3.1 Overview

The following standard good practice mitigation measures have been considered at the Appropriate Assessment stage.

It is recommended that Anglian Water work closely with Natural England and the Designated Site owners/managers to discuss the specific mitigation measures to be included at the project stage HRA. The agreed mitigation measures would be expected to form part of planning conditions and/or conditions of relevant environmental permits, and their implementation managed through contractual obligations with supervision from an Environmental Clerk of Works.

2.3.3.2 Assumptions during construction

The following assumptions constitute good practice for the FR scheme and are control measures which are essential features of the project and should be integrated into the construction phase. These are good practice measures recommended and are not considered to be targeted mitigation to avoid or reduce significant effects or adverse effects on Designated Sites but can mitigate for some of the scheme effects and therefore only mentioned at the AA stage. Any further mitigation would be detailed in the subsequent sections for the scheme. Best practice for the scheme design, pollution control, biosecurity, disturbance, (normally listed within a Construction and Environmental Management Plan (CEMP)) may include:

- During the development of the design every opportunity for avoiding potential effects on Designated Sites (e.g., through alternative transfer routes, micro siting, etc.) should be taken.
- Construction of new pipeline at watercourse crossings should be designed to avoid direct impacts on riverbed and permanent habitat loss. If project-level hydrological investigations imply that there would be disruption to the water table, it would be recommended that a directional drilling method is employed to ensure that no direct impact on the water course or adjoining Designated Site(s) occurs. Directional drilling should be used at all watercourses >3m wide.
- For water courses <3m wide pollution control good practices should be applied to all water course crossings at all times. The potential for increased flood risk and groundwater impacts would be confirmed in the hydrological investigations which would inform the HRA at this stage.

Pollution control

- Indirect construction-related pollution is identified as one key pathway through which Designated Sites may be affected. There is numerous guidance on environmental good practice measures during construction which can be relied on (at this level) to prevent significant adverse effects on a Designated Site occurring. The best-practice procedures detailed in the following documents should be followed for all construction works derived from scheme, as a minimum standard:
  - CIRIA C741 Environmental good practice on site guide (Charles and Edwards, 2015)[13]
  - CIRIA C532 Control of water pollution from construction sites (Masters-Williams et al. 2001)[14]

[13] Charles P. and Edwards P (2015) *Environmental good practice on site guide.* CIRIA C741, 260p.

[14] Masters-Williams H., Heap A., Kitts H. *et al.* (2001) *Control of water pollution from construction sites*. CIRIA C532, 27p.

  - Environment Agency's Pollution Prevention Guidance Notes[15] including PPG1: General Guide to Prevention of Pollution (July 2013); PPG5: Works and maintenance in or near water (October 2007), PPG6: Pollution prevention guidance for working at construction and demolition sites (April 2010); PPG21: Pollution incident response planning (March 2009); PPG22: Dealing with spills (April 2011).
- The installation of sediment traps near or in watercourses or the use of cofferdams should be specified at the project stage.
- Compliance with the provisions of the *Health and Safety at Work Act 1974, the Environmental Protection Act 1990, the Environment Act 1995, the Clean Air Act 1993 and the regulations made thereunder, including the Control of Substances Hazardous to Health Regulations (SI 2002/2677)* with regard to air quality management.
- Mitigation plans to help mitigate air quality impacts to support this should include an Air Quality/Dust Management Plan and a Construction Traffic Management Plan (CTMP).

Biosecurity

- Biosecurity measures should be in place to ensure the management of invasive non-native species on construction sites and during controlled activities. The following considerations should be given pre-construction:
  - Invasive non-native species (INNS) risk assessment to be undertaken at site feasibility stage.
  - Where INNS are identified, legal requirements and mitigation plan developed at early planning stage.
  - INNS to be included on all site method statements including CEMP and any Ecological Protection Plans. INNS risk to be managed by Clerk of Works and INNS brief given to all site contractors.
- Where a species requires long-term management (such as Japanese knotweed *Fallopia japonica*), a specific INNS management plan should be developed.
- The best-practice procedures detailed in the following documents should be followed to reduce the spread of INNS for all construction works derived from the scheme, as a minimum standard:
  - CIRIA Manual C679 'Invasive species management for infrastructure managers and the construction industry'; The Knotweed Code of Practice – managing Japanese Knotweed on development sites'.

Disturbance - noise

- Construction activities should be conducted in accordance with noise limits to avoid disturbance.
- Construction related noise disturbance should be minimised by implementing good practice such as BS 5228-1:2009+A1:2014 (The British Standards Institute, 2008)[16].

Disturbance - light

- Lighting should be kept to a minimum to reduce disturbance. Should the works be undertaken at night and flood lighting required, lighting should be kept to a minimum, and

[15] Note, the Environment Agency Pollution Prevention Guidance Notes have been withdrawn by the Government, although the principles within them are robust and still form a reasonable basis for pollution prevention measures. Documents are still available online at: [ARCHIVED CONTENT] Environment Agency - Pollution prevention advice and guidance (PPG) (nationalarchives.gov.uk) (last accessed April 2022).

[16] The British Standards Institute, 2008. BS 5228-1:2009+A1:2014. *Code of practice for noise and vibration control on construction and open sites. Noise*. BSI Standards Limited, London.

hooded spotlights directed away from potentially suitable habitat for qualifying species of Designated Sites, to reduce disturbance while ensuring standards for health and safety.

- The potential impact of artificial light may be minimised through the implementation of good practice such as '*Guidance Notes for the Reduction of Obtrusive Light*' (Institute of Lighting Professionals, 2011)[17].

Construction Environmental Management Plan

A CEMP should be developed prior to construction, including measures to ensure that the risk of uncontrolled discharges from construction is reduced (including sediment management) and detailing an Emergency Response Plan in the event of a pollution incident. This plan must be prepared for all works and include the industry good practice measures listed above and any targeted mitigation measures identified during the formal HRA.

2.3.3.3 Assumptions during operation

No general assumptions are made for the operation phase at this stage of the design development.

[17] Institution of Lighting Professionals (2020) Guidance note for the reduction of obtrusive light. Guidance Note1/20.

3 Habitats Regulations Assessment

3.1 Scheme overview

The FR scheme includes the development of a new embanked raw water reservoir for water storage for public water supply. It also comprises abstractions from the River Great Ouse and River Delph, raw water transfers, treatment works, and distribution into supply.

Key scheme parameters include:

- River Great Ouse maximum abstraction and transfer flow to reservoir: 300Ml/d
- River Delph maximum abstraction and transfer flow to reservoir: 400Ml/d
- Reservoir total capacity: 55Mm^3
- Reservoir usable volume: 50Mm^3
- Treatment distribution flow [18]: 150Ml/d
  - Fens Reservoir to Anglian Water
  - Fens Reservoir to Cambridge Water (North)
  - Fens Reservoir to Cambridge Water (South)

3.1.1 Reservoir overview

The proposed reservoir site is shown in Figure 3.1, located within the Fenland district of Cambridgeshire. The proposed site is between Chatteris and March, near to Doddington, Wimblington and Manea. The Forty Foot Drain, the Sixteen Foot Drain and the A141 surround the site on three sides.

An indicative concept plan has been developed for the scheme. This indicative concept has been established to provide reference for cost and carbon estimation in gate two. The summary provisional details are provided below, but much work is still required to develop the scheme and the final details would develop accordingly.

The provisional reservoir parameters are:

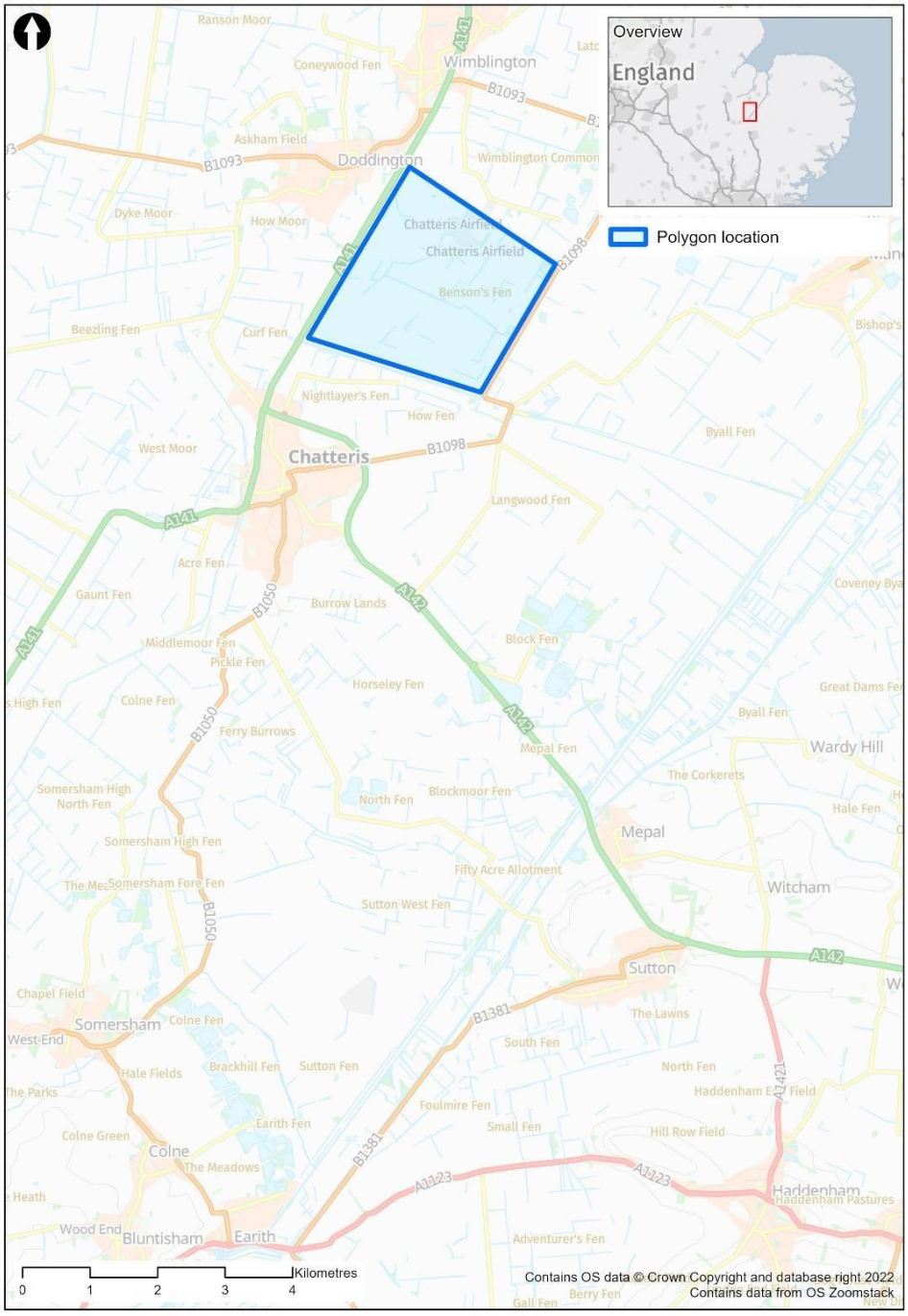
- At its greatest dimensions the reservoir is about 2.6km wide and 2.4km long to the embankment toe.
- The embankment crest is estimated at 12.5mAOD (above ordnance datum) making the embankment an average of 12m above the typical existing ground level at the toe. This is with approximate relative embankment elevations of maximum 15m and a minimum of 4m above existing ground levels.
- The total perimeter length of the crest is about 8.5km and the estimated reservoir surface area is about 4.4km^2.

The reservoir would include key infrastructure necessary for its safe operation, including intake and outtake structures; drawdown facilities; a spillway and water sampling facilities. The reservoir would also be expected to provide benefits beyond public water supply. Opportunities to incorporate facilities to enable recreation (such as a visitor centre and parking), infrastructure

[18] The proposed capacity of the water treatment works and transfer pipelines has been updated since this assessment was completed. The figures quoted in the gate two report include a scheme deployable output of 87Ml/d and works capacity up to 100Ml/d. These changes are not anticipated to have any material impact on the completed assessments.

to improve health and wellbeing (such as multi-use footpaths, quiet areas and leisure opportunities) and careful design to enhance and encourage biodiversity are planned and would be developed further, with the features that would deliver these wider benefits being subject to further assessment and consultation. Landscaping would be carefully designed surrounding the reservoir to minimise the visual impact of the reservoir whilst ensuring it sits within the existing landscape and delivers wider recreational and biodiversity benefits.

Figure 3.1: Site context map



3.1.2 Raw water, transfer and treatment

It is proposed that water is abstracted from the River Great Ouse at an intake located south of Earith and transferred to the reservoir via approximately 18km of 1500mm diameter steel pipeline. An additional abstraction point is also proposed from the River Delph, with water transferred to the reservoir by about 6km of 1600mm diameter steel pipeline. The precise abstraction location would be identified following further detailed work (including stakeholder engagement) for gate three.

The proposed abstraction rate from the River Great Ouse is up to 300Ml/d and from the River Delph up to 400Ml/d when flows allow. This is subject to further assessment to be undertaken in collaboration with the Environment Agency (EA) to develop an abstraction rate which is licensable. The associated abstraction licences are expected to stipulate a minimum flow and water level requirement at the point of abstraction below which it would not be possible to abstract. Abstraction to fill the reservoir would only be possible during high flow periods.

Further work is planned for the next stage to confirm locations for the abstraction points and routes for the transfers involving landowner engagement, environmental surveys, and preliminary ground investigations. The opportunity for the transfer conveyance to be open channel is still being investigated and would be confirmed during the next stage of project development. The information provided in this report and accompanying appendices are assumptions based on indicative locations only at this stage. The indicative transfer routes for are shown in Figure 3.2.

The abstraction facilities are expected to comprise an intake structure, a transfer pumping station (TPS) and pipeline.

3.1.3 Water treatment and potable transfers

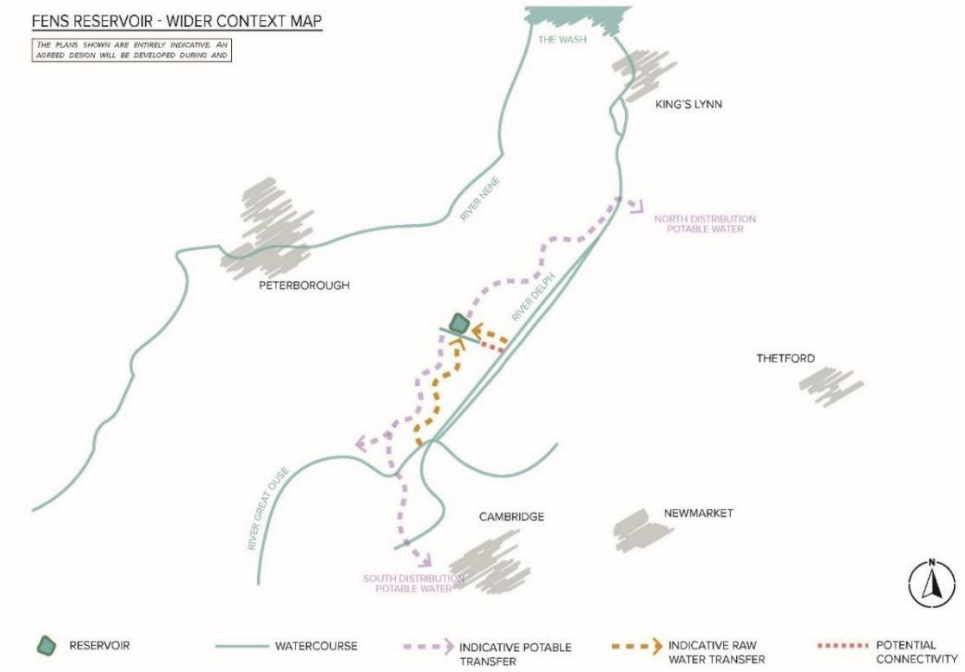
Stored water would subsequently be abstracted from the reservoir and treated to a potable quality. It is proposed that a WTW is located on land adjacent to the reservoir with a peak throughput capacity of 100Ml/d.

It is proposed that the treated water would be transferred by an approximate 32km 900mm diameter steel pipeline to an existing Anglian Water Service Reservoir (SR). The Cambridge Water connection would include about 12km 900mm steel pipeline to one take-off point, and approximately 22km 700mm steel pipeline spur to a second take-off point. The reservoir is to supply over 250,000 homes in Cambridgeshire.

Further work is planned for the next stage to confirm the routes for the transfers involving landowner engagement, environmental surveys, and preliminary ground investigations. The information provided in this report and accompanying appendices are assumptions based on indicative locations only at this stage.

See Figure 3.2 for an illustration of indicative proposed transfer corridor locations.

Figure 3.2: Indicative transfer corridors



3.1.4 Summary of operation and use

Development and operation of the reservoir would be subject to the Reservoirs Act 1975 (as amended by the Floods and Water Management Act 2010). The embankments and associated water retaining elements of the reservoir would need to be maintained and supervised in accordance with the Act to maintain public safety.

Provision of EDD must be designed in accordance with the Reservoirs Act. The proposed solution at this stage is to discharge to the Forty Foot Drain, but this is to be further modelled and confirmed as part of the next stage of development. Although the risk of needing to fully drawdown the reservoir is very low, there is a need for regular testing and maintenance to confirm functionality. This would involve the opening and testing of relevant valves and gates. Test flows are envisaged to be held in a pond to avoid disruption and to enable water to be returned back to the reservoir.

The operation and maintenance of the water treatment works and the distribution water supply system inclusive of distribution pump stations are expected to be in constant regular use according to water supply demand. The water supply components would need regular inspections and maintenance activities in accordance with the requirements of the respectively installed equipment.

3.1.5 Associated infrastructure and features

It is proposed that there would be a need for associated infrastructure and other features such as environmental mitigation to minimise the impacts of the reservoir, as well as enhancement opportunities. The location and design of the additional infrastructure has not been established and would therefore need to be confirmed at the next phase of scheme development.

3.2 Stage 1 Screening Review

The Stage 1 Screening identified six Designated Sites within the ZoI of the proposed reservoir site. These are:

- Ouse Washes SAC (UK0013011)
- Ouse Washes Ramsar Site (UK11051)
- Ouse Washes SPA (UK9008041)
- The Wash SPA (UK9008021)
- The Wash Ramsar Site (UK11072)
- The Wash and North Norfolk Coast SAC (UK0017075)

LSE could not be ruled out for the any of these sites during construction and operation and, therefore, this scheme has progressed to the next HRA stage – Appropriate Assessment. A map with the scheme location in relation to the designated sites and buffer considered is provided in Appendix A. Full HRA screening review is presented in Appendix B. Information on the Designated Sites is provided in Appendix C, including qualifying features, conservation objectives, and threats and pressures to site integrity.

3.3 Stage 2 Appropriate Assessment

3.3.1 Scope

Six sites are assessed in the Stage 2 Appropriate Assessment of this report:

- Ouse Washes SPA (UK9008041)
- Ouse Washes Ramsar Site (UK11051)
- Ouse Washes SAC (UK0013011)
- The Wash SPA (UK9008021)
- The Wash Ramsar Site (UK11072)
- The Wash and North Norfolk Coast SAC (UK0017075)

3.4 Potential effects on Designated Sites

The potential effects of the construction and operation phases for the scheme are described below, considering the type, size, and scale of the scheme.

An assessment of each potential effect on the integrity of the designated sites is made, in view of the sites' structure, function and conservation objectives. Where adverse effects are deemed significant, mitigation measures are also proposed in the following section.

At this stage, a worst-case scenario is assumed, with effects and required mitigation measures outlined in Table 3.4.

3.4.1 Ouse Washes SPA (UK9008041)

Information on this Designated Site is provided in Appendix C**,** including qualifying features, conservation objectives, and threats and pressures to site integrity.

3.4.1.1 Construction effects

Construction of the reservoir

The proposed reservoir lies approximately 200m outside of Natural England's *Goose and Swan Functional Land Impact Risk Zone (IRZ)* for Ouse Washes SPA. This represents land beyond the Designated Site's boundary which may also provide important functional habitat for

qualifying bird species, specifically geese and swans. This land has been identified through a British Trust of Ornithology (BTO) research project and has the potential to be used by qualifying species for foraging and roosting. Bewick's swan (*Cygnus columbianus bewickii*), whooper swan (*Cygnus cygnus*) and mute swan (*Cygnus olor*), among other wildfowl and waders, are all qualifying species of the Ouse Washes SPA. Due to the distance of the proposed reservoir to the boundary of the IRZ, potential adverse effects on these qualifying bird species can be expected as a result of biological disturbances during the construction phase.

The Ouse Washes SPA is designated for its high ornithological importance for wintering waterfowl, providing good quality feeding areas for an excellent diversity of waterfowl species. Over winter, the site regularly supports a population of hen harrier (*Circus cyaneus*). This species is strongly associated with wetland areas, especially those rich in common reed (*Phragmites australis*) and occupies large ranges. Habitats close to the proposed reservoir may be functionally linked with this designated site when supporting highly mobile species like the hen harrier. As a bird of open country, biological disturbance should be considered up to 5km from the scheme. Therefore, activities during construction could result in permanent and temporary loss of functional linked land used by this qualifying species.

Physical loss and damage, including fragmentation and degradation of functional linked land used by qualifying bird species are expected as a result of land clearance during construction. Birds are likely to avoid areas of qualifying habitat within the vicinity of the works. The use of vehicles, machinery and movement of personnel within this Designated Site may result in adverse effects due to noise and light pollution potentially affecting sensitive bird species. Traffic activity during construction may also exceed critical loads of emissions (such as NOx, SOx and particulates) that can lead to nutrient enrichment and eutrophication having adverse effects on this Designated Site and its protected bird species. Disturbance to qualifying species when foraging may jeopardise adult fitness, survival, and breeding success by displacing birds from preferred feeding and/or roosting areas.

Effects of displacement, including displacement from the reservoir construction embankments, may be temporary or long-lasting and may result in redistribution within or from a site, increased energy expenditure due to more frequent flights, disrupted incubation of eggs and abandonment of nests. The identified effects may also have the potential to reduce the extent and distribution of functional linked habitat used by qualifying species' populations outside the designated site.

The reservoir site is hydrologically connected to the Ouse Washes Designated Sites via the River Great Ouse, constituting a potential pathway for effects during construction, including pollution events. Changes in water quality due to pollution events including toxic and non-toxic contamination during construction may also lead to changes in turbidity and increased sedimentation which can also have negative effects on the life cycle of the qualifying species. The effects of non-toxic contamination are considered to be temporary and localised, assuming that directional drilling is employed at main river crossings and small tributaries.

Construction of the indicative transfers and associated infrastructure

Overall, the Stage 2 AA concluded that adverse effects on the Ouse Washes SPA could not be ruled out, even when considering mitigation measures, for the following transfer option:

- River Delph to FR.

Therefore, as this route is only indicative, the final corridor would be chosen to avoid or minimise these effects.

The Stage 2 AA also concluded that the proposed scheme would involve permanent land take from the Designated Sites in order to accommodate an intake and intake/transfer pumping station compounds. As such, alternative options should be explored that do not require land take from the Designated Sites' boundary, for example by using existing infrastructure or seeking alternative locations outside of the SPA boundary.

The following effects from the construction of the transfer and associated infrastructure include:

- Construction of the intake within the River Delph would result in the permanent loss of up to 70m of modified riparian bankside habitat within the SAC, SPA and Ramsar site. This habitat is potentially suitable for qualifying SPA/Ramsar bird species such as breeding mute swan and mallard, though is considered to be of lesser importance to the qualifying feature of the SAC; spined loach, which are generally found close to the bottom of rivers/drains where they utilise submerged macrophytes and sandy/silty substrate for spawning and refuge.
- Construction of the river intake and transfer pumping station compounds meanwhile would result in the permanent loss of approximately 10,800m^2 of lowland grassland habitat within the SPA/Ramsar site boundary which supports breeding, foraging and roosting waterbirds. This loss represents approximately 0.05% of the overall lowland grassland habitat within the SPA/Ramsar site.
- Loss of habitats to accommodate both the intake and intake/transfer pumping station compounds, albeit small scale, would reduce the availability of habitats supporting the qualifying bird species, potentially resulting in SPA/Ramsar populations being displaced from current foraging, breeding and roosting sites. This may affect adult fitness, survival and breeding success by displacing birds from preferred breeding and foraging grounds.
- There is also the potential for indirect effects on the qualifying species of the SAC, SPA and Ramsar through noise, visual and artificial lighting disturbances generated as a result of construction activities (including directional drilling), increasing vehicular movement and personnel. Disturbance effects can result for example in changes to the feeding or roosting behaviours of birds, increased energy expenditure due to more frequent flights, abandonment of nests, disrupted incubation of eggs and desertion of supporting habitat. Disturbance to qualifying species when foraging may affect adult fitness, survival and breeding success by displacing them from preferred foraging and breeding/spawning grounds. Effects of displacement may be temporary or long-lasting and may result in redistribution within or away from a site.
- This option also partly intersects land beyond the SPA and Ramsar boundary that falls within Natural England's Goose and Swan Functional Land IRZ
- Temporary loss of this habitat therefore has the potential impact the ability of the surrounding functional land to support the SPA and Ramsar populations. The ability of these qualifying species to move safely and successfully to and from nesting, feeding and roosting areas is critical to adult fitness and survival, and breeding success.
- There is also the potential for non-physical disturbance to the qualifying swan species utilising the surrounding functional land through noise, visual and artificial lighting disturbances generated from construction activities which could affect adult fitness, survival and breeding success.

However, the Stage 2 AA concluded that when applying mitigation measures, adverse effects on the integrity of the Ouse Washes Designated Sites could be avoided for the following transfer options:

- River Great Ouse to FR
- FR to Cambridge Water (South)
- FR to Cambridge Water (North)
- FR to Anglian Water

The mitigation measures proposed to avoid or reduce adverse effects include reducing the working transfer width in order to minimise the temporary loss of functional land, as well as sensitive timings of construction and operation works to avoid the spawning season for spined loach and key periods for overwintering and breeding bird populations. It is also recommended that a Construction Environmental Management Plan (CEMP) be in place that would include the proposed mitigation measures in this AA as well as any other specific measures identified following an HRA undertaken at project level.

Further design iterations would require revisions to this document and may result in changes to the current conclusion.

3.4.1.2 Operation effects

Emergency drawdown effects

There would be requirement for an assessment of the effects of options for emergency drawdown from the reservoir. However, this is currently subject to investigation and consultation and would be finalised for gate three.

The new reservoir would be lined with clay and therefore not hydrologically connected to any Designated Sites during operation, apart from situations where a drawdown would be required.

There is a residual risk of flooding if the proposed reservoir embankments were to fail in an uncontrolled manner. The probability of such a failure is very low in a non-impounding reservoir because the risk from a dam breach is managed by the design, maintenance, and emergency plan under the Reservoir Safety Act 1975, including an emergency drawdown.

A potential option for managing drawdown in an emergency situation would be to discharge to the Forty Foot Drain. Hydraulic modelling indicates that the River Delph have the capacity to convey the 1 in 2-year flood event along with the emergency drawdown flows without causing an increase in flood risk downstream.

The Forty Foot Drain can be used to transfer flows from the reservoir to then discharge to land both north and south of the drain.

Notified interests (including breeding birds, overwintering birds and supporting grassland communities) are being adversely affected by increased flooding on the River Delph. Flooding during spring / early summer severely damages the breeding bird interest by flooding nests, drowning young and affecting habitat. Deep flooding during winter also impacts overwintering birds such as wigeon and impacts on the wetland fauna, especially invertebrate populations. Prolonged summer flooding disrupts essential management of the washland, affecting the condition of the grassland for breeding birds in subsequent spring/summer season(s)[19]. Consequently, a high flood discharge could result in adverse effects to the site integrity.

[19] Natural England. 2014. Site Improvement Plan: Ouse Washes (SIP160). Available at: http://publications.naturalengland.org.uk/publication/5354106084392960

At this stage, adverse effects cannot be ruled out as a result of changes in water levels and flows. Emergency drawdowns into the Forty Foot Drain could lead to permanent and/or temporary habitat loss and degradation of the Designated Site itself and/or functional linked land used by the qualifying species. Changes in turbidity and increased sedimentation may also have adverse effects on the life cycle of the qualifying species.

A high-level dam breach assessment has been carried out to understand the risk from flooding were the reservoir embankments to fail, looking at likely receptors and pathways for water following a breach at a non-impounding reservoir (raised banks, offline from a river) built on relatively flat ground. More detailed dam breach modelling would be undertaken at a later Gateway stage.

Operation of the transfers and associated infrastructure

It is acknowledged that the effects discussed above in relation to the construction phase may also occur during operation as a result of any necessary repair or maintenance activities.

It is not envisaged that there would be any additional permanent habitat loss within the Habitats Sites during the operational phase.

Abstraction effects

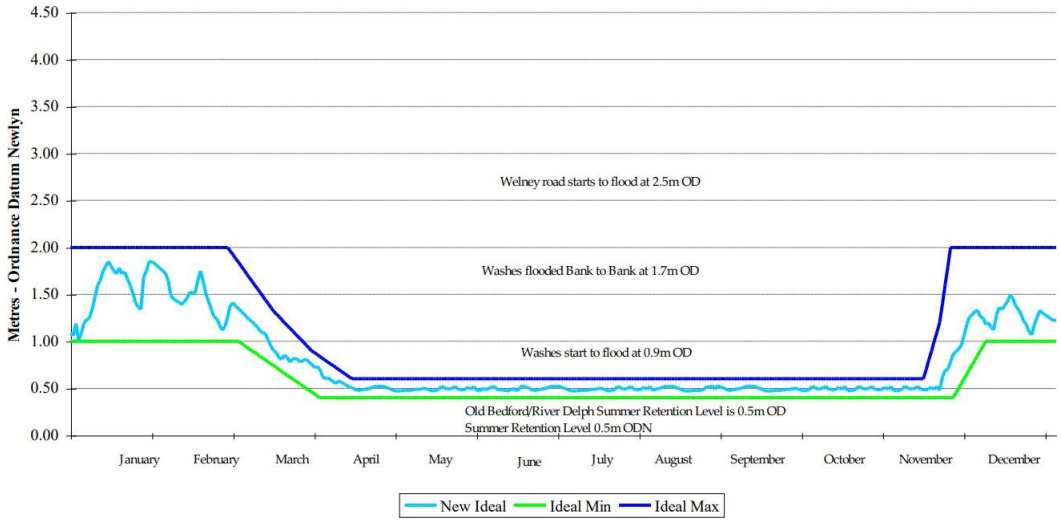
Changes in flows

The River Delph Hydro-ecological Prescriptions for Favourable Conditions[20] considered both the role of flooding and nutrient enrichment in driving ecological conditions in the River Delph. It set out a 'new ideal' physical water regime for the River Delph that would benefit designated bird features by securing the plant communities they rely upon for nesting, feeding and roosting. This 'new ideal' water regime is based on 30 years of bird recording by the Royal Society for the Protection of Birds (RSPB).

The 'new ideal' water regime is presented in Figure 3.3 (Graham, 2003) suggested that the water level in the River Delph should fluctuate widely between the ideal maximum and ideal minimum shown in the figure below to accommodate a wide range of bird species with differing water level requirements. Water levels should ideally abide by this regime for three in every four years[21].

[21] Graham, J., 2003. Hydro-ecological Prescriptions for Favourable Condition Ouse Washes Special Protection Area (SPA) and Candidate Special Area of Conservation (cSAC)

Figure 3.3: 'New ideal' water regime for the Old Bedford River / River Delph to benefit designated bird features



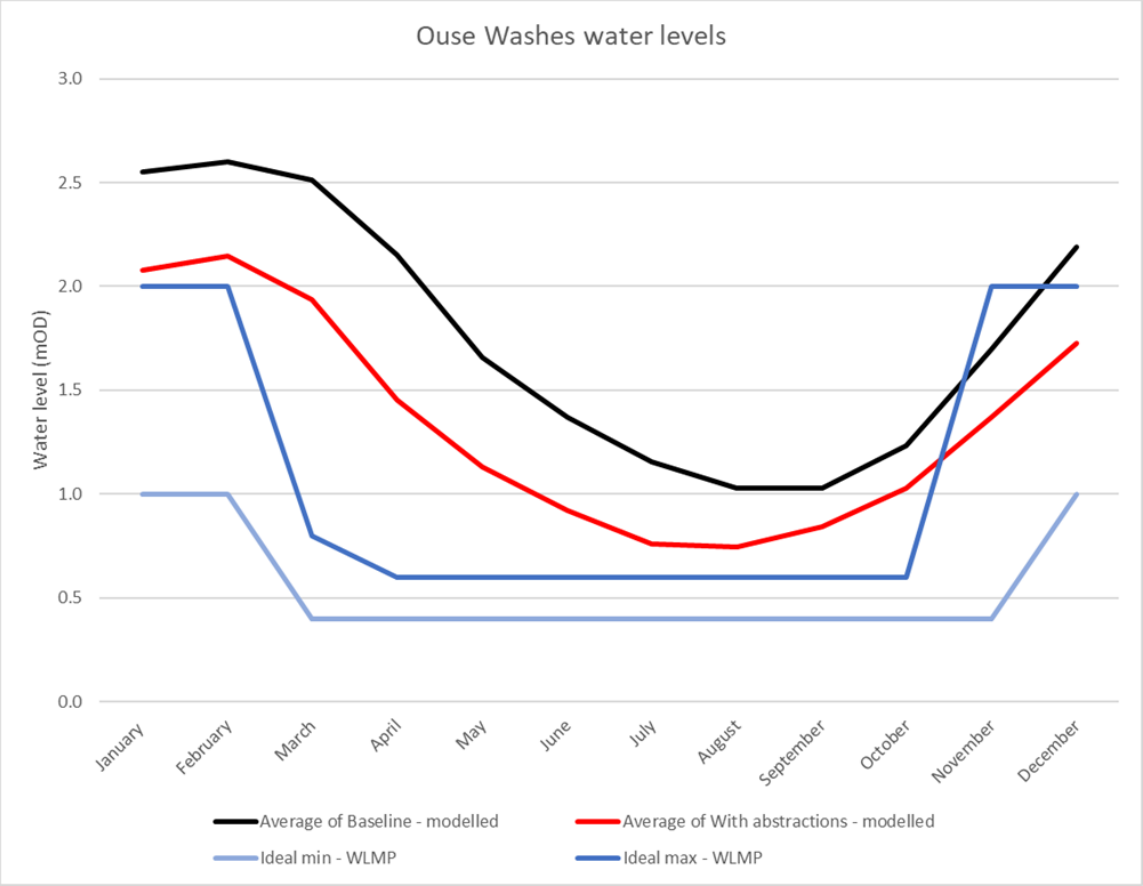
Source: Graham, 2003

The potential abstraction from the two surface water bodies proposed to supply the Fens Reservoir would result in decreases in flows under medium and high flow conditions along the system downstream of the proposed abstraction points. These reductions would primarily occur during the winter months between November and March. In consideration of the Hands Off Flow conditions, no abstraction is permitted below a certain threshold and as such, no reduction in flows is observed for lower flow conditions.

Modelling has been undertaken to investigate the potential hydrological changes associated with the FR scheme abstraction schemes (Mott MacDonald, 2022). Figure 3.4 shows the outcome of the modelling as average monthly water level in the River Delph against the average monthly levels of the baseline (current) regime and the ideal minimum and maximum water levels identified by Graham (2003).

As shown in Figure 3.4, the average water level between January and October for the abstraction scenario is closer to the levels proposed under the 'new ideal' water regime than current baseline conditions are. Although, water levels for the most part still exceed the recommended maximum.

Figure 3.4: River Delph modelled water levels shown against the 'new ideal' maximum and minimum levels



Source: Mott MacDonald, 2022.

The abstraction at Earith would impact the diversion and result in less frequent and lower flows entering the River Delph. In combination with the second abstraction occurring from the River Delph, this would drive lower water levels across the designated site/flood storage area, which would primarily occur in winter when sufficient flows are passing through the system that trigger both abstractions and the diversion. Overall, the abstractions would lead to lower flows along the tidal Great Ouse, further exacerbated by reductions in flows from the Middle Level, discharged into the River Great Ouse at St Germans.

Though water table/availability are important aspects of the designated features of the Ouse Washes SPA, the main listed management concern relates to negative effects of summer flooding identified as an issue within the site improvement plan for these sites[22]. Consequently, the abstraction has the potential to have a positive influence removing some water when flows are excessive. However, there is potential for increased siltation leading to water quality degradation further downstream, which has been linked to flooding of potentially important bird areas[23]. As such, there is potential that likely significant effects could occur if slowing of flows increases siltation and results in increased flooding rather than reducing excessive flows. Given that the degree of flow change is unclear, it has been determined as a precaution that a significant impact on the designated features of the Ouse Washes SPA could occur.

[22] Natural England, 2014. Site Improvement Plan: Ouse Washes. Available from http://publications.naturalengland.org.uk/file/6561880306876416. Accessed 29/07/2022

[23] WWT, 2021. Flooding on the Ouse Washes. Available from https://www.wwt.org.uk/news-and-stories/news/flooding-on-the-ouse-washes. Accessed 09/08/2022.

Further work would be undertaken at the next stages of the design process to investigate this further and determine the potential changes in sediment transport on the River Delph as a result of abstraction.

Changes in water quality

The plant species found within the washlands, ditch systems and grassland that support the SPA qualifying bird species are susceptible to water pollution and nutrient enrichment which is a factor in the decline of grasses in the Ouse Washes[24].

It is expected there would be little to no change to water quality concentration as any new abstraction would remove flow containing some of the load of pollutants from the river at the point of abstraction, however dilution opportunity may alter as other discharges and tributaries join the river system. SIMCAT and SAGIS models were used to estimate the potential change in water quality parameters of interest.

The proposed abstractions on the Bedford Ouse at Earith, are unlikely to have a significant long-term impact on water quality, as demonstrated by the SIMCAT modelling and flow concentration load calculations which both showed very small changes to the annual average concentrations with no impact on WFD status.

In SIMCAT modelling, all sites showed both minor increase and decrease in concentration of the modelled determinants along the length of the watercourse from abstraction points down to the Wash Estuary.

The study concluded that the greatest impact downstream due to a new abstraction at Earth would be on the Great Ouse downstream of the connection with Relief Channel. The water quality in the Great Ouse and Relief Channel are different to one another and this point of mixing was modelled to be at greater risk of changes to water quality, however this did suggest a decrease in parameter concentrations which should improve water quality, with the exception of dissolved oxygen.

Due to the control of flows for flood management using sluice gates, there is potential that the change in flows could impact water quality during events such as drought when there is less dilution in parts of the catchment where flows are limited such as on the River Delph and flood relief channel between Downham Market and Kings Lynn. This is to be mitigated against by abstractions being limited by flow in the river so a minimum flow remains which considers detailed hydrological modelling; therefore, this risk would not be realised.

The new abstractions are unlikely to impact water quality, however flow regimes downstream should be re-evaluated should a new abstraction be implemented.

3.4.2 Ouse Washes Ramsar Site (UK11051)

Information on this Designated Site is provided in Appendix C**,** including qualifying features, conservation objectives, and threats and pressures to site integrity.

3.4.2.1 Construction effects

Reservoir construction effects

The construction effects of the reservoir would be similar for the Ouse Washes Ramsar Site as the ones listed in the section above for the Ouse Washes SPA.

[24]Natural England, 2014. Site Improvement Plan: Ouse Washes. Available from http://publications.naturalengland.org.uk/file/6561880306876416. Accessed 29/07/2022

Indicative transfer construction effects

- River Delph to FR

The construction effects of the transfer would be similar for the qualifying bird species at the Ouse Washes Ramsar Site as the ones listed above for the Ouse Washes SPA.

Additionally, there is also the potential for adverse effects on the Ramsar qualifying vegetation and invertebrate species as an indirect result of physical habitat damage, habitat degradation and/ or fragmentation. These could be within the Designated Site itself and/or in adjacent areas functioning as supporting habitats. Changes in water quality due to pollution events as result of construction may lead to changes in turbidity and increased sedimentation can also have negative effects on the life cycle of these qualifying species.

3.4.2.2 Operation effects

Reservoir operation effects

The reservoir operation effects would be similar for the Ouse Washes Ramsar Site as the ones listed above for the Ouse Washes SAC and Ouse Washes SPA. However, there is potential for net gain in terms of eventually providing additional connected habitats for waders (planned floating islands to increase riparian habitat) associated with the Ouse Washes SPA/Ramsar Site.

Abstraction effects

The abstraction effects would be the similar for the Ouse Washes Ramsar Site qualifying bird species as the ones listed above for the Ouse Washes Ouse Washes SPA qualifying bird species.

Additionally, the altered flow effects on red-listed macroinvertebrate, particularly the rifle beetle (*Oulimnius major*), are currently unknown and the distribution of nationally scarce plant species sensitive to potential changes is also poorly understood. As such and as a precaution, likely significant effects must also be concluded upon the Ouse Washes Ramsar Site given the red-listed macroinvertebrate and nationally scarce plant assemblages are part of its qualifying features.

Habitats within Ouse Washes Sites including the MG11 and MG13 grassland communities are expected to benefit from the reduction in flows as the water levels after abstraction are more in line with the ‘new ideal’ set out in the Hydro-ecological Prescriptions Review (Graham, 2003). Likewise, a reduction in the amount of spring and summer flooding at the Ouse Washes may also benefit the designated bird species for which the site is designated. However, some uncertainty remains regarding the impact on some Nationally Scarce plant species. This is because the distribution of this species within the site is currently unknown. Furthermore, at this stage, there is insufficient knowledge on how the proposed water regime would affect the internal ditch system. Further assessment of the effects of the water intake in the Ouse Washes and the River Great Ouse are recommended.

Emergency drawdowns

Wetland flora can also be affected through submersion by emergency drawdowns, favouring swamp communities over the designated grassland species. Inappropriate levels of nutrients from diffuse pollution in combination with inappropriate water levels from flooding can adversely affect the extent/composition of vegetation communities on the washes. Resulting changes to the grassland mosaic has potential to affect the notified bird interests by destroying habitat suitable for many of the birds that visit or breed at the site.

3.4.3 Ouse Washes SAC (UK0013011)

Information on this Designated Site is provided in Appendix C**,** including qualifying features, conservation objectives, and threats and pressures to site integrity.

3.4.3.1 Construction effects

Reservoir construction effects

The scheme is potentially hydrologically connected to the Ouse Washes SAC. Small, likely slow-flowing ditches within the scheme's construction footprint are connected to the Sixteen Foot Drain which is linked hydrologically to the Ouse Washes via the Forty Foot, or Vermuyden's Drain approximately 5km to the east; this is a Water Framework Directive (WFD) waterbody (GB205033000050). The construction area itself is approximately 30m west of the Sixteen Foot Drain, and 80m north of the Forty Foot / Vermuyden's Drain. The Forty-foot Drain is connected to the Counter Drain which is particularly important for supporting a healthy population of spined loach.

The hydrological connectivity via the Forty Foot / Vermuyden's Drain, constitutes a pathway for potential adverse effects during construction, including habitat loss and/or degradation of functionally linked habitat used by spined loach populations as a result of water quality changes in case of pollution events.

The construction of water course crossings has the potential to impact downstream water quality, increase sedimentation and affect the hydrological regime, resulting in adverse effects on the qualifying species.

The spined loach is a small bottom-living fish that prefers clear oxygen-rich waters and has a restricted microhabitat associated with a specialised feeding mechanism. They use a complex branchial apparatus to filter-feed in fine but well-oxygenated sediments. Optimal habitat is patchy cover of submerged (and possibly emergent) macrophytes, which are important for spawning, and a sandy (also silty) substrate, into which juvenile fish tend to bury themselves. Construction activities may lead to changes in water turbidity and increased sedimentation that can have adverse effects on the life cycle of this qualifying species.

Non-physical disturbance, including vibration effects during the construction of the pipeline river crossing may also affect functional linked habitat used by spined loach, leading to changes in species distributions and habitat avoidance. Physical damage and disturbance of functional linked habitat may displace populations from current spawning grounds and feeding areas, affecting adult survival.

The construction of the new transfer, could have the potential to introduce contaminants into the connected watercourses, modify flows, or cause increased turbidity and sedimentation, potentially affecting spawning grounds and habitat connectivity for the designated species.

Indicative transfer construction effects

- River Delph to FR

The construction effects of the transfer would be similar for the Ouse Washes SAC as the ones listed in the section above for the Ouse Washes SPA and the Ouse Washes Ramsar Site.

The proposed works may lead to temporary and permanent effects on this site and its qualifying features as a direct result of physical habitat loss, habitat degradation and/ or fragmentation, as the proposed transfer intake would be located within the SAC.

Additionally, physical modification of river channels may remove habitat heterogeneity and the mosaic of microhabitats utilised by spined loach at different stages of their lifecycle. Spined loach may be particularly vulnerable to deposited pollutants due to their burrowing and feeding

habits. Pollutants may result in obvious lethal effects, however, a wide variety of sub-lethal effects, such as reduced fertility may affect the overall fitness of spined loach. Increases in temperature may produce synergistic effects with other environmental stresses such as increased toxicity of pollutants and more rapid deoxygenation.

3.4.3.2 Operation effects

Emergency drawdown effects

The reservoir operation effects would be similar for the Ouse Washes SAC as the ones listed above for the Ouse Washes Ramsar Site.

Abstraction effects

As part of the operational phase there is intended to be abstraction from the abstractions on the Bedford Ouse at Earith and the River Delph in order to supply water to the reservoir. The abstractions have the potential to modify hydrological conditions in terms of altering flow and changing water table/availability from the connection points located within the SAC. The SAC is designated for the presence of spined loach (*Cobitis taenia*), this species is sensitive to hydrological changes and[25],[26]. consequently, potential effects on the qualifying feature of the Ouse Washes SAC are possible.

Hydrological and water quality targets for spined loach[27] are presented in Table 3.1.

Table 3.1: Hydrology and water quality targets for spined loach in the Ouse Washes SAC

Attribute	Targets	Explanatory note
Flow regime	Maintain a flow regime which is characteristic of the river channels.	The natural flow regime is critical to all aspects of the spined loach life cycle, maintaining the habitat that is optimal for the species.
Sediment regime	Maintain in-channel substrate character of at least 20% sand and no more than 40% silt	Excessive delivery of very fine sediment, from the catchment or artificially enhanced bank erosion can produce sub-optimal feeding conditions for spined loach and can interfere with submerged plant communities on which the species relies for cover and spawning. For optimal conditions substrates should be at least 20% sand and no more than 40% silt. Whilst the species can tolerate silt and mud, it has a preference for sandy substrate. High sediment cohesiveness is likely to adversely affect the feeding process.
Water quality - nutrients	Maintain the nutrient regime of the river channels at or below the following levels; Annual mean of 0.1mgl-1 total phosphorous. Biological Water Quality in ditches target equivalent to Class 'B' in the biological module of the General Quality Assessment scheme (GQA).	Nutrient enrichment can lead to a decline in substrate condition for spined loach due to benthic algal growth and associated enhanced siltation. It also increases the risk of impacts on the cover of the submerged plant community, which the spined loach uses for cover. In ditches, spined loach can be abundant in enriched conditions with high levels of filamentous algal cover. However, this is not considered to be optimal habitat conditions for the species in the longer-term and is not

[25] See separate hydroecology study for strategic resource options report. Report Reference: 421065052-MMD-XX-00-RP-Z-0006

[26] Natural England, 2015.Ouse Washes SAC Conservation Objectives Supplementary Advice. Available from: http://publications.naturalengland.org.uk/file/5662963216154624. Accessed 29/07/2022.

[27] JNCC (2018) European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) Fourth Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2013 to December 2018 Conservation status assessment for the species: S6963 - Spined loach (*Cobitis taenia*) UNITED KINGDOM. Available at: https://jncc.gov.uk/jncc-assets/Art17/S6963-UK-Habitats-Directive-Art17-2019.pdf

Attribute	Targets	Explanatory note
	Dissolved oxygen, ammonia, BOD equivalent quality to Chemical GQA Class 'C'. Mean cover of filamentous macro-algae and Enteromorpha not more than 10%.	consistent with the conservation of supporting ditch habitat. Any anthropogenic enrichment above natural/background concentrations should be limited to levels at which adverse effects on the feature are unlikely.
Water quality - organic pollution	Organic pollution levels should be controlled to levels that have minimal impact on spined loach populations	The spined loach is susceptible to both episodic and chronic organic pollution. Episodic pollution causes direct mortalities whilst chronic pollution affects substrate condition through the build-up of sediment oxygen demand and excessive microbial populations. If the organic content of the substrate becomes too high, reduced oxygen availability near the sediment-water interface may lead to enhanced egg and juvenile mortality.
Water quality - other pollutants	Achieve at least 'Good' chemical status (i.e., compliance with relevant Environmental Quality Standards).	Spined loach can be affected by a range of pollutants. A wide range of pollutants may impact on habitat integrity depending on local circumstances. Good chemical status includes a list of Environmental Quality Standards (EQS) for individual pollutants that are designed to protect aquatic biota with high levels of precaution. These values should be applied throughout the site.
Screening of intakes and outfalls	Ensure any intakes and outfalls likely to entrain a significant number of spined loach are adequately screened.	Spined loach can be caught or entrained in intakes and outfalls along with other fish species if appropriate protection is not provided, ideally using good practice guidelines such as those produced by the Environment Agency.

Changes to the hydrological regime may increase deposition rates of fine sediment on gravels, and the intake infrastructure may lead to stranding of fish or desiccation of eggs during low flows[28]. In addition, river engineering works may increase spate flow velocities within the catchment which may result in spined loach being washed out of areas of favourable habitat within the river system. If low flows are maintained over long periods of time, elevated water temperatures, deoxygenation, siltation and bed armouring may become evident. Conversely very high flows may scour spawning substrates and deposited eggs or silt substrates for adult refuge. Low flows may reduce the ability of spined loach to pass barriers and reach new habitat. High spate flows may lead to fish and eggs being washed out of areas of suitable habitat. Due to their relatively sedentary nature, they may be susceptible to direct entrainment in water abstractions or dissolved oxygen fluctuations due to the discharge of artificially warm water. Occasional incidences of low oxygen levels on River Delph and Counter Drain have potential to impact spined loach populations.

The potential abstraction proposed to supply the Fens Reservoir would result in decreases in flows under medium and high flow conditions along the system downstream of the proposed abstraction points. These reductions would primarily occur during the winter months between November and March. In consideration of the Hands-Off Flow conditions, no abstraction is permitted below a certain threshold and as such, no reduction in flows is observed for lower flow conditions.

The abstraction at Earith would impact the diversion and result in less frequent and lower flows entering the River Delph. In combination with the second abstraction occurring from the River Delph, this would drive lower water levels across the designated site/flood storage area, which

[28] JNCC (2018) European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) Fourth Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2013 to December 2018 Conservation status assessment for the species: S6963 - Spined loach (*Cobitis taenia*) UNITED KINGDOM. Available at: https://jncc.gov.uk/jncc-assets/Art17/S6963-UK-Habitats-Directive-Art17-2019.pdf

would primarily occur in winter when sufficient flows are passing through the system that trigger both abstractions and the diversion.

Though water table/availability are important aspects of the designated features of the Ouse Washes SAC, the main listed management concern relates to negative effects of summer flooding identified as an issue within the site improvement plan for this site[29]. Consequently, the abstraction has the potential to have a positive influence removing some water when flows are excessive. However, there is potential for increased siltation further downstream, which has been linked to flooding of potentially important bird areas[30]. As such, there is potential that likely significant effects could occur if slowing of flows increases siltation and results in increased flooding rather than reduce excessive flows. Given that it is unclear the degree of flow change it has been determined as a precaution that a significant impact on the designated features of the Ouse Washes SAC could occur.

Summary on the potential effects on the Ouse Washes designations

Table 3.2 lists the potential effects on the Ouse washes designated sites qualifying features.

SAC

During the construction phase, habitat loss and degradation, including fragmentation are expected as a result of the proposed intake-built structure within the SAC.

The SAC is designated for the population of spined loach. During the operation phase, there is not expected to be an impact on the Counter Drain as the abstraction would not take place in this waterbody. However, there is also an important spined loach population within the Old Bedford/Delph River. This could be impacted by the reduction in flow due to the abstraction on the Bedford Ouse at Earith. There would also be a reduction in flows on the Hundred Foot/New Bedford River where spined loach has also been recorded. This would similarly see a reduction in flows. The reduction in flows could lead to a reduction in flow velocity. As well as this the water quality modelling suggests that the abstractions may lead to occasional localised water quality changes. This could impact the spined loach population in the Hundred Foot/New Bedford River. Further analysis is required to determine whether this would have an impact on this species.

SPA

During the construction phase, habitat loss and degradation, including fragmentation of functionally linked land used by qualifying bird species is expected as a result of the proposed transfer and intake-built structure located within the SPA.

During operation, the water levels which are predicted to be seen when the abstractions are in place are expected to be more in line with the ‘new ideal’ water regime which was advised in the Hydro-ecological Prescriptions Review. Therefore, this is expected to benefit the bird species which are designated features of this SPA. In addition, there are potential benefits in terms of eventually providing additional connected habitats for waders (planned floating islands to increase riparian habitat) associated with the Ouse Washes SPA (and Ramsar Site). However, there is potential for increased siltation leading to water quality degradation further downstream, which has been linked to flooding of potentially important bird areas[31]. As such, there is potential that likely significant effects could occur if slowing of flows increases siltation and

[29] Natural England, 2014. Site Improvement Plan: Ouse Washes. Available from http://publications.naturalengland.org.uk/file/6561880306876416. Accessed 29/07/2022

[30] See WWT, 2021. Flooding on the Ouse Washes. Available from https://www.wwt.org.uk/news-and-stories/news/flooding-on-the-ouse-washes. Accessed 09/08/2022.

[31] WWT, 2021. Flooding on the Ouse Washes. Available from https://www.wwt.org.uk/news-and-stories/news/flooding-on-the-ouse-washes. Accessed 09/08/2022.

results in increased flooding rather than reduce excessive flows. Given that it is unclear the degree of flow change it has been determined as a precaution that a significant impact on the designated features of the Ouse Washes SPA could occur.

Ramsar Site

The impact on the Nationally Scarce plants which were outlined in Ramsar Criterion 2 requires further investigation. The current distribution of these species is not known. Further monitoring and assessment are required to understand how the internal ditch system would be impacted by the change in flooding regime in the River Delph. As these species may be present in this habitat it is not possible to determine whether they would be impacted at this point. The IUCN Red Listed invertebrate species also require further analysis as currently flow velocity impacts due to the abstraction are not known and this information is required to determine an impact. The Washland habitat and the wetland plant assemblage is expected to benefit from the reduction in flow into the Old Bedford/Delph River and the Hundred Foot/New Bedford River, as this would lead to a reduction in spring and summer flooding which is attributed to the decline in this habitat. However, inappropriate levels of nutrients from diffuse pollution and sedimentation in combination with inappropriate water levels from flooding can adversely affect the extent/composition of designated vegetation communities on the washes.

Table 3.2: The potential impacts to the designated features in the Ouse Washes SAC, SPA, and Ramsar

Designated feature	Potential impact of the scheme	Designation(s) affected
Bird		
Bewick's swan (*Cygnus columbianus bewickii)* Black-tailed godwit (*Limosa limosa limosa)* Coot (*Fulica atra)* Gadwall *(Anas strepera)* Garganey (*Anas querquedula)* Hen harrier (*Circus cyaneus)* Mallard (*Anas platyrhynchos)* Mute swan (*Cygnus olor*) Pintail (*Anas acuta)* Pochard (*Aythya farina*) Ruff (*Philomachus pugnax)* Shoveler (*Anas clypeata)* Teal (*Anas crecca)* Tufted duck (*Aythya fuligula*) Whooper swan (*Cygnus cygnus)* Wigeon (*Anas penelope)*	Hydrological modelling suggests that water levels in the Ouse Washes would move towards the 'new ideal' water regime, which was devised to benefit the waterbird features of the site.	SSSI, SPA, Ramsar Site
Bird assemblage		
Assemblages / aggregations of breeding waterbirds / wetland birds	Hydrological modelling suggests that water levels in the Ouse Washes would move towards the 'new ideal' water regime, which was devised to benefit the waterbird features of the site.	SSSI, SPA, Ramsar Site
Assemblages / aggregations of overwintering waterbirds	Hydrological modelling suggests that water levels in the Ouse Washes would move towards the 'new ideal' water regime, which was developed to benefit the waterbird features of the site.	SSSI
Fish		
Spined loach (*Cobitis taenia*)	Spined loach inhabit the internal ditches of the Ouse Washes, the Hundred Foot River / New Bedford River	SSSI, SAC

Designated feature	Potential impact of the scheme	Designation(s) affected
	and the Counter Drain. The Counter Drain is not expected to be impacted by the FR scheme abstractions, so this population is unlikely to be affected. Spined loach populations within the ditches and Hundred Foot River / New Bedford River could be impacted by abstraction from the Bedford Ouse at Earith and the Ouse Washes due to reductions in flow. The reduction in flow may impact spined loach via a decrease in water quality, for example an increase in BOD has been predicted in association with the flow reduction. Additionally, a decrease in downstream flows may result in an increase in saline intrusion in the Hundred Foot River / New Bedford River. Further investigation is required to understand the impact of abstractions on spined loach.	
Habitat		
Ditches	Further modelling is required to understand if abstractions would impact water level and water quality in the ditches.	SSSI
Lowland wet neutral grassland (MG11, MG13) (washland)	The plant species found within the washlands are expected to benefit from the proposed abstraction as it would likely lead to a reduction in spring and summer flooding, which is noted as being a cause of grassland decline since the 1970s. The reduction in flow into the Hundred Foot River/New Bedford and Old Bedford River/Delph would result in lower water levels in the Ouse Washes. However, nutrient enrichment is also a factor in the decline of grasses in the Ouse Washes. The impact of the abstraction on nutrient enrichment requires further assessment. However, as the abstraction would limit the inundation of water on the washlands it may reduce nutrient enrichment.	SSSI
Invertebrate		
Large darter dragonfly (*Libellula fulva)*	This species could be impacted by abstraction from the Bedford Ouse at Earith and the Ouse Washes. However, it has been found to prefer slow or sluggish waters, so should tolerate a change in flow velocity.	Ramsar Site
Rifle beetle (*Oulimnius major)*	This species is particularly associated with deeper waters and could be adversely affected by reductions in water depth. The impact to this species requires further hydrological modelling.	Ramsar Site
Wetland invertebrate assemblage	On the whole, aquatic invertebrates are expected to benefit from the FR scheme as water levels would be more closely aligned with the 'new ideal' than they are currently. The 'new ideal' water regime was developed to benefit macroinvertebrate supporting habitat. However, the wetland invertebrate assemblage comprises numerous species with differing hydrological preferences. While the hydrological changes may be beneficial at a community-level, some individual species may be adversely impacted.	Ramsar Site
Plant		
Fringed water-lily (*Nymphoides peltate)* Grass-wrack pondweed *(Potamogeton compressus)*	These species are considered unlikely to be impacted by abstraction from the Bedford Ouse at Earith or from the Ouse Washes as they prefer slow flowing or still waters.	Ramsar Site

Designated feature	Potential impact of the scheme	Designation(s) affected
Greater water parsnip (*Sium latifolium)* Long-stalked pondweed *(Potamogeton praelongus)* Whorled water-milfoil (*Myriophyllum verticillatum)*		
Hair-like pondweed (*Potamogeton trichoides)* Marsh dock (*Rumex palustris)* River water-dropwort (*Oenanthe fluviatilis*) Small water-pepper (*Polygonum minus)* Tasteless water-pepper (*Polygonum mite)*	Given their water quality and/or hydrological preferences, these species have the potential to be impacted by abstraction from the Bedford Ouse at Earith or from the Ouse Washes. However, the location of these species in the Ouse Washes is not recently recorded. In order to assess the impact, further monitoring of species distribution is required.	Ramsar Site
Wetland plant assemblage	On the whole, wetland plants are expected to benefit from the FR scheme as water levels would be more closely aligned with the 'new ideal' than they are currently. The 'new ideal' water regime was developed specifically to benefit the plants that support the designated bird features of the Washes. However, the wetland plant assemblage comprises numerous species with differing hydrological preferences. While the hydrological changes may be beneficial at a community-level, some individual species may be adversely impacted.	Ramsar Site

3.4.4 The Wash SPA (UK9008021) (approximately 35km north of site)

Information on this Designated Site is provided in Appendix C**,** including qualifying features, conservation objectives, and threats and pressures to site integrity.

3.4.4.1 Construction effects

Reservoir construction effects

The Wash SPA is located is located approximately 35km from the proposed reservoir construction area. Therefore, it is sufficiently distant to exclude adverse effects on the qualifying species due to noise, vibration, visual or human disturbance during the construction stage. Additionally, there is no potential for the physical loss, degradation or fragmentation of supporting habitats for this Designated Site due to construction activities associated with the reservoir.

Indicative transfers and associated infrastructure construction effects

The Wash SPA is located is located approx. 35km from the transfer route construction corridor, but hydrologically connected to it. Therefore, it is sufficiently distant to exclude adverse effects on the qualifying species due to noise, vibration, visual or human disturbance during the construction phase. However, in the event of a pollution event at the intake construction there is a possibility for The Wash SPA to be affected through changes in water quality.

3.4.4.2 Operation effects

Reservoir emergency drawdown effects

There would be requirement for emergency drawdown however this is currently subject to investigation and consultation and would be finalised for gate three.

The new reservoir would be lined with clay and therefore not hydrologically connected to any Designated Sites during operation. As mentioned before the proposed option for managing drawdown in an emergency situation would be to discharge to the Forty Foot Drain.

At this stage, adverse effects cannot be ruled out as a result of changes in water levels and flows. Emergency drawdowns into the Forty Foot Drain can lead to changes in turbidity and increased sedimentation may result in changes in intertidal habitats that support bird species. Effects are uncertain due to the distance (approximately 35km) and therefore further dam breach modelling analysis are recommended to understand the potential effects on The Wash estuarine system.

Abstraction effects

The Wash SPA is hydrologically connected to the scheme via the River Great Ouse. Therefore, there is a potential pathway for adverse effects during operation which cannot be ruled out at this stage.

Water quality

During operation potential changes to water levels and flows due to direct intake and outfall from/to the River Great Ouse could lead to changes to water quality due to increased turbidity and sedimentation that could affect natural estuarine-coastal processes downstream.

The saltmarshes, wading birds and coastal lagoons of the Wash SPA are dependent on freshwater availability and maintaining levels of dissolved oxygen[32].

The modelling undertaken at this stage, indicates that there would be changes to the amount of dissolved oxygen and flow rates of water in the section of the Great Ouse that lies within these designated sites. The extent of change is unclear therefore as a precaution likely significant effects are considered to the designated features of The Wash SPA.

Changes to salinity, nutrient levels and thermal regime may also adversely affect this Designated Site and its qualifying features due to the direct increased water abstraction, discharges, storage, and reduced compensation flow releases into the River Great Ouse.

New abstractions from the Ouse at Earith and the Ouse Washes are unlikely to have a significant long-term impact on water quality, as demonstrated by the SIMCAT modelling which showed very small changes to the concentrations that would not impact WFD status.

The SIMCAT model is a mathematical model which describes in-river water quality across a catchment and apportions loads to contributing sectors. SAGIS is the GIS interface of the SIMCAT model and allows a graphical representation of modelled results. The SIMCAT model is used to investigate changes to in-river water quality[33] under a suite of scenarios. This is

[32] See the following:

Natural England, 2014. Site Improvement Plan: The Wash and North Norfolk Coast. Available from http://publications.naturalengland.org.uk/publication/5327498292232192. Accessed 29/07/2022.

Natural England, 2022. The Wash SPA. Supplementary advice. Available from https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK9008021&SiteName=The+Wash&SiteNameDisplay=The+Wash+SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=21 Accessed 29/07/2022.

Natural England, 2022. The Wash and North Norfolk Coast SAC. Supplementary advice. Available from https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0017075&SiteName=the+wash+and&SiteNameDisplay=The+Wash+and+North+Norfolk+Coast+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=2. Accessed 29/07/2022.

[33] Parameters modelled included: Ammonia un-ionised as N; Ammoniacal Nitrogen as N; BOD: 5 Day ATU; Nitrate as N; Nitrite as N; Nitrogen, Total as N; Orthophosphate, reactive as P; Oxygen, Dissolved as O2 (DO); Phosphorus, Total as P; Salinity: In Situ.

achieved by predicting the variability of water quality using summary statistics, such as the mean and 90th percentile. The SIMCAT model recognises that quality standards must be defined as statistics to allow a correct assessment of compliance with water quality objectives while also incorporating changes in river flow and quality.

SIMCAT provides an understanding of catchment water quality behaviour; this is based on historic river and effluent monitoring for continuous discharges and abstractions. SIMCAT has been designed to recognise the limitations of the existing data and provides results with confidence levels for comparison against water quality standards.

All sites showed a mixture of increased and decreased concentration of the modelled determinants along the length of the watercourse from abstraction to estuary. However, the abstractions at Earith showed a more negative impact on water quality. However, as mentioned, these changes to water quality are not significant in the long term and are unlikely to impact the annual average to change WFD status. In conclusion, the new abstractions are unlikely to impact water quality in the long term such as across an annual average, however in the short term due to pollution incidents, wash off storm events or drought the water quality from abstraction to the estuary have the potential to deteriorate water quality by one WFD classification.

Habitats found within the Great Ouse estuary and wider Wash embayment are extremely tolerant to changes in salinity. The average annual salinity in the Wash embayment is over 31 parts per thousand (ppt) (Dare et al., 2004). Salinity decreases gradually between the entrance to the embayment and the bayhead. It becomes polyhaline[34] in the intertidal zone of the bayhead, and mesohaline[35] in the river mouths. Communities in this ecological group are salt marshes characterised by very low species diversity and low plant stature. Overarchingly, habitats found within the Wash are generally considered to be euryhaline, meaning that salinity concentrations change regularly. Salinity conditions are widely fluctuating within saltmarsh habitats. No clear salinity gradient can be determined with saltmarsh elevation as the interaction of tidal submergence, rainfall and evapotranspiration produces extensive fluctuation in salinity across the marsh. Therefore, all saltmarsh plants, independent of their distribution across the marsh, exhibit high salt tolerance (Natural England and RSPB, 2014). The estimated changes in salinity at the mouth of the Wash are predicted to be less than 0.2ppm and therefore it is considered that this would not alter the conditions of the habitats in the wash.

Habitats within The Wash embayment are subject to significant daily changes in flow velocity from flooding and draining of the waterbody into the North Sea. Flow conditions are in constant flux and the habitats associated with these areas are adept at coping with stressors derived from these changes. The proposed changes to flow at the Great Ouse outlet are unlikely to affect estuarine habitats that are subject to greater daily background changes due to the tidal nature of the Wash embayment. However, further studies and modelling are recommended to confirm that any changes to flow would be negligible.

Qualifying bird species can be adversely affected by increased sedimentation altering estuarine processes and food webs. Suspended sediment can decrease the light levels needed for photosynthesis affecting primary productivity of coastal ecosystems. Sediment deposition can also smother the estuarine floor leading to anoxic conditions and reducing habitat complexity. Additionally, sediments can also transport pollutants and microplastics to The Wash estuarine environment, which can bioaccumulate in the prey of seabirds and shorebirds. Sedimentation effects may be worsened by the projected increase in the frequency and intensity of storm and flood events triggered by climate change leading to less-resilient ecosystems.

[34] Polyhaline is a salinity category term applied to brackish estuaries and other water bodies with a salinity between 18 and 30 ppt

[35] Mesohaline conditions comprise salt concentrations between 5 and 18 ppt.

Further studies and modelling of the water demand from the River Great Ouse are needed to identify whether the abstraction would have an impact on this site and its designated features. Further modelling of sedimentation effects and variations in estuarine salinity levels due to water flows modifications and discharge and abstraction is also required to determine the effects on the habitats and species and coastal-estuarine natural processes at The Wash. A detailed review of the baseline ecological data is also recommended.

Hydrology

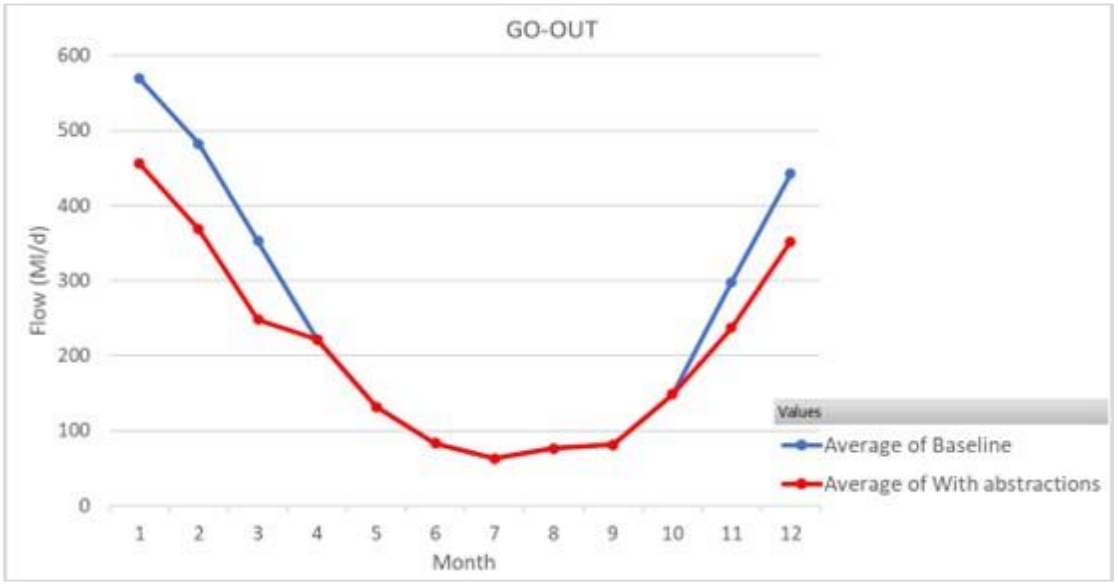
The abstraction regime proposed to supply the Fens Reservoir would result in decreases in flows under medium and high flow conditions along the system downstream of the proposed abstraction points. These reductions would primarily occur during the winter months between November and March. In consideration of the Hands-Off Flow conditions, no abstraction is permitted below a certain threshold and as such, no reduction in flows is observed for lower flow conditions. The abstraction at Earith would impact the diversion and result in less frequent and lower flows entering the Ouse Washes. In combination with the second abstraction occurring along the Ouse Washes, this would drive lower water levels across the designated site which would primarily occur in winter when sufficient flows are passing through the system that trigger both abstractions and the diversion. The conveyance capacity of the river Great Ouse along its downstream section would be further increased by the impact of the fourth abstraction. Flow reductions would occur along the downstream system in medium and high flows (beyond Q80) and reach 20 to 25% across some of the flow range (Table 3.3).

Table 3.3: Changes in flows at the outlet of the Great Ouse system.

Month	Average of Baseline	Average of Width abstractions	Average of % change
January	6036.6	4859.2	-20
February	5832.1	4670.3	-20
March	4943.6	3965.9	-19
April	3877	3217.5	-16
May	2675.6	2278.5	-11
June	1754.8	1557	-7
July	1296.2	1212.8	-2
August	1285.5	1219.6	-2
September	1430.8	1361.6	-2
October	2144.2	1955.7	-4
November	3413.1	2884.1	-11
December	4766.1	3872.6	-.17

Source: Mott MacDonald analysis

Figure 3.5: Comparative analysis of change in flow (ml/d) for the monthly average of baseline and average with abstractions.



Source: Mott MacDonald analysis

Habitats within the Great Ouse estuary and larger Wash embayment are subject to significant daily changes in flow velocity from flooding and draining of the waterbody into the North Sea. Flow conditions are in constant flux and the habitats associated with these areas are adept at coping with stressors derived from these changes. The proposed changes to flow at the Great Ouse outlet are unlikely to affect estuarine habitats that are subject to daily background changes that are beyond these changes in flow due to the tidal nature of the Wash embayment. While it is thought that any changes are likely to be below natural ecosystem variation, and therefore any changes to flow would be negligible when considering the environmental conditions of the whole ecosystem long term changes to sediment transport could lead to potential changes to the estuarine habitats. It is considered that further studies are required to address these potential effects.

3.4.5 The Wash Ramsar Site (UK11072) (approximately 35km east of site)

Information on this Designated Site is provided in Appendix C**,** including qualifying features, conservation objectives, and threats and pressures to site integrity.

3.4.5.1 Construction effects

Reservoir construction effects

The reservoir construction effects would be similar for The Wash Ramsar Site qualifying bird species as the ones listed above for The Wash SPA.

Indicative transfers construction effects

The transfer construction effects would be similar for The Wash Ramsar Site qualifying habitats and species as the ones listed above for The Wash Ramsar Site.

3.4.5.2 Operation effects

Emergency drawdown effects

The reservoir operation effects would be similar for The Wash Ramsar Site qualifying bird species as the ones listed above for The Wash SPA.

Abstraction effects

The water abstraction effects would be similar for The Wash Ramsar Site qualifying bird species as the ones listed above for The Wash SPA.

Additionally, there is potential for the loss or damage of the Ramsar qualifying vegetation an indirect result of physical habitat damage and habitat degradation due to changes in salinity, turbidity and increased sedimentation. These could be within the Designated Sites itself and/or in adjacent areas functioning as supporting habitats.

3.4.6 The Wash and North Norfolk Coast SAC (UK0017075) (approximately 35km east of site)

Information on this Designated Site is provided in Appendix C**,** including qualifying features, conservation objectives, and threats and pressures to site integrity.

3.4.6.1 Construction effects

Reservoir construction effects

The reservoir construction effects would be similar for The Wash and North Norfolk Coast SAC qualifying habitats and species as the ones listed above for The Wash Ramsar Site.

Indicative transfers construction effects

The transfer construction effects would l be similar for The Wash and North Norfolk Coast SAC qualifying habitats and species as the ones listed above for The Wash Ramsar Site.

3.4.6.2 Operation effects

Emergency drawdown effects

The reservoir construction effects would be similar for The Wash and North Norfolk Coast SAC qualifying species as the ones listed above for The Wash Ramsar Site.

Abstraction effects

The reservoir construction effects would be similar as the ones listed above for The Wash Ramsar Site.

Additionally, The Wash and North Norfolk Coast SAC is designated for supporting otters (*Lutra lutra*). Otters can occupy very large ranges (around 32km for males and 20km for females) and the habitats close to the scheme may be used by these qualifying species when they are functionally linked to the Designated Site (linkage habitat). Populations in coastal areas utilise shallow, inshore marine areas for feeding but also require freshwater for bathing and terrestrial areas for resting and breeding holts. Therefore, otters can potentially be adversely affected by habitat degradation as a result of changes in water quality leading to a reduction in their food supply. The following targets have been set for otter habitats that might be affected by the proposed abstraction regime:

- Maintain the natural flow regime of the river to that close to what would be expected in the absence of abstractions and discharges (the 'naturalised' flow).

- Maintain water quality and quantity to a standard that provides the necessary conditions to support the feature.

Water quality modelling has indicated that changes in water quality are expected to be small and compliant with WFD objectives and therefore no significant effects are anticipated. However, DO concentrations may decrease which can affect fish populations in the Great Ouse and indirectly affect otter populations through changes to food supply.

The Wash and North Norfolk Coast SAC is also designated for supporting the largest colony of common seals (*Phoca vitulina*) in the UK, with some 7% of the total UK population. The extensive intertidal flats here and on the North Norfolk Coast provide ideal conditions for breeding and hauling out. Changes in water quality and flows, including changes in turbidity as a result of increased sedimentation could potentially affect the intertidal banks of sand, mud and shallow water in The Wash as well as functionally linked land used by these qualifying species. Changes to supporting processes including sediment movement and hydrodynamic regime can affect common seal habitats and habitats that the species rely on. The sediment movement is mostly influenced by tide and wave-driven water flow and hydrodynamic conditions that support this include the speed and direction of wave and tidal currents, seabed shear stress and wave exposure, which are not expected to be affected by this scheme. However, the reduction in flow during high flow conditions could affect the quantity of the sediments reaching estuarine habitats changing natural water flow and sediment movement is not significantly altered. Alterations to these processes could affect species presences and distribution.

Further studies are recommended to reduce the uncertainty the effects on The Wash common seal and otter populations.

Table 3.4: Potential effects on designated sites and qualifying features

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
Ouse Washes SAC (UK0013011)	1149 Spined loach *Cobitis taenia*	The scheme is hydrologically connected to this designated site via the River Great Ouse, which represents a functionally linked habitat for the qualifying freshwater fish species spined loach. Therefore, there is the potential for a pathway for effects due to construction, including eventual pollution events and biological disturbances. The proposed works may also lead to temporary and/or permanent effects on functionally linked habitat for this site's qualifying species. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised. **During construction, this scheme is likely to result in:** • Physical damage – Physical modification of river channels may remove habitat heterogeneity and the mosaic of microhabitats utilised by spined loach at different stages of their lifecycle; functionally linked habitat degradation as a result of water quality changes in case of pollution events may also adversely affect spined loach populations. • Non-physical disturbance – vibration effects affecting functional linked habitat leading to changes in species distributions as a result of habitat avoidance. Due to their relatively sedentary nature, spined loach may be susceptible to direct entrainment into pumps in water abstractions. • Biological disturbance – changes in functional linked habitat quality and availability; potential for populations to be displaced from current spawning grounds and feeding areas adversely affecting adult survival. • Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by Spined loach. Spined loach may be particularly vulnerable to deposited pollutants due to their burrowing and feeding habits. Pollutants may result in obvious lethal effects, however, a wide variety of sub-lethal effects, such as reduced fertility may affect the overall fitness of this qualifying species. • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition; Changes to thermal regime due to increased water abstraction, and reduced compensation flow releases into the River Great Ouse; reduced oxygen levels affecting functional linked habitat used by Spined loach. **During operation, this scheme is likely to result in:** • Water table / availability – Change to water levels and flows due to water abstraction, storage and emergency discharge	Standard good practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of good practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These mitigation measures can include: • CIRIA C741 Environmental good practice on site guide. • Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites). • To add fish screens at the intake and discharge structures to avoid eventual fish entrapment as guided by (but not limited to): 'Screening for Intake and Outfalls: a good practice guide, (Environment Agency, Science Report - ISBN: 1 84432 361 7,2005) to avoid significant effects due to intake and outfall installations. • Where possible, installation works for the intake/outfall should also avoid important nursery/spawning grounds of prey species. • Biosecurity measures to ensure appropriate removal and/or management control of INNS at source. • Directional drilling in watercourses >3m wide. • Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material. • The application of industry good practice on 'Engineering in the Water Environment Good Practice Guide - Intakes and outfalls (SEPA)' and 'Screening for intake and outfalls: a good practice guide' (Environment Agency). • Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.	It is considered that no residual effects remain for the construction phase of the proposed scheme assuming that all proposed mitigation is implemented. At this stage it is not possible, to exclude adverse effects during the operation phase, as residual effects are expected in relation to the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely due to the physical loss, physical damage, toxic and non-toxic contamination biological disturbances and changes in water levels and flows identified. Further and information and assessment are required particularly in relation to the sedimentation effects and the change in water levels and flows to reduce uncertainty.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
		drawdown flows into the Ouse Washes, via the Forty Foot Drain. Spined loach require a habitat mosaic of fine silt for refuge and feeding, macrophytes for cover and coarser substrates and/or macrophytes for egg deposition. Changes to the hydrological regime may increase deposition rates of fine sediment on gravels, increase the resistance of structures to passage by spined loach and lead to stranding of fish or desiccation of eggs during low flows. Due to their relatively sedentary nature, Spined loach may be also susceptible to dissolved oxygen fluctuations due to the discharge of artificially warm water. • Physical damage – functionally linked habitat degradation as a result of water quality changes in case of pollution events • Biological disturbance – changes in functional linked habitat quality and availability; potential for populations to be displaced from current spawning grounds and feeding areas affecting spined loach's life cycle. • Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by the qualifying species. • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition; reduced oxygen levels affecting functional linked habitat used by qualifying species. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised assuming directional drilling is employed at main river crossings and small tributaries.		
Ouse Washes Ramsar Site (UK11051)	**Ramsar criterion 1** The site is one of the most extensive areas of seasonally-flooding washland of its type in Britain	The scheme is hydrologically connected to the site via the River Great Ouse, which represents a potential pathway for effects due to construction and operation, including eventual pollution events and changes in water levels and flows. The proposed works may lead to temporary and/or permanent effects on functionally linked habitat for this site's qualifying species. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised. **During construction, this scheme is likely to result in:** • Physical damage –habitat degradation as a result of water quality changes in case of pollution events of reservoir and transfers . • Toxic contamination – water pollution / changes to water quality (degradation). • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition affecting designated habitats **During operation, this scheme is likely to result in:**	Standard good practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of good practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These mitigation measures can include: • CIRIA C741 Environmental good practice on site guide • Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites). • Biosecurity measures to ensure appropriate removal and/or management control of INNS at source. • Directional drilling at watercourses >3m wide.	At this stage it is not possible to exclude adverse effects during the construction and the operation phases of this scheme, as residual effects are expected in relation to the structure and function of the qualifying habitats and the supporting processes on which habitats rely. Further and information and assessment are required particularly in relation to the sedimentation effects and the change in water levels and flows to reduce uncertainty.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
		• Water table / availability – Change to water levels and flows due to water abstraction, storage and emergency discharge drawdown flows into the Ouse Washes, via the Forty Foot Drain. • Physical damage – functionally linked habitat degradation as a result of water quality changes in case of pollution events. • Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by the qualifying species. • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition affecting designated habitats The identified effects have the potential to reduce the extent and quality of designated habitats. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised assuming directional drilling is employed at main river crossings and small tributaries.	• Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material. • Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.	
	Ramsar criterion 2 The site supports several nationally scarce plants, including small water pepper *Polygonum minus*, whorled water-milfoil *Myriophyllum verticillatum*, greater water parsnip *Sium latifolium*, river waterdropwort *Oenanthe fluviatilis*, fringed water-lily *Nymphoides peltata*, long-stalked pondweed *Potamogeton praelongus*, hair-like pondweed *Potamogeton trichoides*, grass-wrack pondweed *Potamogeton compressus*, tasteless water-pepper *Polygonum mite* and marsh dock *Rumex palustris*.	The scheme is hydrologically connected to the site via the River Great Ouse, which represents a potential pathway for effects due to construction and operation, including habitat loss and degradation and changes in water levels and flows. The proposed works may lead to temporary and/or permanent effects on functionally linked land supporting qualifying nationally scarce plants and vegetation. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised. **During construction, this scheme is likely to result in:** • Physical damage –habitat loss and degradation including fragmentation leading to a hostile landscape to species dispersal. • Non-toxic contamination –changes in turbidity, sediment loading, and silt deposition associated to run-off during construction which may lead to smothering of habitats supporting qualifying species; air pollution (dust) affecting photosynthesis and reducing productivity. • Biological disturbance – changes in functional linked habitat quality and availability; changes in natural succession; reduced productivity. **During operation, this scheme is likely to result in:** • Water table / availability – Change to water levels and flows due to water abstraction, storage and emergency discharge drawdown flows into the Ouse Washes, via the Forty Foot Drain. • Physical damage – functionally linked habitat degradation as a result of water quality changes in case of pollution events.	Same as above	At this stage it is not possible to exclude adverse effects during the construction and the operation phases of this scheme, as residual effects are expected in relation to the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely due to the physical loss, physical damage, toxic and non-toxic contamination biological disturbances and changes in water levels and flows identified. Further and information and assessment are required particularly in relation to the sedimentation effects and the change in water levels and flows to reduce uncertainty.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
		• Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by the qualifying species. • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition affecting designated habitats and species The identified effects have the potential to reduce the extent and quality of designated habitats. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised assuming directional drilling is employed at main river crossings and small tributaries.		
	Invertebrate records indicate that the site holds relict fenland fauna, including the British Red Data Book species large darter dragonfly *Libellula fulva* and the rifle beetle *Oulimnius major*.	The scheme is hydrologically connected to the site via the River Great Ouse, which represents a potential pathway for effects due to construction and operation, including habitat loss and degradation and changes in water levels and flows. The proposed works may lead to temporary and/or permanent effects on functionally linked land supporting qualifying nationally scarce plants and vegetation. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised. **During construction, this scheme is likely to result in:** • Physical damage –habitat loss; degradation and fragmentation of functionally linked land used by qualifying invertebrate species as a result of water quality degradation in case of pollution events of reservoir and transfers and pipelines. • Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by qualifying invertebrate species highly vulnerable to water quality changes. • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition **During operation, this scheme is likely to result in:** • Water table / availability – Change to water levels and flows due to water abstraction, storage and emergency discharge drawdown flows into the Ouse Washes, via the Forty Foot Drain. • Physical damage – functionally linked habitat degradation as a result of water quality changes in case of pollution events • Biological disturbance – changes in functional linked habitat quality and availability; potential for populations to be displaced from current reproduction and feeding areas. • Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by the qualifying species.	Standard good practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of good practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These mitigation measures can include: • CIRIA C741 Environmental good practice on site guide • Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites). • Biosecurity measures to ensure appropriate removal and/or management control of INNS at source. • Directional drilling at watercourses >3m wide. • Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material. • Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.	At this stage it is not possible to exclude adverse effects during the construction and the operation phases of this scheme, as residual effects are expected in relation to the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely due to the physical loss, physical damage, toxic and non-toxic contamination biological disturbances and changes in water levels and flows identified. Further and information and assessment are required particularly in relation to the sedimentation effects and the change in water levels and flows to reduce uncertainty.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
		• Non-toxic contamination – changes in turbidity, sediment loading and silt deposition; reduced oxygen levels affecting functional linked habitat used by qualifying species. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised assuming directional drilling is employed at main river crossings and small tributaries.		
	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 59133 waterfowl (5 year peak mean 1998/99-2002/2003)	The option scheme is hydrologically connected to the site via the River Great Ouse, which represents potential pathway for effects due to construction, including eventual pollution events and biological disturbances. The proposed works may lead to temporary and/or permanent effects on functionally linked habitat for this site's qualifying species. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised. **During construction, this scheme is likely to result in:** • Physical loss - habitat loss and/or habitat degradation leading to a reduction in functionally linked land as a result of direct land-take for pipeline construction. • Physical damage – habitat degradation as a result of water quality changes in case of pollution events that may affect bird nesting/feeding grounds. • Non-physical disturbance – displacement of qualifying species from functional linked land due to noise, visual and/or artificial lighting pathways, associated with construction activities, increasing vehicular movement, personnel and lighting can impact survival and distribution of bird species. • Biological disturbance – changes in habitat availability and potential for SPA populations to be displaced from current foraging areas. • Toxic contamination – water pollution / changes to water quality (degradation) • Non-toxic contamination – changes in turbidity leading to changes in sediment loading and silt deposition which may lead to smothering of functionally linked SPA habitats. **During operation, this scheme is likely to result in:** • Water table / availability – Change to water levels and flows due to water abstraction, storage and emergency discharge drawdown flows into the Ouse Washes, via the Forty Foot Drain.	Standard good practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of good practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These mitigation measures can include: • CIRIA C741 Environmental good practice on site guide • Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites). • Biosecurity measures to ensure appropriate removal and/or management control of INNS at source. • Directional drilling at watercourses >3m wide. • Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material. • Works should be agreed with Natural England and, if possible, be undertaken outside the breeding period to avoid adverse effects on qualifying SPA bird species, including the Goose and Swan Functional Land IRZ. • Any works which are undertaken between October and March which may disturb or displace this species from suitable functional land would only be permitted if the population present at risk of disturbance is less than 1% of the cited SPA population in the advice note (i.e. the threshold for Bewick's swan would be 50, based on the cited population of 4,980). • Specific mitigation for night works and artificial lighting would incorporate lighting hoods to minimise the light spill. • Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.	At this stage it is not possible to exclude adverse effects during the construction and the operation phases of this scheme, as residual effects are expected in relation to the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely due to the physical loss, physical damage, toxic and non-toxic contamination biological disturbances and changes in water levels and flows identified. Further and information and assessment are required particularly in relation to the sedimentation effects and the change in water levels and flows to reduce uncertainty.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
		• Physical damage – functionally linked habitat degradation as a result of water quality changes in case of pollution events. • Biological disturbance – changes in functional linked habitat quality and availability; potential for populations to be displaced from current foraging areas. • Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by qualifying species. • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition affecting functional linked habitat used by qualifying species. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised assuming directional drilling is employed at main river crossings and small tributaries.		
	Ramsar criterion 6 species/populations occurring at levels of international importance. **Species with peak counts in winter:** Tundra swan, *Cygnus columbianus bewickii*, NW Europe; Whooper swan, *Cygnus cygnus*, Iceland/UK/Ireland; Eurasian wigeon, *Anas penelope*, NW; Gadwall, *Anas strepera strepera*, NW Europe; Eurasian teal , *Anas crecca*, NW Europe; Northern pintail, *Anas acuta*, NW Europe; Northern shoveler, *Anas clypeata*, NW & C Europe **Species/populations identified subsequent to designation for possible future consideration under criterion 6.** **Species with peak counts in winter:** Mute swan, *Cygnus olor*, Britain; Common pochard, *Aythya ferina*, NE & NW; Black-tailed godwit, *Limosa limosa islandica*, Iceland/W Europe	See '*Possible adverse effects before mitigation'* listed above	See '*Mitigation measures'* listed above	See '*Adverse effects after Mitigation'* listed above
Ouse Washes SPA (UK9008041)	**ARTICLE 4.1** **Over winter the area regularly supports:** *Circus cyaneus, Cygnus columbianus bewickii, Cygnus cygnus, Philomachus pugnax*	See '*Possible adverse effects before mitigation'* listed above	See '*Mitigation measures'* listed above	See '*Adverse effects after Mitigation'* listed above
	ARTICLE 4.2 **During the breeding season the area regularly supports:** *Anas clypeata, Anas platyrhynchos, Anas querquedula, Anas strepera, Limosa limosa limosa* **Over winter the area regularly supports:** *Anas acuta, Anas clypeata, Anas crecca, Anas penelope, Anas strepera, Aythya farina, Aythya*	See '*Possible adverse effects before mitigation'* listed above	See '*Mitigation measures'* listed above	See '*Adverse effects after Mitigation'* listed above

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
	fuligula, Cygnus olor, Fulica atra, Phalacrocorax carbo.			
	ARTICLE 4.2 AN INTERNATIONALLY IMPORTANT ASSEMBLAGE OF BIRDS **Over winter the area regularly supports:** 64428 waterfowl (5-year peak mean 1991/92-1995/96) Including: *Phalacrocorax carbo, Cygnus columbianus bewickii, Cygnus cygnus, Anas penelope, Anas strepera, Anas crecca, Anas acuta, Anas clypeata, Aythya ferina, Aythya fuligula, Fulica atra, Philomachus pugnax*	See '*Possible adverse effects before mitigation'* listed above	See '*Mitigation measures'* listed above	See '*Adverse effects after Mitigation'* listed above
The Wash SPA (UK9008021)	**ARTICLE 4.1** **During the breeding season the area regularly supports:** *Sterna albifrons, Sterna hirundo* **Over winter the area regularly supports:** *Cygnus columbianus bewickii, Limosa lapponica*	The Wash SPA is located sufficiently distant from the proposed scheme to exclude direct adverse effects during the construction phase. However, this designated site is hydrologically connected to the scheme via the River Great Ouse. Therefore, there is a potential pathway for adverse effects during operation which cannot be ruled out at this stage. **During operation this scheme is likely to result in:** • Non-toxic contamination – Changes to water salinity, nutrient levels, turbidity, sedimentation/silting, thermal regime due to increased water abstraction, discharges, storage, or reduced compensation flow releases into the River Great Ouse. • Water table/availability – Changes to water levels and flows due to direct intake and outfall from/to the River Great Ouse. • Biological disturbance– Changes to habitat availability including functional linked habitat used by qualifying bird species; changes in species abundance or distribution; potential for populations to be displaced from current foraging areas. Birds can be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on, e.g. sediment deposition can smother the estuarine floor, which can decrease habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources.	Standard good practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of good practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These mitigation measures can include: • CIRIA C741 Environmental good practice on site guide • Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites). • TIDE Toolbox: Guiding Estuarine Management • TIDE Toolbox: Waterbird Disturbance and Mitigation Toolkit • Biosecurity measures to ensure appropriate removal and/or management control of INNS at source. • Directional drilling at watercourses >3m wide. • Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material. • A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refugee (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region). • Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.	At this stage it is not possible to exclude potential adverse effects during the operation phase of this scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, salinity and water temperature regime on the designated sites located downstream of the scheme. These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely. Further information and assessment are required, particularly in relation to the sedimentation effects and the change in water levels and flows to reduce uncertainty.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
	ARTICLE 4.2 **Over winter the area regularly supports:** *Anas acuta, Anas Penelope, Anas strepera, Anser brachyrhynchus Arenaria interpres, Branta bernicla bernicla, Bucephala clangula, Calidris alba, Calidris alpina alpine, Calidris canutus, Haematopus ostralegus, Limosa limosa islandica, Melanitta nigra, Numenius arquata, Pluvialis squatarola, Tadorna tadorna, Tringa totanus*	See '*Possible adverse effects before mitigation'* listed above	See '*Mitigation measures'* listed above	See '*Adverse effects after Mitigation'* listed above
	ARTICLE 4.2 AN INTERNATIONALLY IMPORTANT ASSEMBLAGE OF BIRDS 400367 waterfowl (5-year peak mean 1991/92-1995/96) Including: *Cygnus columbianus bewickii, Anser brachyrhynchus, Branta bernicla bernicla,Tadorna tadorna, Anas penelope, Anas strepera, Anas acuta, Melanitta nigra, Bucephala clangula,Haematopus ostralegus, Pluvialis squatarola, Calidris canutus, Calidris alba, Calidris alpina alpina, Limosa limosa islandica, Limosa lapponica, Numenius arquata, Tringa totanus, Arenaria interpres*	See '*Possible adverse effects before mitigation'* listed above	See '*Mitigation measures'* listed above	See '*Adverse effects after Mitigation'* listed above
The Wash Ramsar Site (UK11072)	**Ramsar criterion 1** The Wash is a large shallow bay comprising very extensive saltmarshes, major intertidal banks of sand and mud, shallow water and deep channels.	The Wash Ramsar Site is located sufficiently distant from the proposed scheme to exclude direct adverse effects during the construction phase. However, this designated site is hydrologically connected to the scheme via the River Great Ouse. Therefore, there is a potential pathway for adverse effects during operation which cannot be ruled out at this stage. **During operation this scheme is likely to result in:** • Physical damage - effects on natural estuarine-coastal processes. • Non-toxic contamination – Changes to water salinity, nutrient levels, turbidity, sedimentation/silting, thermal regime due to increased water abstraction, discharges, storage, or reduced compensation flow releases into the River Great Ouse. • Water table/availability – Changes to water levels and flows due to direct intake and outfall from/to the River Great Ouse. • Biological disturbance – Changes to habitat availability; changes in species abundance and/or distribution.	Standard good practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of good practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These mitigation measures can include: • CIRIA C741 Environmental good practice on site guide • Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites). • TIDE Toolbox: Guiding Estuarine Management • TIDE Toolbox: Waterbird Disturbance and Mitigation Toolkit • Biosecurity measures to ensure appropriate removal and/or management control of INNS at source. • Directional drilling at watercourses >3m wide. • Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material. • A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refugee (as a compensation effect for habitat	At this stage it is not possible to exclude potential adverse effects during the operation phase of this scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, salinity and water temperature regime on the designated sites located downstream of the scheme. These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely. Further information and assessment are required, particularly in relation to the sedimentation effects and the change in water levels and flows to reduce uncertainty.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
			damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region). • Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.	
	Ramsar criterion 3 Qualifies because of the inter-relationship between its various components including saltmarshes, intertidal sand and mud flats and the estuarine waters. The saltmarshes and the plankton in the estuarine water provide a primary source of organic material which, together with other organic matter, forms the basis for the high productivity of the estuary.	See '*Possible adverse effects before mitigation*' listed above	See '*Mitigation measures*' listed above	See '*Adverse effects after Mitigation*' listed above
	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 292541 waterfowl (5-year peak mean 1998/99-2002/2003)	The Wash SPA is located sufficiently distant from the proposed scheme to exclude direct adverse effects during the construction phase. However, this designated site is hydrologically connected to the scheme via the River Great Ouse. Therefore, there is a potential pathway for adverse effects during operation which cannot be ruled out at this stage. **During operation this scheme is likely to result in:** • Non-toxic contamination – Changes to water salinity, nutrient levels, turbidity, sedimentation/silting, thermal regime due to increased water abstraction, discharges, storage, or reduced compensation flow releases into the River Great Ouse. • Water table/availability – Changes to water levels and flows due to direct intake and outfall from/to the River Great Ouse. • Biological disturbance– Changes to habitat availability including functional linked habitat used by qualifying bird species; changes in species abundance or distribution; potential for populations to be displaced from current foraging areas. Birds can be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on, e.g., sediment deposition can smother the estuarine floor, which can decrease habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources.	Standard good practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of good practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These mitigation measures can include: • CIRIA C741 Environmental good practice on site guide • Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites). • TIDE Toolbox: Guiding Estuarine Management • TIDE Toolbox: Waterbird Disturbance and Mitigation Toolkit • Biosecurity measures to ensure appropriate removal and/or management control of INNS at source. • Directional drilling at watercourses >3m wide. • Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material. • A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refugee (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and	At this stage it is not possible to exclude potential adverse effects during the operation phase of this scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, salinity and water temperature regime on the designated sites located downstream of the scheme. These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely. Further information and assessment are required, particularly in relation to the sedimentation effects and the change in water levels and flows to reduce uncertainty.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
			interconnections to supporting habitats in this region). • Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.	
	Ramsar criterion 6 Species/populations occurring at levels of international importance. **Species with peak counts in spring/autumn:** Eurasian oystercatcher, *Haematopus ostralegus ostralegus*, Europe & NW Africa -wintering Grey plover, *Pluvialis squatarola*, E Atlantic/W Africa -wintering; Red knot, *Calidris canutus islandica*, W & Southern Africa (wintering) Sanderling, *Calidris alba*, Eastern; Eurasian curlew, *Numenius arquata arquata*, N. a. arquata Europe (breeding; Common redshank, *Tringa totanus totanus*, Ruddy turnstone, *Arenaria interpres interpres*, NE Canada, Greenland/W Europe & NW Africa **Species with peak counts in winter:** Pink-footed goose, *Anser brachyrhynchus*, Greenland, Iceland/UK; Dark-bellied brent goose, *Branta bernicla bernicla*, Common shelduck, *Tadorna tadorna*, NW Europe Northern pintail, *Anas acuta*, NW Europe;Dunlin, *Calidris alpina alpina*, W Siberia/W Europe Bar-tailed godwit, *Limosa lapponica lapponica*, W Palearctic **Species/populations identified subsequent to designation for possible future consideration under criterion 6.** Species with peak counts in spring/autumn: Ringed plover, *Charadrius hiaticula*, Europe/Northwest Africa, Black-tailed godwit, *Limosa limosa islandica*, Iceland/W Europe Species with peak counts in winter: European golden plover, *Pluvialis apricaria*, P. a. altifrons Iceland & Faroes/E Atlantic Northern lapwing, *Vanellus vanellus*, Europe - Black-headed gull, *Larus ridibundus*, N & C Europe	See '*Possible adverse effects before mitigation*' listed above	See '*Mitigation measures*' listed above	See '*Adverse effects after Mitigation*' listed above
The Wash and North Norfolk Coast SAC (UK0017075)	1110 Sandbanks which are slightly covered by sea water all the time 1140 Mudflats and sandflats not covered by seawater at low tide 1160 Large shallow inlets and bays 1170 Reefs 1310 Salicornia and other annuals colonising mud and sand 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) 1420 Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*) 1150 Coastal lagoons * Priority feature	The Wash and North Norfolk Coast SAC is located sufficiently distant from the proposed scheme (approx. 35km) to exclude direct adverse effects during the construction phase. However, this designated site is hydrologically connected to the scheme via the River Great Ouse. Therefore, there is a potential pathway for adverse effects during operation which cannot be ruled out at this stage. **During operation this scheme is likely to result in:** • Physical damage - effects on natural estuarine-coastal processes.	Standard good practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of good practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These mitigation measures can include: • CIRIA C741 Environmental good practice on site guide • Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).	At this stage it is not possible to exclude potential adverse effects during the operation phase of this scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, salinity and water temperature on the designated sites located downstream of the scheme. These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
		• Non-toxic contamination – Changes to water salinity, nutrient levels, turbidity, sedimentation/silting, thermal regime due to increased water abstraction, discharges, storage, or reduced compensation flow releases into the River Great Ouse. • Water table/availability – Changes to water levels and flows due to direct intake and outfall from/to the River Great Ouse. • Biological disturbance – Changes to habitat availability; changes in species abundance and/or distribution.	• TIDE Toolbox: Guiding Estuarine Management • TIDE Toolbox: Waterbird Disturbance and Mitigation Toolkit • Biosecurity measures to ensure appropriate removal and/or management control of INNS at source. • Directional drilling at watercourses >3m wide. • Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material. • A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refugee (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region). Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.	Therefor further information and assessment are required particularly in relation to the sedimentation effects and the change in water levels and flows to reduce uncertainty.
	1365 Common seal *Phoca vitulina*	The Wash and North Norfolk Coast SAC is located sufficiently distant from the proposed scheme to exclude direct adverse effects during the construction phase. However, this designated site is connected through small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to this SAC, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage. This site is designated for supporting the largest colony of common seals in the UK, with some 7% of the total UK population. The extensive intertidal flats at The Wash and on the North Norfolk Coast provide ideal conditions for breeding and hauling out. Changes in water quality and flows, including changes in turbidity as a result of increased sedimentation could potentially affect the intertidal banks of sand, mud and shallow water as well as functional linked land used by these qualifying species. **During operation this scheme is likely to result in:** Physical-damage – Habitat loss and degradation of functional linked land used by otters as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to	Standard good practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of good practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These mitigation measures can include: • CIRIA C741 Environmental good practice on site guide • Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites). • TIDE Toolbox: Guiding Estuarine Management • TIDE Toolbox: Waterbird Disturbance and Mitigation Toolkit • Biosecurity measures to ensure appropriate removal and/or management control of INNS at source. • Directional drilling at watercourses >3m wide. • Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of	At this stage it is not possible to exclude potential adverse effects during the operation phase of this scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, salinity and thermal regime on the designated sites located downstream of the scheme. These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely. Further assessment and modelling are, therefore, required to understand the changes which may take place on The Wash, including changes on flow velocity, water quality, turbidity, water depth and temperature particularly during spring/summer. Additional studies including INNS assessments and field-based hydraulic and river physical habitat investigations are also recommended to enable better quantification of potential effects and reduce uncertainty.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
		changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources. • Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels. • Toxic-contamination – Sediments can transport pollutants and microplastics to The Wash estuarine environment, which can bioaccumulate in the prey. • Water table/availability – Changes to water levels and flows due to direct intake from the River Trent and transfer into the River Witham. • Biological disturbance– Changes to habitat availability including functional linked habitat used by otters; changes in species abundance or distribution; potential for populations to be displaced from current feeding areas. Otters can be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.	works to limit the movement and redeposition of material. • A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refugee (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region). • Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.	
	1355 Otter *Lutra lutra*	The Wash and North Norfolk Coast SAC is located sufficiently distant from the proposed scheme (approx. 35km) to exclude direct adverse effects during the construction phase. However, this designated site is hydrologically connected to the scheme via the River Great Ouse which represents a functionally linked habitat for otters. Therefore, there is a potential pathway for adverse effects during operation which cannot be ruled out at this stage. Otters can occupy very large ranges (around 32km for males and 20km for females) and the habitats close to the scheme may be used by these qualifying species when they are functionally linked to the designated site (linkage habitat). Therefore, otters can potentially be adversely affected by habitat degradation as a result of changes in water quality leading to a reduction in their food supply (e.g., as a result of fish mortality). **During operation this scheme is likely to result in:** • Non-toxic contamination – Changes to water salinity, nutrient levels, turbidity, sedimentation/silting, thermal regime due to increased water abstraction, discharges, storage, or reduced compensation flow releases into the River Great Ouse. • Water table/availability – Changes to water levels and flows due to direct intake and outfall from/to the River Great Ouse. • Biological disturbance – Changes to habitat availability; changes in species abundance and/or distribution. Otters can	Standard good practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of good practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These include: • CIRIA C741 Environmental good practice on site guide • Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites). • TIDE Toolbox: Guiding Estuarine Management • Biosecurity measures to ensure appropriate removal and/or management control of INNS at source. • Directional drilling at watercourses >3m wide. • Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material. • A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refugee (as a	It is considered that no residual effects remain for the construction phase of the proposed scheme, assuming that all proposed mitigation is implemented. At this stage it is not possible, to exclude adverse effects during the operation phase, as residual effects are expected in relation to the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely due to the physical loss, physical damage, toxic and non-toxic contamination biological disturbances and changes in water levels and flows identified. Further and information and assessment are required particularly in relation to the sedimentation effects and the change in water levels and flows to reduce uncertainty.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Mitigation measures	Adverse effects after mitigation
		be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on, e.g. sediment deposition can smother the estuarine floor, which can decrease habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources. The proposed works may also lead to temporary and/or permanent effects on functionally linked habitat for this site's qualifying species. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.	compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region). • Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.	

3.4.7 In-combination effects

3.4.7.1 In-combination effects with other plans and projects

Adverse effects were identified during the operation stage that can affect the integrity of the following sites:

- Ouse Washes SAC (UK0013011)
- Ouse Washes Ramsar Site (UK11051)
- Ouse Washes SPA (UK9008041)
- The Wash SPA (UK9008021)
- The Wash Ramsar Site (UK11072)
- The Wash and North Norfolk Coast SAC (UK0017075)

Consequently, an in-combination assessment is required for this scheme. The following developments have been identified within 10km of the option (Table 3.5). This geographic distribution is based on UKWIR guidance (UKWIR, 2022).

Table 3.5: Plans and developments within 10km of the FR Scheme

Planning Authority	Local Plan	Reference	Location/ Description	Potential for in-combination effects
Peterborough district council	Cambridgeshire and Peterborough Mineral and waste development plan	Mineral safeguarding zone	Earith and Mepal zone Mineral safeguarding zone for earith and Mepal area	Yes, some sites are sufficiently close to the Ouse Washes Designated Site so that potential adverse effects to the integrity of the site are possible due to pollution events.
N/A	21/00033/FUM	Land At Coveney Byall Fen Old Lynn Drove Coveney Cambridgeshire	To Divert existing Internal Drainage Board Main drain to create a coherent contiguous block of lowland wet grassland to add on to the already created habitat at Coveney Byall Fen under the auspices of the Ouse Washes Habitat Creation Project	Yes, the site is sufficiently close to the Ouse Washes Designated Site so that potential adverse effects to the integrity of the site are possible due to pollution events.

3.4.7.2 In-combination effect with South Lincolnshire Reservoir (SLR)

The proposed SLR includes the development of a new raw water reservoir for public water supply within the Anglian Water region. The proposed reservoir site is located within the North Kesteven district of Lincolnshire, between the villages of Scredington, Helpringham and Swaton.

The scheme comprises all elements to realise the provision of a new water supply system, including abstraction, conveyance including pumps, storage, treatment and distribution into supply. Raw water source for the reservoir would be from the River Witham and River Trent with a transfer conveyance between the two rivers. Water would be conveyed from the abstraction point on the River Witham to the reservoir for storage. The reservoir would supply water for treatment and onwards distribution to the established potable water network.

The abstraction facilities are expected to comprise:

- An intake structure;
- Invasive Non Native Species (INNS) treatment facility (to eliminate the possibility of transferring INNS between the Trent and Witham catchments);

- A transfer pumping station (TPS);
- The inter river flow conveyance, Witham to Trent is proposed as a 10.5km transfer.
- The River Witham abstraction point is proposed to be located north of Langrick Bridge, borough of Boston, Lincolnshire. The abstraction facilities are expected to comprise:
- Intake structure;
- Transfer pumping station;
- The River Witham to SLR flow conveyance is proposed as an 18.0km transfer;
- It is currently proposed that the reservoir outlet discharges to a Water Treatment Works (WTW) located at the reservoir site with a transfer pumping station located to the treatment works outlet distributing potable water to the established distribution network;

The HRA undertaken for this scheme has identified potential effects to the following sites:

- The Wash SPA (UK9008021)
- The Wash Ramsar Site (UK11072)
- The Wash and North Norfolk Coast SAC (UK0017075)
- Humber Estuary

The following effects that could result in in-combination effects from both SLR and FR schemes are presented in Table 3.6. Humber Estuary is not going to be affected by the FR Scheme and therefore not included in the in-combination assessment.

Table 3.6: FR and SLR in-combination effects

Designated Sites/Qualifying Feature	FR	SLR	In-combination effects
The Wash SPA and Ramsar bird assemblages	Yes – uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Yes– uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Uncertain – further modelling should aim to look at the potential effects from water quality changes and changes in flows. Further modelling would reduce uncertainty in this assessment.
SAC Common seals	Yes -– uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Yes– uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Uncertain – further modelling should aim to look at the potential effects from water quality changes and changes in flows. Further modelling would reduce uncertainty in this assessment.
SAC Otters	Yes – uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Yes– uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Uncertain – further modelling should aim to look at the potential effects from water quality changes and changes in flows. Further modelling would reduce uncertainty in this assessment.
The Wash and North Norfolk Coast SAC and The Wash Ramsar saltmarsh vegetation	Yes -– uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Yes– uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Uncertain – further modelling should aim to look at the potential effects from water quality changes and changes in flows. Further modelling would reduce uncertainty in this assessment.

3.4.8 Stage 2 outcomes for FR scheme

Following this HRA Appropriate Assessment, it is considered that residual effects remain for the construction phase of the scheme at The Wash SPA/Ramsar Site and The Wash and Norfolk Coast SAC, assuming that all proposed mitigation is implemented. Residual effects also remain during the construction phase for Ouse Washes SAC/SPA/Ramsar sites. This includes effects from noise, disturbance and light. Effects are considered possible during the construction of the reservoir and transfers due to changes in water quality.

It is also not possible to rule out adverse effects for the operational phase for The Wash SPA/SAC/Ramsar Site and the Ouse Washes SPA/SAC/Ramsar Sites, as the potential adverse effects of increased sedimentation and changes in water levels and flows and are currently unknown. These effects have the potential to affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely due to the physical loss, physical damage and biological disturbances identified.

Studies and modelling of the water demand from the Ouse Washes and the River Great Ouse are needed to identify whether the changes in the water levels and flows as a result of the operation of the Fenland Reservoir would have an impact on the Designated Sites and their qualifying features. Further modelling of the current nutrient level analysis due to the abstraction also is required to determine the effect of nutrient loading.

Additional information about the scheme including a further assessment and modelling of the effects of the new discharge and abstraction on the River Great Ouse is needed to reduce uncertainty and determine the effects on the Designated Sites located downstream. A detailed review of the baseline ecological data is also recommended.

Finally, the adverse effects identified through this HRA may be compounded through the more frequent and intense effects of climate change, climate change scenario analysis from simulations with Global Climate Models (GCMs) are also recommended to account for these mid and long-term effects on the Designated Sites and the functional linked land located downstream of the scheme.

4 Conclusions and recommendations

The HRA Stage 1 Screening concluded that the proposed scheme is likely to result in Likely Significant Effects on the following Designated Sites:

- Ouse Washes SPA (UK9008041)
- Ouse Washes Ramsar (UK11051)
- Ouse Washes SAC (UK0013011)
- The Wash SPA (UK9008021)
- The Wash Ramsar Site (UK11072)
- The Wash and North Norfolk Coast SAC (UK0017075)

Consequently, the scheme has progressed to Stage 2 AA as several pathways and potential effects were identified at screening. This informal HRA Appropriate Assessment, considered that residual effects remain for the Ouse Washes SPA, SAC and Ramsar Site, both during the construction and operational phases. Details are outlined as follows:

During construction, the scheme may result in the following effects on designated sites:

- Physical loss during the construction of the pipelines, the reservoir, and their associated built infrastructure. This may also include loss of land functionally linked to the Designated Sites and used by qualifying species with large distribution ranges like birds.
- Physical damage, including habitat degradation as a result of water quality changes in case of pollution events may affect spawning areas for designated fish species.
- Non-physical disturbance caused by noise/visual presence and light pollution leading to the displacement of qualifying bird species from foraging areas.
- Toxic contamination leading to biomass reduction and food web disruptions that may affect the life cycle of qualifying species.
- Non-toxic contamination as a result of changes in water turbidity, sediment loading and silt deposition altering ecosystem processes and food webs; as well as dust effects smothering habitats, affecting photosynthesis and reducing productivity.
- Biological disturbance as a result of changes to habitat availability including functional linked habitat; changes in species abundance or distribution; potential for populations to be displaced from current spawning grounds and feeding areas; changes in natural succession.

During operation, the scheme may result in:

- Changes to water levels and flows due to abstraction, storage and emergency discharge drawdown flows leading to fluctuations in water temperature regimes and salinity levels downstream.
- Physical damage as a result of changes in flow velocity and sediment fluxes leading to changes in natural coastal processes; functionally linked habitat degradation as a result of water quality changes in case of pollution events.
- Toxic contamination leading to biomass reduction and food web disruptions that may affect the life cycle of qualifying species.
- Non-toxic contamination as a result of changes in water turbidity, sediment loading and silt deposition altering ecosystem processes and food webs; as well as dust effects smothering habitats, affecting photosynthesis and reducing productivity.

- Biological disturbance including direct mortality, changes to habitat availability including functional linked habitat; changes in species abundance or distribution; potential for populations to be displaced from current spawning grounds and feeding areas; changes in natural succession.

The Wash SPA, Ramsar Site and The Wash and Norfolk Coast SAC to be affected at both construction and operation. The potential effects may lead to changes on:

- The extent and distribution of qualifying habitats.
- The structure and function of the qualifying habitats.
- The supporting processes on which habitats of qualifying species rely.

The recommended mitigation measures detailed within this document assume a worst-case scenario at this stage, in the absence of detailed survey data or local records. As with the design information on this Scheme this mitigation measures are indicative and would need to be reviewed as the Scheme design progresses. Furthermore, this assessment constitutes an Informal HRA. With preliminary results that would be changed based on further work and scheme refinement.

It is also recommended that a Construction Environmental Management Plan (CEMP) be put in place that would include the proposed mitigation measures in this AA as well as any other specific measures identified following an HRA undertaken at project level.

At this stage some effects are still uncertain and therefore adverse effects on the Designated sites' integrity cannot be excluded. Further studies are recommended to address uncertainty and would include:

- Hydrodynamic modelling of flows and salinity into The Wash Designated Sites.
- Studies and modelling of the water demand from the River Delph and the River Great Ouse are needed to identify whether the changes in the water levels and flows as a result of the operation of the FR would have an impact on the Designated Sites and their qualifying features. Further modelling of the current nutrient level analysis due to the abstraction is also required to determine the effect of nutrient loading. In addition, potential changes in levels, salinity and sediment transport would also be investigated.
- Additional information about the option, including a further assessment and modelling of the effects of the new discharge and abstraction on the River Great Ouse are needed to reduce uncertainty and determine the effects on the Designated Sites located downstream. A detailed review of the baseline ecological data is also recommended including bird data.
- Finally, the adverse effects identified through this HRA may be compounded through the more frequent and intense effects of climate change, including heat waves, droughts, floods and rising sea levels. Therefore, climate change scenario analysis from simulations with Global Climate Models (GCMs) are also recommended to account for mid and long-term effects on the Designated Sites and functional linked land located downstream of the option.

An in-combination assessment was undertaken with other plans or projects and identified potential effects in-combination with:

- SLR – potential effects on The Wash Ramsar Site and SPA and Wash and North Norfolk Coast SAC.
- Cambridgeshire and Peterborough Mineral and waste development plan - potential effects on the Ouse Washes SAC, Ramsar Site and SPA.
- Land At Coveney Byall Fen Old Lynn Drove Coveney Cambridgeshire - potential effects on the Ouse Washes SAC, Ramsar Site and SPA.

Adverse effects to the Designated sites' integrity cannot be ruled out at this stage and further investigation is required to assess these potential changes in water, quality, flows, sediment transport and disturbance. Further design iterations would require revisions to this document and may result in changes to the current conclusion.

Ultimately, a strong and robust evidence base would be required to conclude that there would be no adverse effects on the integrity of any designated site. as a result of the construction or operation of the scheme. The level of detail available at this stage (which is considered proportionate) means that such effects cannot be ruled out at this stage. As a result, this would need further consideration and assessment as part of the next stages of design development to conclude what the effects (if any) of the project on designated sites would be, and any further work required by the HRA process. All of this would need to be undertaken in dialogue with key stakeholders, including Natural England and the Environment Agency.

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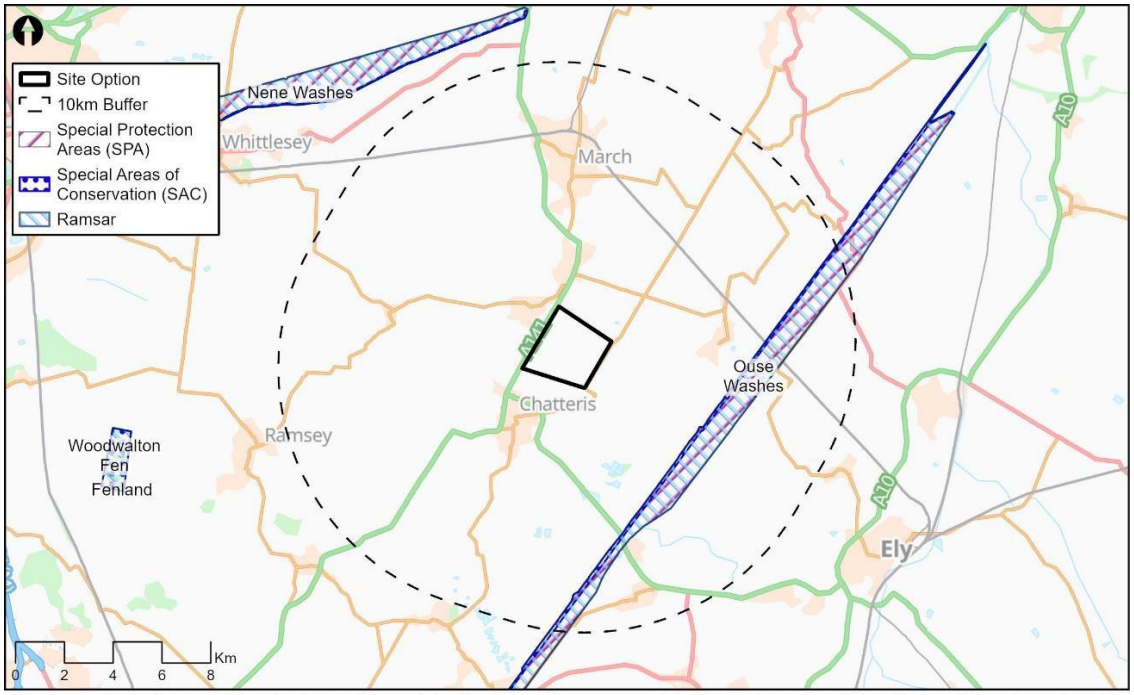
A. Proposed reservoir location



B. Screening Review

Designated Sites Assessed	Qualifying Features	Screening Result	Justification for Assessment
Ouse Washes SPA (UK9008041) (approximately 5km east of site)	**ARTICLE 4.1** Over winter the area regularly supports: *Circus cyaneus, Cygnus columbianus bewickii, Cygnus cygnus, Philomachus pugnax* **ARTICLE 4.2** During the breeding season the area regularly supports: *Anas clypeata, Anas platyrhynchos, Anas querquedula, Anas strepera, Limosa limosa limosa* Over winter the area regularly supports: *Anas acuta, Anas clypeata, Anas crecca, Anas penelope, Anas strepera, Aythya farina, Aythya fuligula, Cygnus olor, Fulica atra, Phalacrocorax carbo.* **ARTICLE 4.2 AN INTERNATIONALLY IMPORTANT ASSEMBLAGE OF BIRDS** Over winter the area regularly supports: 64428 waterfowl (5-year peak mean 1991/92-1995/96) Including: *Phalacrocorax carbo, Cygnus columbianus bewickii, Cygnus cygnus, Anas penelope, Anas strepera, Anas crecca, Anas acuta, Anas clypeata, Aythya ferina, Aythya fuligula, Fulica atra, Philomachus pugnax*	**Likely Significant Effects**	The option is hydrologically connected to the site via the River Great Ouse, which represents potential pathway for effects due to construction, including eventual pollution events and biological disturbances. The proposed works may lead to temporary and/or permanent effects on functionally linked habitat for this site's qualifying species. **During construction, this option is likely to result in:** • Physical loss - habitat loss and/or habitat degradation leading to a reduction in functionally linked land as a result of direct land-take for pipeline construction. • Physical damage – habitat degradation as a result of water quality changes in case of pollution events that may affect bird nesting/feeding grounds. • Non-physical disturbance – displacement of qualifying species from functional linked land due to noise, visual and/or artificial lighting pathways, associated with construction activities, increasing vehicular movement, personnel and lighting can impact survival and distribution of bird species. • Biological disturbance – changes in habitat availability and potential for SPA populations to be displaced from current foraging areas. • Toxic contamination – water pollution / changes to water quality (degradation) • Non-toxic contamination – changes in turbidity leading to changes in sediment loading and silt deposition which may lead to smothering of functionally linked SPA habitats. **During operation, this option is likely to result in:** • Water table / availability – Change to water levels and flows due to water abstraction, storage and emergency discharge drawdown flows into the Ouse Washes, via the Forty Foot Drain. • Physical damage – functionally linked habitat degradation as a result of water quality changes in case of pollution events. • Biological disturbance – changes in functional linked habitat quality and availability; potential for populations to be displaced from current foraging areas. • Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by qualifying species. • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition affecting functional linked habitat used by qualifying species. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised assuming directional drilling is employed at main river crossings and small tributaries.
Ouse Washes Ramsar Site (UK11051) (approximately 5km east of site)	**Ramsar criterion 1** The site is one of the most extensive areas of seasonally-flooding washland of its type in Britain **Ramsar criterion 2** The site supports several nationally scarce plants, including small water pepper Polygonum minus, whorled	**Likely Significant Effects**	The option is hydrologically connected to the site via the River Great Ouse, which represents a potential pathway for effects due to construction and operation, including eventual pollution events and changes in water levels and flows. The proposed works may lead to temporary and/or permanent effects on functionally linked habitat for this site's qualifying species. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised. **During construction, this option is likely to result in:** • Physical damage –habitat degradation as a result of water quality changes in case of pollution events; habitat loss and degradation including fragmentation leading to a hostile landscape to species dispersal; degradation and fragmentation of functionally linked land used by qualifying invertebrate species as a result of water quality degradation in case of pollution events; habitat degradation as a result of water quality changes in case of pollution events that may affect bird nesting/feeding grounds. • Toxic contamination – water pollution / changes to water quality (degradation); –changes in turbidity, sediment loading, and silt deposition associated to run-off during construction which may lead to smothering of habitats supporting qualifying species; air pollution (dust) affecting photosynthesis and reducing productivity.

water-milfoil Myriophyllum verticillatum, greater water parsnip Sium latifolium, river waterdropwort Oenanthe fluviatilis, fringed water-lily Nymphoides peltata, long-stalked pondweed Potamogeton praelongus, hair-like pondweed Potamogeton trichoides, grass-wrack pondweed Potamogeton compressus, tasteless water-pepper Polygonum mite and marsh dock Rumex palustris. Invertebrate records indicate that the site holds relict fenland fauna, including the British Red Data Book species large darter dragonfly Libellula fulva and the rifle beetle Oulimnius major. **Ramsar criterion 5** Assemblages of international importance: Species with peak counts in winter: 59133 waterfowl (5 year peak mean 1998/99-2002/2003) **Ramsar criterion 6** species/populations occurring at levels of international importance. Species with peak counts in winter: Tundra swan, Cygnus columbianus bewickii, NW Europe Whooper swan, Cygnus cygnus, Iceland/UK/Ireland Eurasian wigeon, Anas penelope, NW Gadwall, Anas strepera strepera, NW Europe Eurasian teal , Anas crecca, NW Europe Northern pintail, Anas acuta, NW Europe Northern shoveler, Anas clypeata, NW & C Europe Species/populations identified subsequent to designation for possible future consideration under criterion 6. Species with peak counts in winter: Mute swan, Cygnus olor, Britain		• Non-toxic contamination – changes in turbidity, sediment loading and silt deposition affecting designated habitats • Non-physical disturbance – displacement of qualifying species from functional linked land due to noise, visual and/or artificial lighting pathways, associated with construction activities, increasing vehicular movement, personnel and lighting can impact survival and distribution of bird species. • Biological disturbance – changes in habitat availability and potential for SPA populations to be displaced from current foraging areas.changes in functional linked habitat quality and availability; changes in natural succession; reduced productivity. **During operation, this option is likely to result in:** • Water table / availability – Change to water levels and flows due to water abstraction, storage and emergency discharge drawdown flows into the Ouse Washes, via the Forty Foot Drain. • Physical damage – functionally linked habitat degradation as a result of water quality changes in case of pollution events. • Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by the qualifying species. used by the qualifying species. • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition affecting designated habitats The identified effects have the potential to reduce the extent and quality of designated habitats and species The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised assuming directional drilling is employed at main river crossings and small tributaries.

	Common pochard, Aythya ferina, NE & NW Black-tailed godwit, Limosa limosa islandica, Iceland/W Europe		
Ouse Washes SAC (UK0013011) (approximately 5km east of site)	1149 Spined loach *Cobitis taenia*	**Likely Significant Effects**	The option is hydrologically connected to this designated site via the River Great Ouse, which represents a functionally linked habitat for the qualifying freshwater fish species Spined loach. Therefore, there is the potential for a pathway for effects due to construction, including eventual pollution events and biological disturbances. The proposed works may also lead to temporary and/or permanent effects on functionally linked habitat for this site's qualifying species. **During construction, this option is likely to result in:** • Physical damage – Physical modification of river channels may remove habitat heterogeneity and the mosaic of microhabitats utilised by spined loach at different stages of their lifecycle; functionally linked habitat degradation as a result of water quality changes in case of pollution events may also adversely affect spined loach populations. • Non-physical disturbance – vibration effects affecting functional linked habitat leading to changes in species distributions as a result of habitat avoidance. Due to their relatively sedentary nature, Spined loach may be susceptible to direct entrainment into pumps in water abstractions. • Biological disturbance – changes in functional linked habitat quality and availability; potential for populations to be displaced from current spawning grounds and feeding areas adversely affecting adult survival. • Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by Spined loach. Spined loach may be particularly vulnerable to deposited pollutants due to their burrowing and feeding habits. Pollutants may result in obvious lethal effects, however, a wide variety of sub-lethal effects, such as reduced fertility may affect the overall fitness of this qualifying species. • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition; Changes to thermal regime due to increased water abstraction, and reduced compensation flow releases into the River Great Ouse; reduced oxygen levels affecting functional linked habitat used by Spined loach. **During operation, this option is likely to result in:** • Water table / availability – Change to water levels and flows due to water abstraction, storage and emergency discharge drawdown flows into the Ouse Washes, via the Forty Foot Drain. Spined loach require a habitat mosaic of fine silt for refuge and feeding, macrophytes for cover and coarser substrates and/or macrophytes for egg deposition. Changes to the hydrological regime may increase deposition rates of fine sediment on gravels, increase the resistance of structures to passage by spined loach and lead to stranding of fish or desiccation of eggs during low flows. Due to their relatively sedentary nature, Spined loach may be also susceptible to dissolved oxygen fluctuations due to the discharge of artificially warm water. • Physical damage – functionally linked habitat degradation as a result of water quality changes in case of pollution events • Biological disturbance – changes in functional linked habitat quality and availability; potential for populations to be displaced from current spawning grounds and feeding areas affecting spined loach's life cycle. • Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by the qualifying species. • Non-toxic contamination – changes in turbidity, sediment loading and silt deposition; reduced oxygen levels affecting functional linked habitat used by qualifying species. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised assuming directional drilling is employed at main river crossings and small tributaries.
The Wash Ramsar Site (UK11072) (approximately 35km east of site)	**Ramsar criterion 1** The Wash is a large shallow bay comprising very extensive saltmarshes, major intertidal banks of sand and mud, shallow water and deep channels. **Ramsar criterion 3** Qualifies because of the inter-relationship between its various components including saltmarshes, intertidal sand and mud flats and the estuarine waters. The saltmarshes and the plankton in the estuarine	**Likely Significant Effects**	The Wash Ramsar Site is located sufficiently distant from the proposed option to exclude direct adverse effects during the construction phase. However, this designated site is hydrologically connected to the option via the River Great Ouse. Therefore, there is a potential pathway for adverse effects during operation which cannot be ruled out at this stage. **During operation this option is likely to result in:** • Physical damage - effects on natural estuarine-coastal processes. • Non-toxic contamination – Changes to water salinity, nutrient levels, turbidity, sedimentation/silting, thermal regime due to increased water abstraction, discharges, storage, or reduced compensation flow releases into the River Great Ouse. • Water table/availability – Changes to water levels and flows due to direct intake and outfall from/to the River Great Ouse. • Biological disturbance – Changes to habitat availability; changes in qualifying species abundance and/or distribution.

water provide a primary source of organic material which, together with other organic matter, forms the basis for the high productivity of the estuary.

Ramsar criterion 5

Assemblages of international importance:

Species with peak counts in winter:

292541 waterfowl (5-year peak mean 1998/99-2002/2003)

Ramsar criterion 6

Species/populations occurring at levels of international importance.

Species with peak counts in spring/autumn:

Eurasian oystercatcher, Haematopus ostralegus ostralegus, Europe & NW Africa -wintering

Grey plover, Pluvialis squatarola, E Atlantic/W Africa - wintering

Red knot, Calidris canutus islandica, W & Southern Africa (wintering)

Sanderling, Calidris alba, Eastern

Eurasian curlew, Numenius arquata arquata, N. a. arquata Europe (breeding)

Common redshank, Tringa totanus totanus,

Ruddy turnstone, Arenaria interpres interpres,

NE Canada, Greenland/W Europe & NW Africa

Species with peak counts in winter:

Pink-footed goose, Anser brachyrhynchus, Greenland, Iceland/UK

Dark-bellied brent goose, Branta bernicla bernicla,

Common shelduck, Tadorna tadorna, NW Europe

Northern pintail, Anas acuta, NW Europe

Dunlin, Calidris alpina alpina, W Siberia/W Europe

Bar-tailed godwit, Limosa lapponica lapponica, W Palearctic

	Species/populations identified subsequent to designation for possible future consideration under criterion 6. Species with peak counts in spring/autumn: Ringed plover, Charadrius hiaticula, Europe/Northwest Africa Black-tailed godwit, Limosa limosa islandica, Iceland/W Europe Species with peak counts in winter: European golden plover, Pluvialis apricaria apricaria, P. a. altifrons Iceland & Faroes/E Atlantic Northern lapwing, Vanellus vanellus, Europe - Black-headed gull, Larus ridibundus, N & C Europe		
The Wash and North Norfolk Coast SAC (UK0017075) (approximately 35km east of site)	1110 Sandbanks which are slightly covered by sea water all the time 1140 Mudflats and sandflats not covered by seawater at low tide 1160 Large shallow inlets and bays 1170 Reefs 1310 Salicornia and other annuals colonising mud and sand 1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae) 1420 Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*) 1150 Coastal lagoons * Priority feature 1365 Common seal *Phoca vitulina* 1355 Otter *Lutra lutra*	**Likely Significant Effects**	The Wash and North Norfolk Coast SAC is located sufficiently distant from the proposed option (approx. 35km) to exclude direct adverse effects during the construction phase. However, this designated site is hydrologically connected to the option via the River Great Ouse which represents a functionally linked habitat for otters. Therefore, there is a potential pathway for adverse effects during operation which cannot be ruled out at this stage. Otters can occupy very large ranges (around 32km for males and 20km for females) and the habitats close to the scheme may be used by these qualifying species when they are functionally linked to the designated site (linkage habitat). Therefore, otters can potentially be adversely affected by increased water turbidity and sedimentation leading to a reduction in their food supply (e.g. as a result of fish mortality). **During operation this option is likely to result in:** • Physical damage - effects on natural estuarine-coastal processes. • Non-toxic contamination – Changes to water salinity, nutrient levels, turbidity, sedimentation/silting, thermal regime due to increased water abstraction, discharges, storage, or reduced compensation flow releases into the River Great Ouse. • Water table/availability – Changes to water levels and flows due to direct intake and outfall from/to the River Great Ouse. • Biological disturbance – Changes to habitat availability; changes in species abundance and/or distribution. The proposed works may also lead to temporary and/or permanent effects on functionally linked habitat for this site's qualifying species. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.
The Wash SPA (UK9008021) (approximately 35km east of site)	**ARTICLE 4.1** During the breeding season the area regularly supports: Sterna albifrons, Sterna hirundo Over winter the area regularly supports: Cygnus columbianus bewickii, Limosa lapponica **ARTICLE 4.2** Over winter the area regularly supports: Anas acuta, Anas Penelope, Anas strepera, Anser brachyrhynchus Arenaria interpres, Branta bernicla	**Likely Significant Effects**	The Wash SPA is located sufficiently distant from the proposed option to exclude direct adverse effects during the construction phase. However, this designated site is hydrologically connected to the option via the River Great Ouse. Therefore, there is a potential pathway for adverse effects during operation which cannot be ruled out at this stage. **During operation this option is likely to result in:** • Non-toxic contamination – Changes to water salinity, nutrient levels, turbidity, sedimentation/silting, thermal regime due to increased water abstraction, discharges, storage, or reduced compensation flow releases into the River Great Ouse. • Water table/availability – Changes to water levels and flows due to direct intake and outfall from/to the River Great Ouse. • Biological disturbance – Changes to habitat availability; changes in species abundance and/or distribution.

	bernicla, Bucephala clangula, Calidris alba, Calidris alpina alpine, Calidris canutus, Haematopus ostralegus, Limosa limosa islandica, Melanitta nigra, Numenius arquata, Pluvialis squatarola, Tadorna tadorna, Tringa totanus **ARTICLE 4.2 AN INTERNATIONALLY IMPORTANT ASSEMBLAGE OF BIRDS** 400367 waterfowl (5-year peak mean 1991/92-1995/96) Including: Cygnus columbianus bewickii, Anser brachyrhynchus, Branta bernicla bernicla,Tadorna tadorna, Anas penelope, Anas strepera, Anas acuta, Melanitta nigra, Bucephala clangula,Haematopus ostralegus, Pluvialis squatarola, Calidris canutus, Calidris alba, Calidris alpina alpina, Limosa limosa islandica, Limosa lapponica, Numenius arquata, Tringa totanus, Arenaria interpres		

C. Designated Sites

C.1 Ouse Washes SAC

C.1.1 Conservation objectives

With regard to the SAC and the natural habitats and/or species for which the site has been designated, and subject to natural change:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of the habitats of qualifying species
- The structure and function of the habitats of qualifying species
- The supporting processes on which the habitats of qualifying species rely
- The populations of qualifying species
- The distribution of qualifying species within the site

C.1.2 Qualifying features

- S1149. *Cobitis taenia:* Spined loach

C.1.3 Site description

The Ouse Washes play a major land drainage role by acting as a flood water storage area and the washland is thus subject to regular winter flooding. In the summer months the area provides grazing and hay. The regular winter flooding and the continuance of traditional management of cattle grazing and hay cutting maintains the nature conservation value of the area. The site is one of the country's few remaining areas of extensive washland habitat. It is of particular note for the large numbers of wildlife and waders which supports: for the large area of unimproved neutral grassland communities which it holds and for the richness of the aquatic fauna and flora within the associated watercourse. The capacity of the site to hold wintering and breeding waterfowl and waders is of international significance.

The primary reason for the SAC designation is for its representative populations of spined loach. This species is found within the Old Bedford River and Counter Drain areas; clear water and abundant macrophytes are present which are important for healthy populations of this species. The Ouse Washes SAC is one of only four outstanding localities in the UK representing spined loach populations.

C.1.4 Pressures and threats

The threats and pressures on the Ouse Washes SAC include pollution to groundwater and human-induced changes in hydraulic conditions. The Site Improvement Plan (SIP) specifies water pollution as a threat to the qualifying features (spined loach) and therefore the integrity of the SAC.

C.2 Ouse Washes SPA

C.2.1 Conservation objectives

With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified, and subject to natural change:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features
- The distribution of the qualifying features within the site

C.2.2 Qualifying features

- A037 *Cygnus columbianus bewickii*; Bewick's swan (Non-breeding)
- A038 *Cygnus cygnus;* Whooper swan (Non-breeding)
- A050 *Anas penelope;* Eurasian wigeon (Non-breeding)
- A051 *Anas strepera;* Gadwall (Breeding)
- A052 *Anas crecca;* Eurasian teal (Non-breeding)
- A053 *Anas platyrhynchos;* Mallard (Breeding)
- A054 *Anas acuta;* Northern pintail (Non-breeding)
- A055 *Anas querquedula;* Garganey (Breeding)
- A056 *Anas clypeata;* Northern shoveler (Non-breeding)
- A056 *Anas clypeata;* Northern shoveler (Breeding)
- A082 *Circus cyaneus;* Hen harrier (Non-breeding)
- A151 *Philomachus pugnax;* Ruff (Breeding)
- A156a *Limosa limosa limosa;* Black-tailed godwit (Breeding)
- Waterbird assemblage
- Breeding bird assemblage

C.2.3 Site description

The Ouse Washes is a flood storage reservoir, approximately 30 km long and 1 km wide, constructed in the 17th century to drain an extensive area of the fens. It encompasses two canalised main river channels of the River Great Ouse that run each side of its length, and an extensive area of wet grassland and field drains in between. It lies between Earith to the south and Downham Market to the north, within the Fens National Character Area (NCA) of Norfolk and Cambridgeshire.

The site is the largest area of washland habitat remaining in the country, subject to regular winter flooding. The soils of the washes are slightly base-rich deep peats, with a high silt content from floodwaters, which overlie Jurassic clays. In the summer months the low-lying grasslands provide grazing and hay, the frequent field drains both helping to keep groundwater levels high deep into the breeding season and also providing stock control as wet fences. The regular winter flooding and the continuance of traditional management of cattle grazing and hay cutting maintains the nature conservation value of the area. It is of particular note for the large numbers of wintering wildfowl and breeding waders it supports, for the large area of unimproved neutral

grassland communities which it holds, and for the richness of the aquatic fauna and flora within the associated ditches and drainage channels. Wildfowling takes place across parts of the Ouse Washes.

The Ouse Washes SPA was designated in 1993 under the EU Directive on the Conservation of Wild Birds. The boundary of the SPA largely follows that of the Ouse Washes SSSI, and overlaps with the Ouse Washes SAC, notified for spined loach, which is a strip covering two watercourses on the north-western edge. The nature reserves at WWT Welney and RSPB Ouse Washes form part of the SPA

C.2.4 Pressures and threats

The threats and pressures on the Ouse Washes SPA include pollution to groundwater and human-induced changes in hydraulic conditions. The SIP specifies water pollution as a threat to the qualifying features and therefore the integrity of the SPA. Inappropriate water levels are also acknowledged as a pressure on some of the qualifying species, where flooding may result in the decline of breeding bird site availability.

C.3 Ouse Washes Ramsar Site

C.3.1 Conservation objectives

Ramsar sites themselves do not have the same defined conservation objectives as National Sites Network (NSN) sites in the UK. However, a Ramsar Advisory Mission (RAM) was identified at the Ouse Washes in November 2001, which considers the following main issues to address:

- The hydraulics and water management of the Ouse Washes in the context of flood defence measures for the Fens rural area and drainage of summer floods in the catchment of River Great Ouse and its tributaries
- The nature conservation importance of the washlands, its dependence on the traditional grazing regime, grassland management, and its importance for vegetation development, plant species of conservation concern, breeding, migrating and wintering waterbirds and waders, and specific species of fish and invertebrates of conservation concern
- The quality of the water in the river and ditch systems, problems of eutrophication and water pollution affecting plant communities and species diversity

C.3.2 Qualifying features

- Criterion 1
  - The site is a good representative example of a natural or near-natural wetland characteristic of its biogeographic region. It is one of the most extensive areas of seasonally flooding washland of its type in Britain, and the wetland has high conservation value for many plants and animals.
- Criterion 2
  - The site supports appreciable numbers of nationally rare plants and animals. This includes several nationally scarce plants, including, small water pepper *Polygonum minus*, whorled water-milfoil *Myriophyllum verticillatum*, greater water parsnip *Sium latifolium*, river water-dropwort *Oenanthe fluviatilis*, fringed water-lily *Nymphoides peltata*, long-stalked pondweed *Potamogeton praelongus*, hair-like pondweed *Potamogeton trichoides*, grass-wrack pondweed *Potamogeton compressus*, tasteless water-pepper *Polygonum mite* and marsh dock *Rumex palustris*. Invertebrate records indicate that the site holds good relict fenland fauna, including the National Red Data Book species, large darter dragonfly *Libellula fulva* and the rifle beetle *Oulimnius major*.

- Criterion 5
  - This site supports an internationally important waterfowl assemblage (59133 waterfowl; five-year peak mean 1998/99 – 2002/03).
- Criterion 6
  - Over winter the site regularly supports internationally important populations of Bewick's swan, gadwall, pintail, shoveler, teal, whooper swan and wigeon.

C.3.3 Site description

This site is an area of seasonally-flooded washland habitat managed in a traditional agricultural manner. It lies between the Old and New Bedford Rivers, and acts as a floodwater storage system during winter months. The washlands support nationally and internationally important numbers of wintering waterfowl and nationally important numbers of breeding waterfowl. The site is also of note for the large area of unimproved neutral grassland communities which it holds, and for the richness of the aquatic flora within the associated watercourses.

C.3.4 Pressures and threats

The threats and pressures on the Ouse Washes Ramsar Site include: vegetation succession; drainage or reclamation for agriculture; water diversion for irrigation, domestic or industrial use; eutrophication and flooding caused by reservoir, barrage or dam effects.

C.4 The Wash and North Norfolk Coast SAC

C.4.1 Conservation objectives

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:

- The extent and distribution of qualifying natural habitats and habitats of qualifying species
- The structure and function (including typical species) of qualifying natural habitats
- The structure and function of the habitats of qualifying species
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- The populations of qualifying species, and,
- The distribution of qualifying species within the site.

C.4.2 Qualifying features

- 1110 Sandbanks which are slightly covered by sea water all the time
- 1140 Mudflats and sandflats not covered by seawater at low tide
- 1160 Large shallow inlets and bays
- 1170 Reefs
- 1310 Salicornia and other annuals colonising mud and sand
- 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- 1420 Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)
- 1150 Coastal lagoons * Priority feature
- 1365 Common seal (*Phoca vitulina)*
- 1355 Otter (*Lutra lutra)*

C.4.3 Site description

The Wash and North Norfolk Coast is one of the most diverse coastal systems in Britain. This diversity is largely dependent on physical processes that dominate the natural system; consequently, the vulnerability of habitats is linked to changes in the physical environment. The intertidal zone is being threatened from coastal squeeze as a result of land-claim and coastal defence works as well as sea-level rise and storm-surges. Structures which control water along the North Norfolk Coast have fallen into disrepair, preventing appropriate water level controls for breeding birds. Therefore, a review of the water level management on the freshwater marshes of the sites is needed to make the site adaptable to future climate change. Changes in the sediment budgets also threaten these habitats. At present activities which alter the sediment characteristics include dredging and coastal protection works. Current management is underway to address concerns over declines in shellfisheries. The area supports internationally important seal populations that are vulnerable to disturbance and disruption of the marine ecosystem upon which they depend. Such issues should be addressed through the Marine Scheme of Management.

C.4.4 Pressures and threats

- **Public access/ disturbance**

The Wash is a very popular area for recreational activity and visitor numbers are likely to grow, for example as a result of the English Coastal Path and housing development. The range of recreational activities may have adverse impacts on the sites (Boating; motor boating; water skiing; jet skis; commercial and non-commercial wildlife tours; commercial shipping; kiters (including surfers, boarders and buggy boarders); moorings; access to moorings; motorised vehicles; bikes, hovercraft; bird/wildlife watching; (dog) walking; Samphire collection, shellfish collection, bait digging, reed cutting, beachcombing, sea lavender gathering; beach barbecues; littering; wildfowling).

- **Siltation**

Sediment accretion is occurring in the Wash, and in such a dynamic system may be natural.

- **Fisheries: recreational marine and estuarine**

Recreational sea fishing and shoreline angling is a large-scale activity with potential to impact on fish stocks as a resource for designated birds, but the size of the activity locally and its impact is not known.

- **Invasive alien species**

There is a risk of introduction and spread of non-native/invasive species (e.g. American Razor Clam *Ensis directus*; Slipper limpet *Crepidula fornicata*; Pacific Oyster *Crassostrea giga*; oyster parasite Bonamia) from future fisheries and mussel lay stocking. There is also a risk of translocation of invasive species through ballast water transfer and discharge.

- **Inappropriate coastal management**

Following the recent tidal event of December 2013 there may now be conflicts between flood risk management and the protection and provision of SPA/SAC habitats.

- **Fisheries: commercial marine and estuarine**

A consent was granted to a private fishery tenant in 1984 for collection of shellfish, killing of starfish and application of lime to the seabed. No restriction on harvesting methodology or level were applied to the consent. Therefore, there is a risk to site features due to uncertainty of current management.

- **Predation**

Lack of predator control, where appropriate, is having an impact on the ability of sites to support breeding bird populations

- **Coastal squeeze**

Coastal squeeze at this site may lead to a gradual loss of intertidal and coastal habitats due to sea level rise and the erection and maintenance of coastal defences. The Wash Shoreline Management Plan and the North Norfolk Coast Shoreline Management Plan are subject to Habitats Regulations Assessment. Some areas of compensatory habitat still need to be designated.

- **Change in land management**

Grazing management. Areas of saltmarsh may be over and under-grazed throughout the site.

C.5 The Wash SPA

C.5.1 Conservation objectives

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

C.5.2 Qualifying features

ARTICLE 4.1

- During the breeding season the area regularly supports:

Sterna albifrons, Sterna hirundo

- Over winter the area regularly supports:

Cygnus columbianus bewickii, Limosa lapponica

ARTICLE 4.2

- Over winter the area regularly supports:

Anas acuta, Anas penelope, Anas strepera, Anser brachyrhynchus, Arenaria interpres, Branta bernicla bernicla, Bucephala clangula, Calidris alba, Calidris alpina alpina Calidris canutus, Haematopus ostralegus, Limosa limosa islandica, Melanitta nigra, Numenius arquata, Pluvialis squatarola, Tadorna tadorna, Tringa totanus.

ARTICLE 4.2

- Over winter the area regularly supports:

Cygnus columbianus bewickii, Anser brachyrhynchus, Branta bernicla bernicla, Tadorna tadorna, Anas penelope, Anas strepera, Anas acuta, Melanitta nigra, Bucephala clangula, Haematopus ostralegus, Pluvialis squatarola, Calidris canutus, Calidris alba, Calidris alpina alpina, Limosa limosa islandica, Limosa lapponica, Numenius arquata, Tringa totanus, Arenaria interpres.

C.5.3 Site description

The biological richness of the Wash is largely dependent on the physical processes that dominate the natural systems and consequently the ecological vulnerability is closely linked to the physical environment. The intertidal zone is vulnerable to coastal squeeze as a result of land-claim, coastal defence works, sea-level rise, and storm surges. Intertidal habitats are potentially affected by changes in sediment budget caused by dredging and coastal protection, construction of river training walls and flood defence works. The site is also potentially vulnerable to gas exploration. Activities affecting sediment budget and anthropogenic causes of coastal squeeze would be addressed through the management scheme being developed jointly for the SAC/SPA on this site. The estuary is fed by four large rivers which drain a substantial area of Eastern England. The volume and quality of water entering the Wash is dependent on the use made of these rivers for water abstraction and agricultural and domestic effluents. Discharge consents and abstraction licenses would be reviewed under the provisions of the Habitats Regulations.

There are two Air Weapons Ranges within the site; activities on these ranges are covered by a Memorandum of Understanding between the Ministry of Defence and Department of the Environment, a Declaration of Intent between the Ministry of Defence and Natural England and by Site Management Statements with Natural England. There is a Nature Conservation Management Plan and Management Committee for one of the ranges. These issues have been addressed in the Wash Estuary Management Plan and by Local Environment Agency Plans and would be extended through the Marine Scheme of Management which is now in progress. Vegetated shingle is a sensitive habitat. The site is managed to limit recreational pressures. Much of the interest is self-sustaining with little need for intervention. Natural coastal processes would lead to changes in the extent of lagoons at Shingle Street over time.

C.5.4 Pressures and threats

- **Public access/ disturbance**

The Wash is a very popular area for recreational activity and visitor numbers are likely to grow, for example as a result of the English Coastal Path and housing development. The range of recreational activities may have adverse impacts on the sites (Boating; motor boating; water skiing; jet skis; commercial and non-commercial wildlife tours; commercial shipping; kiters (including surfers, boarders and buggy boarders); moorings; access to moorings; motorised vehicles; bikes, hovercraft; bird/wildlife watching; (dog) walking; Samphire collection, shellfish collection, bait digging, reed cutting, beachcombing, sea lavender gathering; beach barbecues; littering; wildfowling).

- **Siltation**

Sediment accretion is occurring in the Wash, and in such a dynamic system may be natural.

- **Fisheries: Recreational marine and estuarine**

Recreational sea fishing and shoreline angling is a large-scale activity with potential to impact on fish stocks as a resource for designated birds, but the size of the activity locally and its impact is not known.

- **Invasive alien species**

There is a risk of introduction and spread of non-native/invasive species (e.g. American Razor Clam *Ensis directus*; Slipper limpet *Crepidula fornicata*; Pacific Oyster *Crassostrea giga*; oyster parasite Bonamia) from future fisheries and mussel lay stocking. There is also a risk of translocation of invasive species through ballast water transfer and discharge.

- **Inappropriate coastal management**

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- **Fisheries: Commercial marine and estuarine**

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- **Predation**

Lack of predator control, where appropriate, is having an impact on the ability of sites to support breeding bird populations

- **Coastal squeeze**

Coastal squeeze at this site may lead to a gradual loss of intertidal and coastal habitats due to sea level rise and the erection and maintenance of coastal defences. The Wash Shoreline Management Plan and the North Norfolk Coast Shoreline Management Plan are subject to Habitats Regulations Assessment. Some areas of compensatory habitat still need to be designated.

- **Change in land management**

Grazing management. Areas of saltmarsh may be over and under-grazed throughout the site.

C.6 The Wash Ramsar Site

C.6.1 Conservation objectives

Ramsar sites themselves do not have the same defined conservation objectives as National Sites Network (NSN) sites in the UK. No further information is available on the conservation objectives of this site, although objectives relating to The Wash are available through The Wash SAC designation.

C.6.2 Qualifying features

- **Criterion 1**

The Wash is a large shallow bay comprising very extensive saltmarshes, major intertidal banks of sand and mud, shallow water and deep channels.

- **Criterion 3**

Qualifies because of the inter-relationship between its various components including saltmarshes, intertidal sand and mud flats and the estuarine waters. The saltmarshes and the plankton in the estuarine water provide a primary source of organic material which, together with other organic matter, forms the basis for the high productivity of the estuary.

- **Criterion 5**
  - Assemblages of international importance:
    - Species with peak counts in winter:

      292541 waterfowl (5-year peak mean 1998/99-2002/2003)
- **Criterion 6**

Species/populations occurring at levels of international importance.

- Species with peak counts in spring/autumn:
  - Eurasian oystercatcher, *Haematopus ostralegus ostralegus*, Europe & NW Africa - wintering
  - Grey plover, *Pluvialis squatarola*, E Atlantic/W Africa -wintering
  - Red knot, *Calidris canutus islandica*, W & Southern Africa (wintering)
  - Sanderling, *Calidris alba*, Eastern Eurasian curlew, *Numenius arquata arquata*, Europe (breeding)
  - Common redshank, *Tringa totanus totanus*,
  - Ruddy turnstone, *Arenaria interpres interpres*, NE Canada, Greenland/W Europe & NW Africa
- Species with peak counts in winter:
  - Pink-footed goose, *Anser brachyrhynchus*, Greenland, Iceland/UK
  - Dark-bellied brent goose, *Branta bernicla bernicla*,
  - Common shelduck, *Tadorna tadorna*, NW Europe
  - Northern pintail, *Anas acuta*, NW Europe
  - Dunlin, *Calidris alpina alpina*, W Siberia/W Europe
  - Bar-tailed godwit, *Limosa lapponica lapponica*, W Palearctic

Species/populations identified subsequent to designation for possible future consideration under criterion 6.

- Species with peak counts in spring/autumn:
  - Ringed plover, *Charadrius hiaticula*, Europe/Northwest Africa
  - Black-tailed godwit, *Limosa limosa islandica*, Iceland/W Europe
- Species with peak counts in winter:
  - European golden plover, *Pluvialis apricaria apricaria*, *P. a. altifrons* Iceland & Faroes/E Atlantic
  - Northern lapwing, *Vanellus vanellus*, Europe
  - Black-headed gull, *Larus ridibundus*, N & C Europe

C.6.3 Site description

The Wash is the largest estuarine system in Britain. It is fed by the rivers Witham, Welland, Nene and Great Ouse. There are extensive saltmarshes, intertidal banks of sand and mud, shallow waters and deep channels. It is the most important staging post and over-wintering site for migrant wildfowl and wading birds in eastern England. It supports a valuable commercial fishery for shellfish and also an important nursery area for flatfish. It holds one of the North Sea's largest breeding populations of common seal *Phoca vitulina* and some grey seals *Halichoerus grypus*. The sublittoral area supports a number of different marine communities including colonies of the reef-building polychaete worm *Sabellaria spinulosa*.

C.6.4 Pressures and threats

None reported but the Ramsar Information Sheet (2008) needs updating. See SAC/SPA Pressures and Threats (Section A. 1.4 & 2.4).