Hampshire Water Transfer and Water Recycling Project

Environmental Water Quality Report

Spring 2025 Consultation

from Southern Water

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Glossary

Term	Definition
Budds Farm Wastewater Treatment Works (WTW)	This is an existing Southern Water site that treats wastewater prior to release into the Solent via the Eastney Long Sea Outfall. The Project would utilise treated wastewater from the Budds Farm WTW to produce recycled water at the proposed Water Recycling Plant.
“Classic” operation scenario	This scenario refers to the maintenance of water levels in Havant Thicket Reservoir, in accordance with Portsmouth Water’s existing planning permission, through the use of spring water inputs from Bedhampton and Havant Springs only.
Eastney Long Sea Outfall (LSO)	This is an existing Southern Water outfall used to release treated wastewater from Budds Farm WTW into the Solent in an area of high dispersion. No physical works to the Eastney LSO are anticipated as part of the Project, however reject water produced at the proposed Water Recycling Plant is proposed to be released from the Eastney LSO using the existing Eastney Pumping Station and Eastney Transfer Tunnel.
Havant Thicket Reservoir	The Havant Thicket Reservoir is a new reservoir, currently under construction, led by Portsmouth Water. In order to facilitate the water recycling process and associated transfer, the Project interfaces with, and proposes to connect into, the reservoir.
Main River	Watercourses designated as ‘Main’ are generally the larger arterial watercourses. The Environment Agency has permissive powers, but not a duty, to carry out maintenance, improvement or construction work on designated Main Rivers.
Million litres per day (Ml/d)	Unit to describe volumes of water.
Peak operation	The period when the Project would be operating at maximum capacity (i.e. during drought conditions). During peak operation the proposed Water Recycling Plant would produce 60Ml/d of recycled water, which would be transferred to Havant Thicket Reservoir. 90Ml/d of source water would be transferred from Havant Thicket Reservoir to Otterbourne Water Supply Works (WSW), an existing facility operated by Southern Water near Winchester.
“Post WRP” operation scenario	This scenario is used to describe an operational scenario following commissioning of the Project and the release of recycled water into Havant Thicket Reservoir. Under this scenario, recycled water is blended with spring water before entering the reservoir.
Proposed Water Recycling Plant (WRP)	The proposed WRP would use an advanced treatment process to turn treated wastewater from Budds Farm WTW into purified

Term	Definition
	recycled water. The proposed WRP would be located in the vicinity of Budds Farm WTW.
Recycled water	Treated, purified water that has been produced by taking treated wastewater and removing remaining impurities using advanced treatment techniques.
Reject water	During the water recycling process, reject water is produced. Reject water is water containing impurities removed from the treated wastewater and would be released into the Solent using the existing Eastney LSO.
Spring 2025 Consultation	Spring 2025 Consultation focussing, in part, on water quality and biodiversity, underpinned by the content of this Report.
WER	The Water Environment (England and Wales) Regulations 2017 (WER). These Regulations transpose the European Water Framework Directive 2000/60/EC into law in England and Wales.
WFD Directions	The Water Framework Directive (WFD) (Standards and Classification) Directions (England and Wales) 2015 (WFD Directions). The WFD Directions establish a series of thresholds that are used in the classification of water body status under the WER.

Non-Technical Summary

This report provides an overview of the environmental water quality modelling and assessments being carried out as part of the Hampshire Water Transfer and Water Recycling Project (the 'Project'). This comprehensive suite of investigations is helping us to understand the potential effects of the Project on the quality of water in the environment and how this may benefit or impact wildlife.

The report specifically looks at the potential effects that may occur in several water bodies as a result of the Project and how they might need to be managed.

These water bodies are:

- Havant Thicket Reservoir
- Riders Lane Stream and Hermitage Stream
- Langstone Harbour and the Solent

We are consulting on the information in this report, before it is developed further and finalised as part of our Development Consent Order application later this year.

A non-technical summary of the key findings for each water body is presented below.

Havant Thicket Reservoir

The water quality modelling and assessments have not highlighted any potential environmental effects from storing purified recycled water in Havant Thicket Reservoir, other than for phosphorus.

The initial water quality modelling predicts an increase in phosphorus in the reservoir following the introduction of purified recycled water from the proposed Water Recycling Plant. This increase is predicted to stimulate the growth of algae in the reservoir.

A water body high in phosphorus would typically have low biodiversity (i.e. it would not support a diverse range of aquatic plants and animals). This is because algae limit the amount of light passing through the water. Also, when algae die, they can reduce the amount of oxygen in the water. As a result, the reservoir would be expected to become home to a smaller range of aquatic wildlife than if there was a lower level of phosphorus within it.

An assessment has been undertaken of how the planned bubbler system in the reservoir, which mixes the water by pumping air through it, would reduce the growth of algae in the summer and retain more oxygen in the water. While using the bubbler would help reduce algae and retain more oxygen in the reservoir, it would not reduce the predicted increase in phosphorus arising from the purified recycled water.

Modelling has predicted that reducing phosphorus in the purified recycled water would support a more diverse range of aquatic plants and animals. As a result, our Development Consent Order application will provide for additional phosphorus treatment measures as part of the water recycling process. As our environmental regulator, the Environment Agency will set the water quality requirements of the purified recycled water that can go into the reservoir.

The level of nitrates would be significantly lower in the purified recycled water than the spring water in the reservoir. This is predicted to reduce the level of nitrates in the reservoir however this is not sufficient enough to offset the increase in phosphorus and likelihood of algal growth.

Riders Lane Stream and Hermitage Stream

Once filled, Havant Thicket Reservoir will help to maintain and improve flows within the downstream watercourses of Riders Lane Stream and Hermitage Stream which will receive water from it.

When purified recycled water is added to the reservoir, these watercourses are predicted to experience some changes in water quality. Levels of nitrate would beneficially decrease. Alkalinity and pH would also decrease while phosphorus would increase. Unlike the reservoir though, the phosphorus would not be at a level which is likely to limit biodiversity. Whilst the modelling has predicted an increase in Biochemical Oxygen Demand (a measure of the amount of oxygen used by small organisms in the water) the level of oxygen in the water is predicted to increase as a result of the operation of the reservoir, resulting in a potential benefit to biodiversity. Adding purified recycled water to the reservoir would support this benefit.

Overall, the predicted changes in water quality arising from the Project in Riders Lane Stream and Hermitage Stream are not predicted to result in any negative effects on biodiversity.

Langstone Harbour and the Solent

As Riders Lane Stream and Hermitage Stream feed into Langstone Harbour, the water quality changes predicted within them are expected to result in some small changes in the harbour too. These changes are not expected to result in negative effects on water quality and the wildlife of the harbour.

The reject water that would be released from the proposed Water Recycling Plant into the Solent, 5.7km offshore via the existing Eastney Long Sea Outfall, is predicted to result in very small water quality changes. These changes are not expected to result in negative effects on the water quality or biodiversity of the Solent.

The proposed Water Recycling Plant would include a surface water drainage system, including a new outfall, to release rainwater to the Hermitage Stream and Langstone Harbour. Modelling has predicted that this outfall would not have negative effects on water quality in the Hermitage Stream or Langstone Harbour.

Next steps

As the design of Havant Thicket Reservoir progresses, further water quality modelling will be undertaken to take account of changes in the design and operation of the reservoir. We will reflect this ongoing modelling work, where possible, in the Development Consent Order application.

Overall, environmental water quality in the downstream watercourses, the harbour and the Solent is predicted to be largely unaffected by the addition of purified recycled water or reject water from the water recycling process. However, the modelling predicts an increase in phosphorus in the reservoir from the introduction of purified recycled water which may limit biodiversity. Our Development Consent Order application will therefore include additional measures for reducing phosphorus as part of the water recycling treatment process.

An Environmental Permit is required for the release of purified recycled water into Havant Thicket Reservoir and of reject water from the proposed Water Recycling Plant to the Solent. We will apply for this permit alongside our Development Consent Order application.

The Environment Agency, our environmental regulator, will stipulate in the Environmental Permit the water quality requirements of the purified recycled water that can go into the reservoir, including for phosphorus. We are working with the Environment Agency to determine how the phosphorus treatment measures are best introduced. Confirming the Environmental Permit requirements is essential to informing these measures and ensuring the Project meets regulatory requirements while delivering best value for customers.

1 Introduction

1.1 Hampshire Water Transfer and Water Recycling Project

Overview of the Project

1.1.1 Abstraction licence reductions, climate change and population growth mean Southern Water is facing a shortfall of 200 million litres of water a day in Hampshire during a drought. As a result, the company is developing new sources of supply to make up this shortfall and maintain public supplies while protecting the county's chalk rivers.

1.1.2 Southern Water is proposing to submit an application for a Development Consent Order (DCO) for the Hampshire Water Transfer and Water Recycling Project (hereafter 'Project') under the Planning Act 2008. The Project seeks to create a new drought resilient source of water that protects and enhances the environment, comprising a combination of both water transfer and water recycling technology that during drought conditions would play a major role in making up any shortfall in water supply across the Hampshire supply area. The Project would be operational throughout the year however peak operation would only occur during drought conditions.

1.1.3 The Project would use an advanced treatment process to turn treated wastewater into purified recycled water (hereafter 'recycled water') at a proposed Water Recycling Plant (WRP), to be located south of Havant in the vicinity of Budds Farm Wastewater Treatment Works (WTW). A portion of the treated wastewater from Budds Farm WTW would be redirected for advanced treatment within the proposed WRP. This would produce recycled water for transfer to Havant Thicket Reservoir, where it would supplement the spring water that will be stored in the reservoir in accordance with Portsmouth Water's existing planning permission. The reject stream from this new treatment process would then be transferred back to Budds Farm WTW by pipeline and released into the existing Eastney Transfer Tunnel, downstream of the treated wastewater channel, where it would be blended with the unused treated wastewater from Budds Farm WTW and released via the existing Eastney Long Sea Outfall (LSO) into the Solent.

1.1.4 Under Portsmouth Water's existing planning permission, the Havant Thicket Reservoir project will require the release of 'compensatory flows' to Riders Lane Stream, a Main River (as classified by the Environment Agency - typically denoting larger watercourses), which flows south from the reservoir before joining the Hermitage Stream. The Hermitage Stream continues to flow south through Bedhampton and into Langstone Harbour. The purpose of the compensatory flows is to maintain and improve flows within these watercourses once the reservoir is operational. The addition of recycled water into the reservoir would not alter the compensatory flow volumes which has been agreed by Portsmouth Water with the Environment Agency as part of the reservoir impoundment licence.

1.1.5 The proposed WRP would also include an on-site surface water Sustainable Drainage System (SuDS) which includes a new outfall releasing to the tidal reach of the adjacent Hermitage Stream, which subsequently flows into Langstone Harbour.

1.1.6 In parallel with the DCO application, Southern Water is seeking to apply for a new Environmental Permit from the Environment Agency for the release of recycled water into Havant Thicket Reservoir and the release of WRP reject water into the Solent via the Eastney LSO. These releases require a surface water pollution risk assessment. Southern Water is engaging with the Environment Agency through a pre-application process to confirm the requirements of this risk assessment and Environmental Permit application process.

Summer 2022 and 2024 Consultations

1.1.7 Southern Water consulted on the Project in Summer 2022 and, more recently, in Summer 2024. During the Summer 2024 Consultation, the company actively sought feedback from consultees and stakeholders on its proposals.

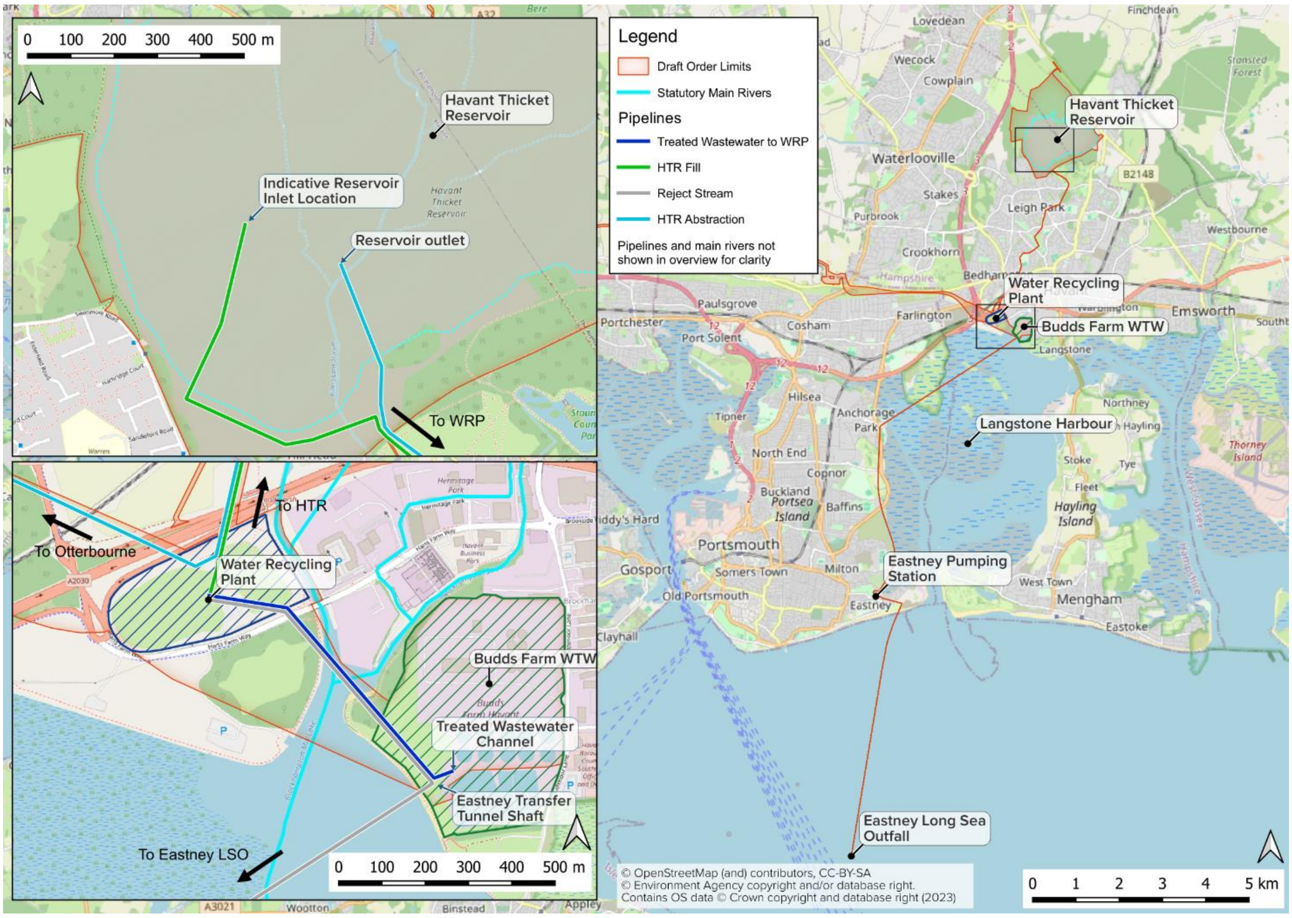
1.1.8 Preliminary impacts and initial proposals for mitigation were provided in a Preliminary Environmental Information (PEI) Report. The PEI Report was prepared to enable consultees to understand the likely significant environmental effects of the Project based on the information available at the time. The PEI Report built on the findings of the Environmental Impact Assessment (EIA) Scoping Report submitted on 21 July 2023, taking account of the EIA Scoping Opinion adopted by the Secretary of State (SoS) on 31 August 2023.

1.2 Spring 2025 Consultation and purpose of this Report

1.2.1 Since the Summer 2024 Consultation, water quality modelling and assessment work, undertaken jointly by Southern Water and Portsmouth Water, has enabled further understanding of the potential effects of the Project on the water environment and supported biodiversity. This Spring 2025 Consultation now provides an opportunity for consultees to provide feedback on this latest information, prior to this being developed further to support the DCO application.

1.2.2 This 'Environmental Water Quality Report, Spring 2025 Consultation' (hereafter 'Report') is focussed solely on water quality matters associated with Havant Thicket Reservoir, downstream watercourses (Riders Lane Stream, Hermitage Stream), Langstone Harbour and the Solent, including consideration of how water quality changes may impact nationally and internationally designated sites, and supported freshwater and marine flora and fauna. The key features considered within this Report are presented in Figure 1-1. The locations of the Riders Lane Stream and Hermitage Stream are presented in Figure 3-1.

Figure 1-1 Key features and water bodies assessed within this Report



1.2.3 The Report primarily utilises the baseline information presented within the PEI Report, supplemented by further additional baseline data collected since the Summer 2024 Consultation.

1.2.4 The emerging conclusions of the water quality assessment work have, and will continue to be, regularly discussed with relevant stakeholders as Southern Water develops and finalises the DCO application.

1.2.5 Water quality modelling has comprised the following four activities:

- Water quality modelling within Havant Thicket Reservoir. The purpose of this modelling is to assess the potential water quality changes associated with releasing recycled water into the reservoir. This modelling is summarised in section 3.1.
- Water quality modelling of water bodies downstream of Havant Thicket Reservoir. The purpose of this modelling is to assess the potential water quality effects to compensatory flows as a result of releasing recycled water into the reservoir. This modelling is summarised in section 3.2.
- Dispersion modelling of reject water via the Eastney LSO in the Solent. This modelling considers the change to the existing release from the Eastney LSO from Budds Farm WTW as a result of the Project. This modelling is summarised in section 3.3.
- Proposed WRP SuDS modelling. The purpose of this modelling is to assess the potential water quality effects of the proposed release of treated surface

water runoff from the proposed WRP SuDS outfall into the tidal reach of the Hermitage Stream and Langstone Harbour. This modelling is summarised in section 3.4. The indicative location of the outfall is shown in Figure 3-14.

1.2.6 Separately to the Project and proposed DCO application, Southern Water is considering changes to Budds Farm WTW so that in times of wet weather storm flows from the site, currently releasing to Langstone Harbour, would instead be directed to Eastney LSO. Treated wastewater (currently releasing via the Eastney LSO) would instead be released from the Langstone Harbour Short Sea Outfall (SSO). Due to the configuration of Budds Farm WTW and its connection to the Eastney Transfer Tunnel, it is not possible for reject water from the proposed WRP to be released into Langstone Harbour via the existing SSO. As this potential reconfiguration project is not sufficiently developed at this stage, the potential interactions with the Project are not considered in this Report. If the reconfiguration project is sufficiently progressed at the time of DCO application, this will be considered within the Environmental Statement.

1.2.7 This Report considers the outcomes of the ongoing modelling activities stated above in terms of the following topics:

- Water environment (including freshwater, estuarine and marine water bodies), as set out in section 4. This section includes a preliminary assessment of compliance of the Project against water quality thresholds established in the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (see section 2 for further information).
- Freshwater biodiversity, as set out in section 5.
- Marine biodiversity, as set out in section 6.

1.2.8 These topics are presented within this Report as the full assessment of water quality modelling will be provided within these equivalent chapters of the Environmental Statement.

1.2.9 This Report is not presented as an addendum to the PEI Report, in that receptor value, magnitude of impact or significance (i.e. ‘neutral’, ‘moderate’, ‘minor’ or ‘major’) are not assigned in accordance with the Project’s EIA methodology (as set out in the PEI Report Chapter 5: EIA Approach and Methodology, Volume I). However, commentary is provided on whether the potential for any new or materially different significant effects, since the PEI Report, have been identified. The modelling and assessments will be refined, finalised and fully reported in the Environmental Statement which will include an assessment of significance. Furthermore, where the potential need for mitigation has been identified, Southern Water’s approach to determining and agreeing this with relevant regulators is summarised and will also be presented further within the Environmental Statement.

1.2.10 Further details of the water quality modelling and assessment work is provided in section 3.

1.3 Report structure

1.3.1 This Report is structured as follows:

- Section 1: Introduction

- Section 2: Water quality parameters and summary of baseline conditions
- Section 3: Summary of ongoing water quality assessments
- Section 4: Potential effects on the water environment
- Section 5: Potential effects on freshwater biodiversity
- Section 6: Potential effects on marine biodiversity
- Section 7: Summary and next steps

2 Water quality parameters and summary of baseline conditions

2.1 Introduction

2.1.1 This section provides a summary of background information on how water quality in rivers, lakes, estuarine and coastal waters is assessed under the Water Framework Directive 2000/60/EC (WFD) (section 2.2), defines the study area assessed in this Report (section 2.3) and describes the baseline conditions of each water body, based on desk study and survey data (section 2.4).

2.1.2 The WFD is a key piece of European environmental legislation aiming to improve and protect the water environment on a catchment scale. Relevant legislation and terminology relating to the WFD used within this Report is presented below:

- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (hereafter 'WER'). The WER transpose the WFD into law in England and Wales.
- The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (hereafter 'WFD Directions'). The WFD Directions establish a series of thresholds that are used in the classification of water body status under the WER.
- WER Compliance Assessment – an assessment of compliance with the WER that must be undertaken for all major infrastructure projects such as this Project, as required by the Planning Inspectorate (2024).

2.2 Water quality parameters

Environmental water quality and the Water Environment Regulations

2.2.2 Government requirements for water quality in rivers, lakes, estuarine and coastal waters are set out in the WER. These regulations continue to be in force following the United Kingdom's withdrawal from the European Union under the terms of the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019.

2.2.3 The WER require Defra and the Environment Agency to prevent deterioration and protect and enhance the status of aquatic ecosystems. These authorities must ensure that new activities do not adversely impact upon the status of aquatic ecosystems or limit the improvements that can be achieved in the future. The potential impacts of historical activities and modifications also need to be considered. The WER apply to all types of water bodies, including those that are artificial, such as reservoirs.

2.2.4 There are two separate components used to classify the status of surface water bodies; ecological and chemical.

2.2.5 The ecological status of a surface water body is assessed according to the condition of:

- Biological quality elements, including fish, invertebrates and aquatic flora.

- Physico-chemical quality elements, including temperature, salinity, pH, and nutrient concentrations.
- Hydromorphological quality elements, including morphological conditions, hydrological regime and tidal regime.

2.2.6 The ecological status of surface waters is recorded on a scale of 'high', 'good', 'moderate', 'poor' and 'bad'. The ecological status of a water body is determined by the Environment Agency using the lowest scoring quality element, which means that the condition of a single quality element can cause a water body to fail to reach the overall environmental objective of Good Ecological Status (GES).

2.2.7 The chemical status of a water body is recorded as either 'good' or 'fail' and is determined by the recorded concentrations of a range of potentially toxic chemicals, which are collectively referred to as 'priority substances' and 'priority hazardous substances'. Concentrations of several "ubiquitous, persistent, bioaccumulative, toxic substances" (uPBTs) found in all surface waters means that no water bodies in England or Wales are currently at 'good' chemical status.

2.2.8 By comparing measured or modelled values of water quality parameters to thresholds set in the WFD Directions, it is possible to determine the status of a water body and therefore provide an indication of its environmental 'quality'.

Definition of key parameters

2.2.9 A brief description of the key water quality parameters assessed in this Report, and their relevance as physico-chemical quality elements under the WFD Directions, is provided below in Table 2-1.

Table 2-1 Water quality parameters and relevance to WFD Directions

Parameter	Description	Relevance to WFD Directions
Basic water quality parameters		
pH	A measure of the acidity or alkalinity of a liquid. Although different organisms have different levels of tolerance to high (alkaline, pH 8 – 14) or low (acid, pH 1 - 6) pH, most organisms prefer broadly neutral pH (pH 6 – 8).	pH is used to classify the physico-chemical status of rivers in the WFD Directions. Status class thresholds are set on the basis of the 5th, 10th and 95th percentiles of the measured data rather than absolute values.
Dissolved Oxygen (DO)	DO is a measure of the amount of gaseous oxygen dissolved in water, which indicates how much oxygen is available to aquatic organisms. Higher DO concentrations are usually indicative of good water quality. As cold water can contain more oxygen than warmer water, DO is subject to natural seasonal variations.	DO is used to classify the physico-chemical status of rivers, lakes, estuaries and coastal waters under the WFD Directions. Status class thresholds for rivers are set on the basis of the 90th percentile of the measured data rather than absolute values. In lakes, thresholds are expressed as mean values for July and August. In estuaries and coastal waters, the 5th percentile is used.

Parameter	Description	Relevance to WFD Directions
Biochemical Oxygen Demand (BOD)	BOD is a measure of the amount of DO required by bacteria to metabolise (consume) organic compounds in water.	Although the WFD Directions sets out thresholds for BOD in rivers, these are not used to classify water body status but are sometimes used by the Environment Agency to determine site-specific limits for releases as part of the Environmental Permitting process.
Nutrients		
Orthophosphate (PO_4)	PO_4, alternatively known as Soluble Reactive Phosphorus or simply 'phosphate', is a soluble, inorganic form of phosphorus that is found in water and is taken up directly by plant cells. Phosphorus is an essential nutrient for aquatic life that is naturally found in water. Phosphorus is an important controller of phytoplankton growth, which can be inhibited if concentrations are too low. However, if concentrations become too high, excess phytoplankton growth can occur, thereby reducing the amount of DO available in the water body and reducing species diversity.	PO_4 is used to classify the physico-chemical status of rivers under the WFD Directions. Status class thresholds are established on the basis of annual mean concentrations.
Total Phosphorus (TP)	TP is a measure of all forms of phosphorus found in water, including PO_4, larger condensed phosphates (linked groups of PO_4 molecules) and organic phosphates (PO_4 molecules linked to an organic molecule).	TP is used to classify the physico-chemical status of lake water bodies under the WFD Directions. Status class thresholds are established on the basis of annual mean concentrations.
Total Ammonia as Nitrogen (TAN)	The term "total ammonia as N' is used to refer to the sum of a range of different chemical compounds that contain nitrogen, including ammonia and (NH_3), ammonium (NH_4). Like phosphorus, nitrogen is an essential nutrient that is naturally found in water, but high concentrations can result in excess phytoplankton growth and adverse impacts on other aquatic organisms.	Total ammonia as N is used to classify the physico-chemical status of rivers and lakes under the WFD Directions. Status class thresholds are set on the basis of the 90th percentile of the measured data rather than absolute values.
Total Nitrogen (TN)	TN is a measure of all forms of nitrogen found in water, including NH_3 and NH_4 and inorganic nitrate (NO_3) and nitrite (NO_2). Nitrates and nitrites are produced by the bacterial breakdown of ammonia	Although TN is not directly used to classify water body status, its importance as a nutrient for phytoplankton growth means that it was considered as part of the reservoir modelling discussed in section 3.1.
Dissolved Inorganic Nitrogen (DIN)	DIN is a form of nitrogen which includes inorganic ammonia, NO_2 and NO_3. Plant cells can very easily take up DIN from water, which means that it is an important controller of phytoplankton growth in sea water.	DIN concentrations are used to classify the physico-chemical status of transitional and coastal water bodies under the WFD Directions. Status class thresholds are established on the basis of mean concentrations between November and February.

Parameter	Description	Relevance to WFD Directions
Other parameters		
Dissolved Organic Carbon (DOC)	DOC is a measure of organic carbon found in water. It is formed as a result of the decomposition of organic matter and is an important food source for aquatic life.	DOC concentrations are not directly used to classify water body status under the WFD Directions. However, DOC is used to determine which thresholds are applicable to the acid neutralising capacity of river water bodies and which standards for invertebrates should be used in lake water bodies.
Dissolved Inorganic Carbon (DIC)	DIC is a measure of the inorganic carbon compounds dissolved in water and includes carbon dioxide (CO_2) bicarbonates (HCO_3), and carbonates (CO_3).	DIC plays an important role in neutralising the acidity of water, but it is not used to classify the physico-chemistry of any water bodies under the WFD Directions.
Chlorophyll-a	Chlorophyll-a is used by plants during photosynthesis and is therefore used as an indicator of phytoplankton growth (i.e., higher concentrations of chlorophyll-a indicate greater growth of phytoplankton).	Chlorophyll-a is not directly used to classify water body status under the WFD Directions. However, it is used as an indicator of phytoplankton growth in lake water bodies.
Total Suspended Solids (TSS)	TSS is a measure of the particulate matter suspended in a body of water and can include inorganic particles of soil and sediment as well as organic particles. TSS influences the turbidity (cloudiness) of water and is therefore a key factor in controlling the amount of light that can penetrate the water column; light availability is important for the growth of aquatic vegetation.	Turbidity is used to determine which thresholds for DIN should be applied in transitional and coastal water bodies under the WFD Directions. However, it is not directly used to classify physico-chemical status.
Total Iron (Fe)	Fe is naturally found in water as either soluble ferrous iron or insoluble ferric iron. Total Fe is a measure of the concentrations of both soluble and insoluble forms of iron in water.	Although Fe is an important nutrient, it can also be toxic in high concentrations. Fe is therefore recognised as a potential pollutant in the WFD Directions and is used to classify water body status.
Total Manganese (Mn)	Like Fe, Mn is naturally found in water. Total Mn is a measure of the concentrations of all forms of manganese in water.	Although Mn is an important nutrient, it can also be toxic in high concentrations. Mn is therefore recognised as a potential pollutant in the WFD Directions and is used to classify water body status.

2.3 Definition of the study area

2.3.1 The study area for this Report encompasses several water bodies which would receive releases of recycled water from the proposed WRP, compensatory flows from Havant Thicket Reservoir or reject water from the Eastney LSO. These water bodies are summarised below:

- Havant Thicket Reservoir: The modelling and assessment presented within this Report assumes that Havant Thicket Reservoir, which will be located in the northern part of the Hermitage Stream catchment, has been constructed. The operational reservoir would receive releases of recycled water from the proposed WRP. The reservoir will be designated by the Environment Agency as an ‘artificial’ or ‘heavily modified’ lake water body under the WER as it will exceed 40ha in area.

- Riders Lane Stream: A tributary of the Hermitage Stream and a Main River currently rising to the north of Havant Thicket and flowing in a broadly southerly direction until it joins the Hermitage Stream. The Riders Lane Stream will be partially severed by the reservoir once constructed, however will receive compensatory flows from the operational reservoir.
- Hermitage Stream: A Main River rising on high ground to the north of Havant, flowing in a broadly southerly direction until it flows into Langstone Harbour.
- Langstone Harbour: A transitional water body located to the south of Havant. The harbour is connected to the Solent via a narrow mouth between Eastney and Hayling Island.
- The Solent: The coastal waters of the Solent are located to the south of Havant and Langstone Harbour. Eastney LSO is an existing Southern Water outfall which releases into the Solent.

2.4 Summary of baseline ecology and water quality conditions

2.4.1 This section summarises the water quality and ecological baseline conditions of the water bodies identified in the study area. In addition to summarising the information already presented as part of the Summer 2024 Consultation, this section also presents more recent supplementary field survey and desk review undertaken to inform the Environmental Statement.

Havant Thicket Reservoir

2.4.2 As Havant Thicket Reservoir has not yet been constructed, there is no water quality or ecological monitoring data available to establish measured baseline conditions. Modelling has therefore been used to predict water quality in the reservoir throughout the “classic” operation phase and “post-WRP” operation phase (see section 3 for details).

Riders Lane Stream

2.4.3 Riders Lane Stream is a headwater stream which currently flows intermittently and is fed by both groundwater and rainfall sources, rising to the north of Havant Thicket and flowing in a broadly southerly direction until it joins the Hermitage Stream.

2.4.4 Riders Lane Stream forms part of the larger Hermitage Stream water body and therefore has the same ecological status (see below). Water quality data for the stream is relatively limited, although monitoring undertaken by Portsmouth Water to inform the EIA for Havant Thicket Reservoir (Portsmouth Water, 2019) suggests that water quality is generally good.

2.4.5 In terms of ecology, the upstream extents of Riders Lane Stream were recorded as largely dry and/or ponded during ecological surveys completed in 2022 and 2024. A large culvert beneath Middle Park Way Road presents a significant obstacle to fish passage and a barrier to flow. Some areas of low flowing run and glide habitat are present downstream of the culvert, however in general instream vegetation is largely absent and macrophyte diversity and species richness from desk study data and field survey data in 2022 and 2024 is low.

2.4.6 Data from the Environment Agency's National Fish Population Database (NFPD; Environment Agency, 2024), supported by data from fish surveys undertaken in 2022 (Southern Water) and 2024 (Portsmouth Water) identified bullhead (*Cottus gobio*; a species of community interest under Annex II of The Conservation of Habitats and Species Regulations 2017) and European eel (*Anguilla anguilla)*; a Species of Principal Importance (SPI) under the Natural Environment and Rural Communities Act 2006) in Riders Lane Stream. Macroinvertebrate surveys undertaken in 2024 identified a community of low diversity with moderate tolerance to water quality based on the Biological Monitoring Working Party (BMWP; Hawkes (1997)) and Whalley, Hawkes, Paisley and Trigg (WHPT; Paisley *et al.* (2014)) index scores.

Hermitage Stream (freshwater reach)

2.4.7 Hermitage Stream rises on high ground to the north of Havant, flowing in a broadly southerly direction until it flows into Langstone Harbour. It is adversely affected by existing point source pollution from public domestic misconnections and urban runoff (Environment Agency, 2023). As a result, the water body is at 'moderate' ecological potential for orthophosphate and pH and fails to meet the required chemical status for mercury and its compounds and polybrominated diphenyl ethers (PBDE) (Environment Agency, 2023). All other physico-chemical parameters monitored by the Environment Agency (acid neutralising capacity, ammonia, BOD, DO and temperature) are at 'high' status, while the remaining priority substances measured in the water body (e.g. groups of hydrocarbons, dioxins, pesticides and herbicides) are at 'good' status (Environment Agency, 2023).

2.4.8 The freshwater reach of the Hermitage Stream has been extensively modified with a significant weir at Bedhampton Spring, and several outfalls and wooden step weirs documented in the freshwater extents upstream of the tidal limit. In-stream habitats are mostly glide and shallow runs, with dense algae present through the freshwater reach indicating significant nutrient enrichment.

2.4.9 Macrophyte diversity and species richness from EA monitoring data and field survey data in 2022 and 2024 is low and no protected or designated macrophyte or macroinvertebrate species have been identified through survey or desk study data. Bullhead (Annex II species), European eel (SPI species) and three-spined stickleback (*Gasterosteus aculeatus*) have been recorded from EA monitoring data and from surveys to inform the Project in 2022. The current Hermitage Stream WFD status for biological quality elements is 'Moderate' based on poor status for fish and moderate status for invertebrates. Macrophytes and diatoms (combined) are not assessed in this catchment.

2.4.10 Portsmouth Water is developing a range of mitigation and compensation measures in the Hermitage Stream catchment as a result of WER Regulation 19 (derogation) requirements of the Havant Thicket Reservoir planning permission. This includes improvements to watercourse connectivity in Riders Lane Stream and the Hermitage Stream through culvert design and habitat improvements. These works aim to achieve improvement in ecological conditions of the catchment over time. The future ecological baseline may therefore alter and show improvements in habitat quality and freshwater biodiversity. These changes are unlikely to alter the conclusions of this Report, however further consideration will be given to the restoration works in the Environmental Statement.

2.4.11 The Hermitage Stream water body is within the Chichester, Langstone and Portsmouth Harbours Eutrophic Nitrate Vulnerable Zone and Langstone Harbour Shellfish Water.

Hermitage Stream (tidal reach)

2.4.12 Hermitage Stream experiences tidal effects in its lower reaches. Previous migratory fish surveys undertaken between June 2022 and June 2023 in the tidal section also identified European eel. Intertidal walkover surveys were undertaken in September 2024 between the A27 Havant bypass and the Harts Farm Way bridge and found that for this tidal section of the Hermitage Stream, habitats present were artificial hard structures and littoral mud. Revetment consisting of concrete blocks went from the upper to mid shore. The lower shore consisted of littoral mud habitat with some boulders and pebbles. An abundant species recorded was estuary wrack (*Fucus ceranoides*), a common species in brackish water. Surface water runoff and litter were noted with presence of a rotten egg smell. No protected or designated macrophyte or macroinvertebrate species have been identified through survey or desk study data.

Langstone Harbour

2.4.13 Langstone Harbour is an estuarine water body located to the south of Havant that is connected to the Solent via a narrow mouth between Eastney and Hayling Island. The water body is located in a number of protected areas: Langstone Harbour Site of Special Scientific Interest (SSSI), Chichester and Langstone Harbours Special Protection Area (SPA)/Ramsar site and the Solent Maritime Special Area of Conservation (SAC).

2.4.14 The water body is currently at ‘good’ status for physico-chemistry (Environment Agency, 2023). With the exception of mercury and PBDE, water quality in Langstone Harbour is generally good, with DIN, DO and a range of other pollutants (e.g. groups of hydrocarbons, dioxins, pesticides and herbicides) all at ‘good’ or ‘high’ status.

2.4.15 Langstone Harbour was formerly affected by eutrophication, caused by an excess of nutrients (particularly nitrates). However, nutrient loads (particularly from diffuse agricultural sources) have now decreased, and eutrophication is no longer considered to be an issue in the harbour. The harbour is designated as part of the Chichester, Langstone and Portsmouth Harbours Nitrate Vulnerable Zone and the Langstone Harbour Shellfish Water.

2.4.16 A comparison of seagrass extent mapped by Natural England in summer 2023 with that mapped by the Project from the seagrass survey conducted in summer 2022 (PEI Report Appendix 9.3 Intertidal seagrass survey, Volume II) indicates there were no seagrass beds mapped along the northern part of Langstone Harbour where the downstream of the Hermitage Stream converges with the harbour or around Long Island or North Binness Island. Nevertheless, migratory fish species

European eel and European smelt (*Osmerus eperlanus*) were identified from the previous migratory fish survey at the intertidal zone of Langstone Harbour (refer to PEI Report Appendix 9.2 Migratory fish surveys, Volume II).

Solent

2.4.17 Water quality in the Solent is under pressure from elevated concentrations of dissolved inorganic nitrogen (from diffuse agricultural runoff and point source releases), mercury compounds and PBDEs.

2.4.18 The water body forms part of multiple protected areas, including the Solent and Dorset Coast SPA, the Solent and Southampton Water SPA/Ramsar site, the Solent Maritime SAC and the South Wight Maritime SAC as well as multiple Marine Conservation Zone (MCZ) sites including Bembridge MCZ, Selsey Bills and the Hounds MCZ and Utopia MCZ. The Solent is also located in several Nitrate Vulnerable Zones (e.g. Hamble Estuary, Chichester, Langstone and Portsmouth Harbours, and Newtown Harbour, Medina Estuary and Eastern Yar), Urban Waste Water Treatment Directive protected areas (Chichester Harbour, Newtown Harbour, Medina Estuary), Shellfish Waters (Cowes and Medina, Approaches to Southampton Water, Pennington, Langstone Harbour), and Bathing Waters (Southsea East, Gurnard)).

2.4.19 Benthic ecology surveys were undertaken around the Eastney LSO (defined by the area of effect estimated by dispersion modelling during both tidal states (spring and neap)) in early 2024. Broadscale habitats identified were mainly subtidal mud and subtidal mixed sediment across the area, with some subtidal sand and sheltered muddy gravel habitats present. There was no Annex I reef or any notable or protected species observed.

2.4.20 Environmental deoxyribonucleic acid (eDNA) sampling and analysis has been completed to establish which fish communities and other species communities are likely to be present within the waters around the Eastney LSO. A total of 13 fish species were detected as well as other species such as sea squirt, sea anemone, bivalve, polychaete, diatom, algae, plant and fungus species. One notable marine fish species, namely common sole (*Solea solea*) (an SPI in England) was detected.

3 Summary of ongoing water quality assessments

3.1 Havant Thicket Reservoir

Summary of ongoing assessment

Modelling approach

3.1.1 Modelling of reservoir water quality is being conducted jointly by Portsmouth Water and Southern Water using the Aquatic Ecosystem Model – Three Dimensional (AEM3D) model which simulates the temporal behaviour of stratified water bodies. The model simulates the velocity, temperature and salinity of surface waters that are subjected to environmental and anthropogenic (human-caused) forces such as wind, surface heating and cooling, inflows, and withdrawals (Future Water, 2024).

3.1.2 The model also represents different compounds of carbon, nitrogen and phosphorus, DO, inorganic suspended solids, phytoplankton (microscopic organisms) and metals. The model predicts reservoir water quality at depth intervals at several locations in the reservoir.

Modelled parameters

3.1.3 As discussed in section 2.2, the model considered a range of common water quality parameters for which water quality standards have been established for lake water bodies under the WFD Directions (see section 4.2 for further discussion). These include:

- Basic water quality parameters, including temperature, pH, alkalinity, DO and BOD.
- Nutrients, including TP and DIN.
- Other parameters, including DOC, Chlorophyll-a, TSS, Total Iron and Total Manganese.

3.1.4 Initial concentrations of these parameters were estimated using measured data, (e.g. inputs from surface watercourses and long-term groundwater quality data from Portsmouth Water) and initial estimates of the quality of recycled water following treatment at the WRP (Future Water, 2024).

Model scenarios

3.1.5 The reservoir water quality modelling has been used to predict changes in water quality resulting from different periods of use during the operation of the reservoir:

- The initial reservoir filling phase (c. two years, late 2026 – February 2029) with water inputs from Bedhampton and Havant Springs over three winter periods.
- The maintenance of water levels through the use of spring water inputs from Bedhampton and Havant Springs only (c. three years, March 2029 – May 2032). This is referred to as the “classic” operation scenario and is assumed as a circa three-year period based on early 2024 design information.

- The onset of recycled water inputs as a result of the Project (c. 10 years included in the simulation, June 2032 – December 2041). This is referred to as the “post-WRP” operation scenario. This period is predicted to include some stabilisation effects, i.e. the recycled water would be introduced into the reservoir before it has fully stabilised.

3.1.6 The timescales set out above were agreed by Portsmouth Water and Southern Water and considered representative at the time of commissioning the modelling study. Any changes to the construction and operational timescales will be reflected in any further modelling as necessary where this is likely to influence the predicted water quality effects.

3.1.7 The model has tested a number of scenarios to evaluate a range of potential operations of the reservoir. These scenarios included an “extended classic” operational scenario, which simulated how the reservoir would develop beyond the end of the “classic” phase in 2032 without the introduction of recycled water from the proposed WRP. This allows long term water quality within the reservoir to be assessed, with and without the Project.

Assumptions

3.1.8 The model assumes maintenance of Havant Thicket Reservoir at or near its top water level during the “post-WRP” operational phase would be achieved by balancing recycled water and spring water inflows with withdrawals for water supply and compensatory flows to Riders Lane Stream. This water balance regime would also fulfil the original objective of the reservoir serving as an emergency water supply during future droughts.

3.1.9 The model has assumed that the inlet for both spring water and recycled water would be located in deep waters within the reservoir. Withdrawals for water supply and compensatory flows to Riders Lane Stream would be from one of three extraction points located in the south basin. The model also assumed that a bubbler would be installed in the two basins of the reservoir to mix the water.

Limitations

3.1.10 Whilst the comprehensive modelling approach adopted for this Project is an accepted method of analysis used to predict general trends in water quality, it is important to note that it has some limitations. As Havant Thicket Reservoir is still under construction, it is not possible to calibrate or verify the model using measured water quality data. The modelling is based upon several key assumptions, agreed by Southern Water and Portsmouth Water, informed by best available information and expert judgement.

3.1.11 This Report provides a summary of predicted water quality effects based on current design information. The modelling and assessments will be refined, finalised and fully reported in the DCO application, alongside details of proposed monitoring and mitigation.

3.1.12 Although the model outputs provide an indication of the likely impacts of the Project on the water environment, they are not intended to be used in the detailed design of any future mitigation options. Details of any future mitigation will be verified following a suitable period of operation of the Project.

Preliminary findings

Initial filling phase

3.1.13 The model results predict that the water quality in the reservoir varies, as expected, while the reservoir is filled with spring water, flows from the streams located to the north of the reservoir (these currently constitute the headwaters of Riders Lane Stream) and surface water rainfall from the contributing catchment.

3.1.14 High Sediment Oxygen Demand, Dissolved Inorganic Matter (DIM) and Dissolved Organic Matter (DOM) sediment fluxes occur as soils and vegetation within the reservoir basin become inundated, stabilising once the reservoir becomes filled.

3.1.15 The addition of a bubbler to mix water within the reservoir basin creates a well-oxygenated reservoir with low sediment fluxes, low concentrations of nutrient compounds such as phosphate and ammonium, low concentrations of dissolved metals (iron and manganese) and low DOM (including DOC).

“Classic” operation scenario

3.1.16 Water quality during the “classic” operation scenario reflects the input of c. 15Ml/d spring water from Bedhampton for one month each winter, continuous withdrawals of c. 1Ml/d to maintain flows in Riders Lane Stream, and withdrawals of c. 3Ml/d to Farlington WSW for three months over the spring and summer (refer to Future Water, 2024).

3.1.17 In terms of macronutrients which support plant growth, the initial modelling predicts that TP concentrations would gradually rise from c. 0.02mg/l (milligrams per litre) at the beginning of the “classic” phase to c. 0.03mg/l at the end of the phase. Conversely, TN concentrations steadily decrease from c. 6mg/l at the beginning of the “classic” phase to c. 3mg/l at the end of the phase.

3.1.18 For the purposes of the assessment presented in this Report, water quality in the reservoir during the “classic” operation phase is used to represent the future baseline, against which changes that could occur as a result of the addition of recycled water from the WRP into the reservoir are compared.

“Post-WRP” operation scenario

3.1.19 The introduction of recycled water into the reservoir is predicted to result in a change to reservoir water quality. Concentrations of phosphorus and carbon compounds are predicted to increase, reflecting the higher concentrations of these compounds in the recycled water in comparison to the spring water. As a result, phytoplankton growth is expected to increase.

3.1.20 The modelling predicts that, in the absence of further measures, TP concentrations rise from 0.03mg/l at the end of the “classic” operation scenario to c. 0.05mg/l following the introduction of recycled water. They then fluctuate slightly between c. 0.05mg/l and c. 0.06mg/l for the remainder of the 15-year simulation period. Chlorophyll-a concentration (an indicator of phytoplankton growth) shows a similar pattern and is likely to reflect the changes in nutrient concentrations.

3.1.21 Modelled TN concentrations reduce from c. 3mg/l at the end of the “classic” operation scenario to between c. 1.5mg/l and c. 2mg/l for the remainder of the simulation period. Although nitrogen is an essential nutrient for phytoplankton growth, there was not a simultaneous decline in the modelled chlorophyll-a concentration. This indicates that despite the reduction in TN concentration, there are still sufficient nutrients available during this scenario for uptake by phytoplankton. Further analysis is provided in section 5.2.

Alternative scenarios (Total Phosphorus reduction in recycled water)

3.1.22 To inform the development of measures to address the predicted increase in phytoplankton growth, the modelling has also considered alternative scenarios in which the concentrations of phosphorus compounds in the incoming recycled water from the proposed WRP were reduced to represent different levels of treatment efficiency (Future Water, 2024). A reduction in TP in the input water under each of the three scenarios resulted in correspondingly lower concentrations of TP within the reservoir, and a reduction in phytoplankton growth rates.

Potential environmental effects

3.1.23 Further discussion on the potential environmental effects of the changes described in the section above is provided in sections 4-6.

3.2 Compensatory flows

Summary of ongoing assessment

Modelling approach

3.2.1 The modelling described in section 3.1 was focussed on water quality in the reservoir and did not simulate potential effects on downstream water bodies. The reservoir model did however include a predicted quality envelope for the compensatory flows. This was used to define the input parameters for further downstream dispersion modelling to investigate the mixing and dispersion of water released from the reservoir through compensatory flows into downstream water bodies. The dispersion modelling approach is considered “conservative” for the majority of water quality parameters as it assumed that concentrations of each parameter are not subject to chemical degradation or biological uptake processes and are only affected by physical dispersion processes such as dilution.

3.2.2 Following completion of the preliminary dispersion modelling, additional degradation modelling has also been undertaken to consider the role of chemical and biological processes on a subset of parameters that are considered to be most sensitive to these processes (e.g. DO).

3.2.3 The preliminary model results described in this section will be used to inform the Environmental Statement and associated assessments (e.g. the WER compliance assessment and Habitats Regulations Assessment) and Environmental Permit application.

Modelled parameters

3.2.4 The dispersion model considered a range of water quality parameters included in the reservoir water quality model (Future Water, 2024) that are used to define the physico-chemical status of river and transitional water bodies and therefore have a water body status threshold set out in the WFD Directions. The following parameters have been modelled:

- Basic water quality parameters, including temperature, pH, alkalinity, DO and BOD.
- Phosphorus parameters, including TP and PO_4.
- Nitrogen parameters, including TN, NH_3 and NO_3.
- Carbon parameters, including DOC and DIC.

3.2.5 The additional degradation modelling focussed on a subset of these parameters, namely DO, BOD, PO_4, HN_4 and NO_3.

Model scenarios

3.2.6 The reservoir modelling has defined concentrations of parameters for the periods pre and post the utilisation of the reservoir for the storage of recycled water from the proposed WRP. This allowed two main scenarios to be considered in the downstream compensatory flow modelling:

- A "pre-implementation" scenario, informed by water quality outputs from the reservoir model during the "classic" operation phase (March 2029 – May 2032), prior to the input of water from the proposed WRP. This represents a future baseline scenario, against which the impacts of the Project need to be assessed.
- The "post-implementation" scenario, informed by water quality outputs from the reservoir model during the operational phase of the Project (June 2032 – December 2041), following the input of recycled water from the proposed WRP.

3.2.7 In each scenario, water quality inputs have been derived from the reservoir water quality model outputs for the corresponding time period. As a precautionary approach, each scenario used the maximum values for each parameter as a worst case, with the exception of DO, where the minimum rather than maximum values were used (reflecting that higher DO concentrations reflect higher water quality).

3.2.8 Water quality in the Hermitage Stream catchment and downstream water bodies is subject to change as a result of natural variations in freshwater flows and tidal patterns, depending upon rainfall events, tidal conditions and seasonality. In order to represent this, the modelling has considered low and bank-full freshwater flows, two spring-neap tidal cycles and summer and winter water temperatures (which are particularly important with respect to degradation modelling).

Comparison with baseline water quality data

3.2.9 The outputs of the modelling, which enables the difference between scenarios to be calculated, have also been compared to measured water quality data from key locations in the downstream water bodies that have been assembled from several sources:

- Water quality data for the Riders Lane Stream and Hermitage Stream collected by Portsmouth Water in 2008 - 2010 and 2018 - 2019 to inform the Havant Thicket Reservoir Environmental Statement (as represented by the "classic" operation phase).

- Water quality data for the Hermitage Stream at New Road from the Environment Agency's online Water Quality Data Archive, encompassing a 24-year period from 2000 to the most recent data available in 2024.
- Water quality data for Langstone Harbour (including the harbour mouth and points further inland) from the Environment Agency Water Quality Data Archive, also encompassing the period from 2000 to 2024.

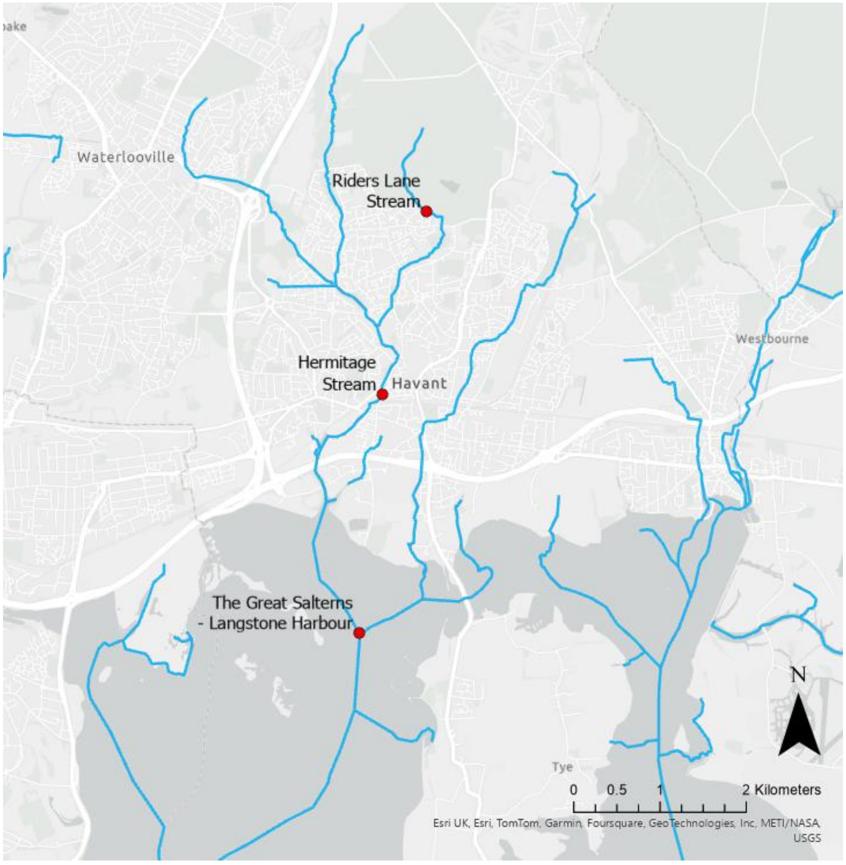
3.2.10 The above data has been used to draw the preliminary conclusions presented in this Report. However, Southern Water is currently collecting further water quality data for the Riders Lane Stream and Hermitage Stream to supplement the Portsmouth Water and Environment Agency data. Once further rounds of this monitoring are available for analysis, this data will be presented in the Environmental Statement included in the DCO application.

3.2.11 The preliminary results of the dispersion modelling have been produced for three sample points, as shown in Figure 3-1.

- Riders Lane Stream (immediately downstream of Havant Thicket Reservoir).
- Hermitage Stream (at the location of the EA water quality monitoring station).
- Great Salterns in Langstone Harbour.

3.2.12 The dispersion modelling outputs included the average (mean) predicted absolute change from the ambient water condition for each chemical parameter at each sample point. The percentage change for each chemical parameter was then predicted by comparing the differences between the baseline data and both modelled scenarios.

Figure 3-1 Sample point locations for comparison of modelled results and measured data



Preliminary findings: Dispersion modelling

3.2.13 Overall, the dispersion modelling predicts that there would be limited differences in concentrations of most water quality parameters between the "classic" and "post-WRP" operation scenarios. Changes are typically greatest in Riders Lane Stream and decrease considerably as water disperses in Langstone Harbour. During summer low flows, changes from the baseline are largely confined to the Riders Lane Stream, Hermitage Stream and the northern parts of Langstone Harbour. The spatial extent of changes increases during periods of higher flow, although they remain confined to the northern part of Langstone Harbour.

3.2.14 The remainder of this section includes a number of 'box and whisker' plots, as set out in Figures 3-2 to 3-4. These plots show the statistical characteristics of each water quality parameter. The vertical 'whiskers' (black lines) show the full range of data, excluding outliers. The solid-coloured boxes for each scenario denote the upper and lower quartiles of each dataset, and the horizontal black lines show the statistical 'median' value. For the purposes of this Report, a median value has been selected, as opposed to mean, to avoid outliers in baseline data skewing the representation of water quality conditions. Further statistical analysis will be completed for the Environmental Statement.

3.2.15 Further discussion on the potential environmental effects of the changes described in the remainder of this section is provided in sections 4, 5 and 6.

Basic water quality parameters: pH, alkalinity, Dissolved Oxygen and Biochemical Oxygen Demand

3.2.16 The median value of pH in Havant Thicket Reservoir is not predicted to change between the "classic" and "post-WRP" operational scenarios, remaining at 8.7 (Figure 3-2).

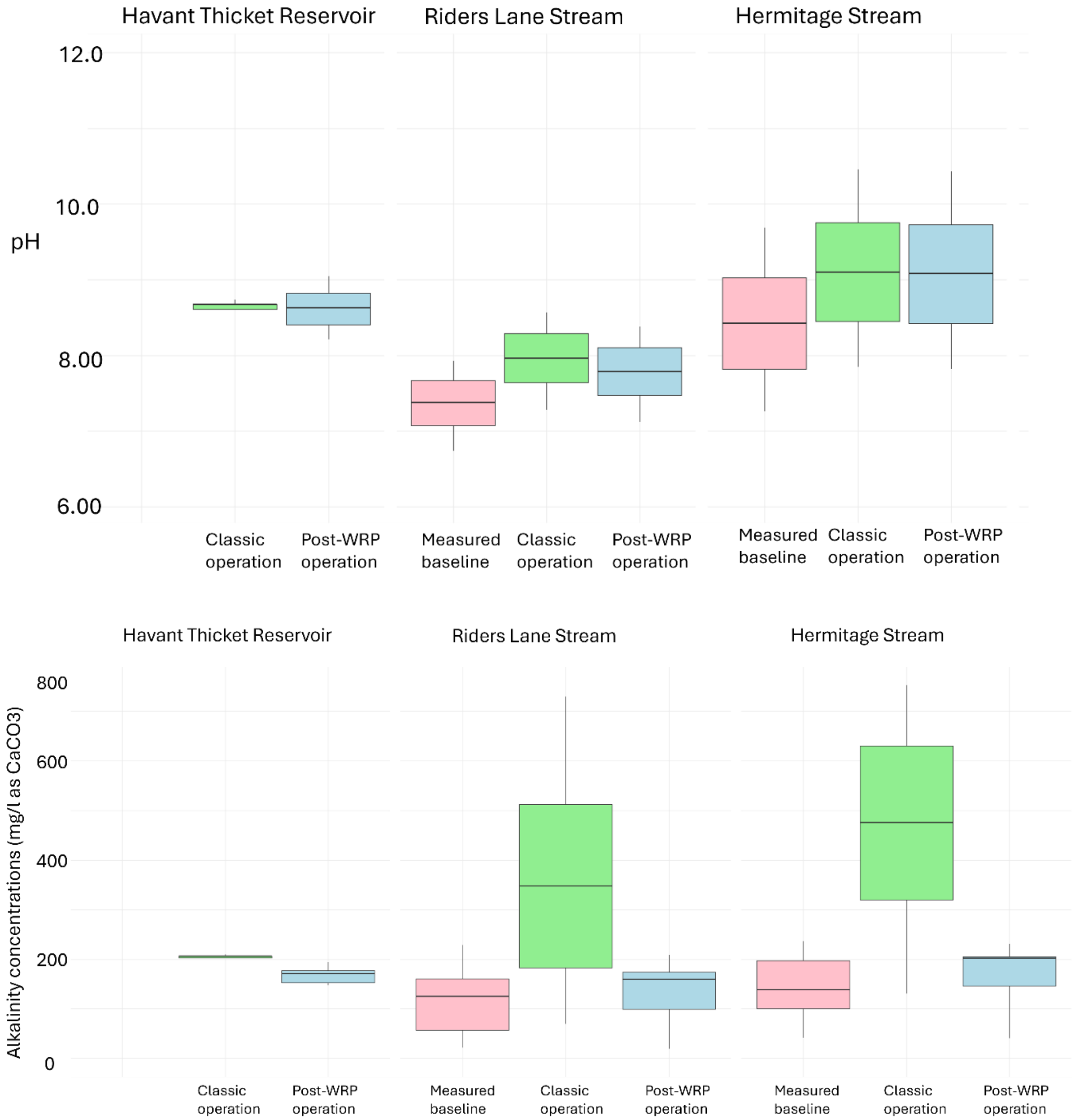
3.2.17 In Riders Lane Stream, a small increase in median pH from a measured baseline of 7.4 to 7.9 is predicted in the "classic" operation scenario; this returns to 7.7 in the "post-WRP" operation scenario.

3.2.18 In Hermitage Stream, median pH is predicted to increase from 8.4 in the measured baseline to, 9.1 in the "classic" operation scenario and reduce slightly to 9.0 in the "post-WRP" scenario (Figure 3-2). The WFD Directions do not include a standard for pH in transitional or coastal water bodies, and as such pH has not been routinely measured in Langstone Harbour by the Environment Agency. It is therefore excluded from Figure 3-2.

3.2.19 Within the reservoir, alkalinity is predicted to decrease from a median of 206mg/l in the "classic" operation scenario to 170mg/l in the "post-WRP" operation scenario (Figure 3-2). This represents the dilution of the naturally alkaline groundwater in the "classic" operation scenario with more neutral recycled water from the proposed WRP.

3.2.20 Alkalinity also shows a similar trend between the operational scenarios at each sample point downstream of the reservoir (Figure 3-2). At the Riders Lane Stream sample point, baseline alkalinity (measured as $CaCO_3$) has a measured baseline median of 124mg/l and is predicted to increase in the "classic" operation scenario to 347mg/l before decreasing to 158mg/l in the "post-WRP" operation scenario (Figure 3-2). Alkalinity in the Hermitage Stream shows the same trend, with a predicted increase in the “classic” operation scenario to a median of 475mg/l (from a measured baseline of 139mg/l) followed by a predicted decrease from “classic” to 201mg/l in the “post-WRP” operation scenario. The WFD Directions do not include a standard for alkalinity in transitional or coastal water bodies. It has not, therefore, been routinely measured in Langstone Harbour by the Environment Agency and is excluded from Figure 3-2.

Figure 3-2 Comparison of baseline data and modelled outputs for pH and alkalinity



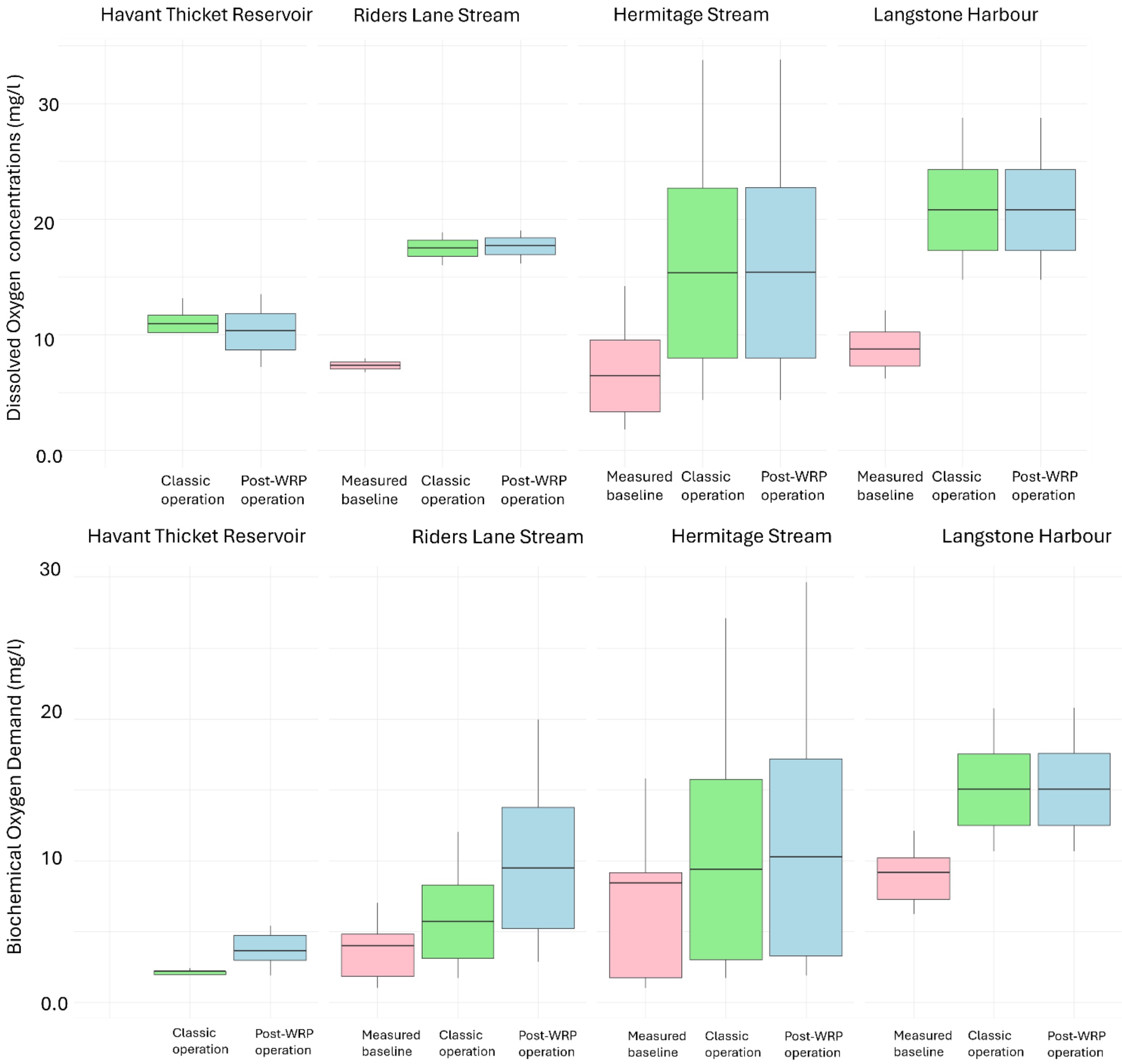
**Note that baseline data for pH and alkalinity is not available for Langstone Harbour.*

3.2.21 Between the “classic” operation and “post-WRP” operation scenarios in Havant Thicket Reservoir, minimum DO decreases from 10.2mg/l in the “classic” to 7.2mg/l in the “post-WRP” operation scenario (Figure 3-2). Although the variance has increased, the median values of DO remain very similar, at 10.9mg/l in the “classic” operation scenario and 10.3mg/l in the “post-WRP” operation scenario. Furthermore, these represent the worst case over the entire period of each scenario and follow the assumption that the operation of a bubbler would ensure that water in the reservoir is well mixed.

3.2.22 In Riders Lane Stream, median DO increases from a measured baseline of 7.4mg/l to 17.5mg/l under the “classic” operation scenario, and increases slightly further to 17.6mg/l in the “post-WRP” operation scenario (Figure 3-3). In Hermitage Stream, the median DO concentration is also predicted to increase from a measured baseline of 6.5mg/l to 15.3mg/l under the “classic” operation scenario and 15.4mg/l under the “post-WRP” operation scenario. Median DO concentrations at the northern (upstream) end of Langstone Harbour are also predicted to increase, from a measured baseline of 8.8mg/l to 20.8mg/l under the “classic” and “post-WRP” operation scenarios.

3.2.23 The median BOD in Havant Thicket Reservoir is predicted to increase from 2.2mg/l in the “classic” scenario to 3.7mg/l in the “post-WRP” scenario. Similarly, median BOD in Riders Lane Stream is predicted to increase from the measured baseline of 3.3mg/l to 5.7mg/l during the “classic” operation scenario. Under the “post-WRP” operation scenario median BOD in Riders Lane Stream is predicted to increase further to 9.5mg/l (Figure 3-3). In Hermitage Stream, median BOD is predicted to increase from a measured baseline of 8.4mg/l to 9.4mg/l during the “classic” operation scenario and is likely to increase further in the “post-WRP” operation scenario to 10.2mg/l. BOD is also predicted to increase in the northern end of Langstone Harbour, from a baseline of 9.1mg/l to 15.0mg/l under both the “classic” and “post-WRP” scenarios.

Figure 3-3 Comparison of baseline data and modelled outputs for DO and BOD



Nutrients: Total Phosphorus, Orthophosphate, Ammonia and Nitrate

3.2.24 Median Total Phosphorus concentrations are predicted to increase in Havant Thicket Reservoir from 0.026mg/l in the “classic” scenario to 0.051mg/l in the “post-WRP” scenario (Figure 3-4). TP is only routinely measured in lakes and is not routinely measured in other types of water body (including rivers and estuaries), where orthophosphate is instead considered, as described in the following paragraphs.

3.2.25 There is a very small increase in orthophosphate from the baseline in Riders Lane Stream, from a median concentration 0.163mg/l to 0.167mg/l in the “classic” scenario. This is followed by a further increase to 0.187mg/l in the “post-WRP” scenario (Figure 3-4). In the Hermitage Stream, median orthophosphate concentrations are predicted to increase very slightly from the measured baseline (0.133mg/l) under the “classic” scenario (0.136mg/l) and the “post-WRP” scenario (0.137mg/l).). No changes in orthophosphate concentrations are predicted in Langstone Harbour.

3.2.26 In Havant Thicket Reservoir, ammonia concentrations would decrease very slightly from 0.06mg/l in the “classic” operational scenario to 0.05mg/l in the “post-WRP” operational scenario. In Riders Lane Stream, ammonia is predicted to increase from a measured baseline of 0.26mg/l to 0.34mg/l in the “classic” operation scenario, increasing slightly further to 0.37mg/l in the “post-WRP” scenario. In Hermitage Stream, a slight increase in ammonia concentrations is predicted, from the measured baseline of 0.07mg/l to 0.08mg/l under both the “classic” and “post-WRP” operational scenarios. In Langstone Harbour, a small increase over the measured baseline is also predicted, from 0.60mg/l to 0.66mg/l under the “classic” scenario and to 0.67mg/l under the “post-WRP” scenario.

3.2.27 Median ammonia concentrations in Havant Thicket Reservoir are predicted to decrease as a result of the input of water from the WRP, falling from 0.06mg/l in the “classic” operation scenario to 0.05mg/l in the “post-WRP” scenario (Figure 3-5). In Riders Lane Stream, median ammonia is predicted to increase from a baseline of 0.26mg/l to 0.35mg/l in the “classic” operational scenario and 0.38mg/l in the “post-WRP” scenario. A similar pattern is also predicted in Hermitage Stream, where median ammonia would increase from a baseline of 0.07mg/l to 0.08mg/l in both the “classic” and “post-WRP” operation scenarios. In Langstone Harbour, median ammonia would also increase, from the baseline of 0.59mg/l to 0.66mg/l under the “classic” scenario and 0.67mg/l under the “post-WRP” scenario.

3.2.28 Median nitrate concentrations in Havant Thicket Reservoir are expected to decrease between the “classic” operation and “post-WRP” operation scenarios, from 3.83mg/l to 1.67mg/l (Figure 3-5).

3.2.29 In Riders Lane Stream, nitrate concentrations for the “classic” operation scenario are predicted to increase from the baseline of 2.74mg/l to 4.33mg/l in the “classic” operation scenario, then decrease down to 0.91mg/l in the “post WRP” operation scenario.

3.2.30 A similar pattern is shown in Hermitage Stream, where median nitrate concentrations are predicted to increase from a baseline of 3.9mg/l to 6.2mg/l in the “classic” scenario, before decreasing to 5.6mg/l in the “post-WRP” scenario (Figure 3-5). In Langstone Harbour, concentrations of nitrate are predicted to increase from a baseline of 0.6mg/l to 0.9mg/l under both the “classic” and “post-WRP” scenarios.

Figure 3-4 Comparison of baseline data and modelled outputs for total phosphorus and orthophosphate

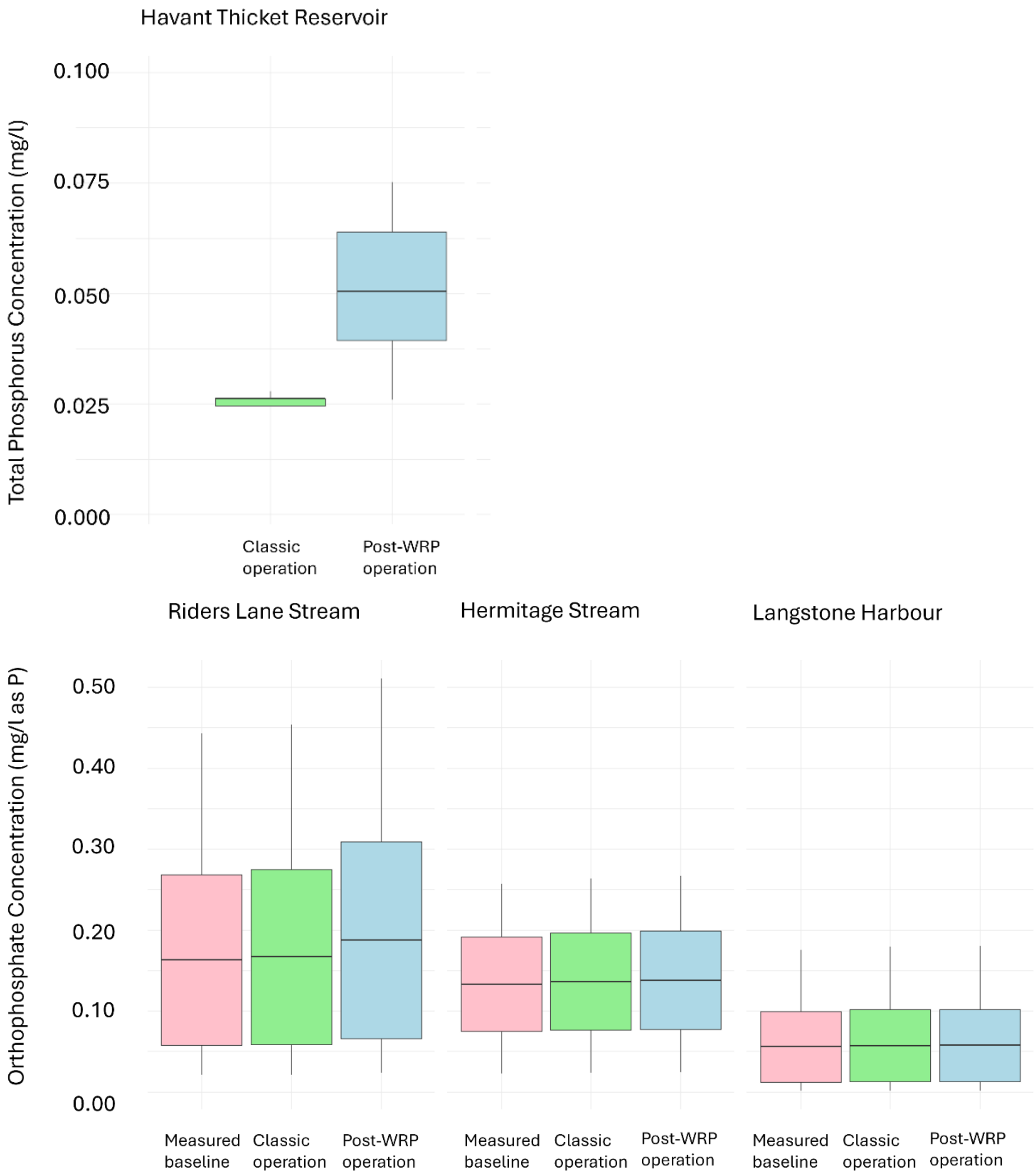
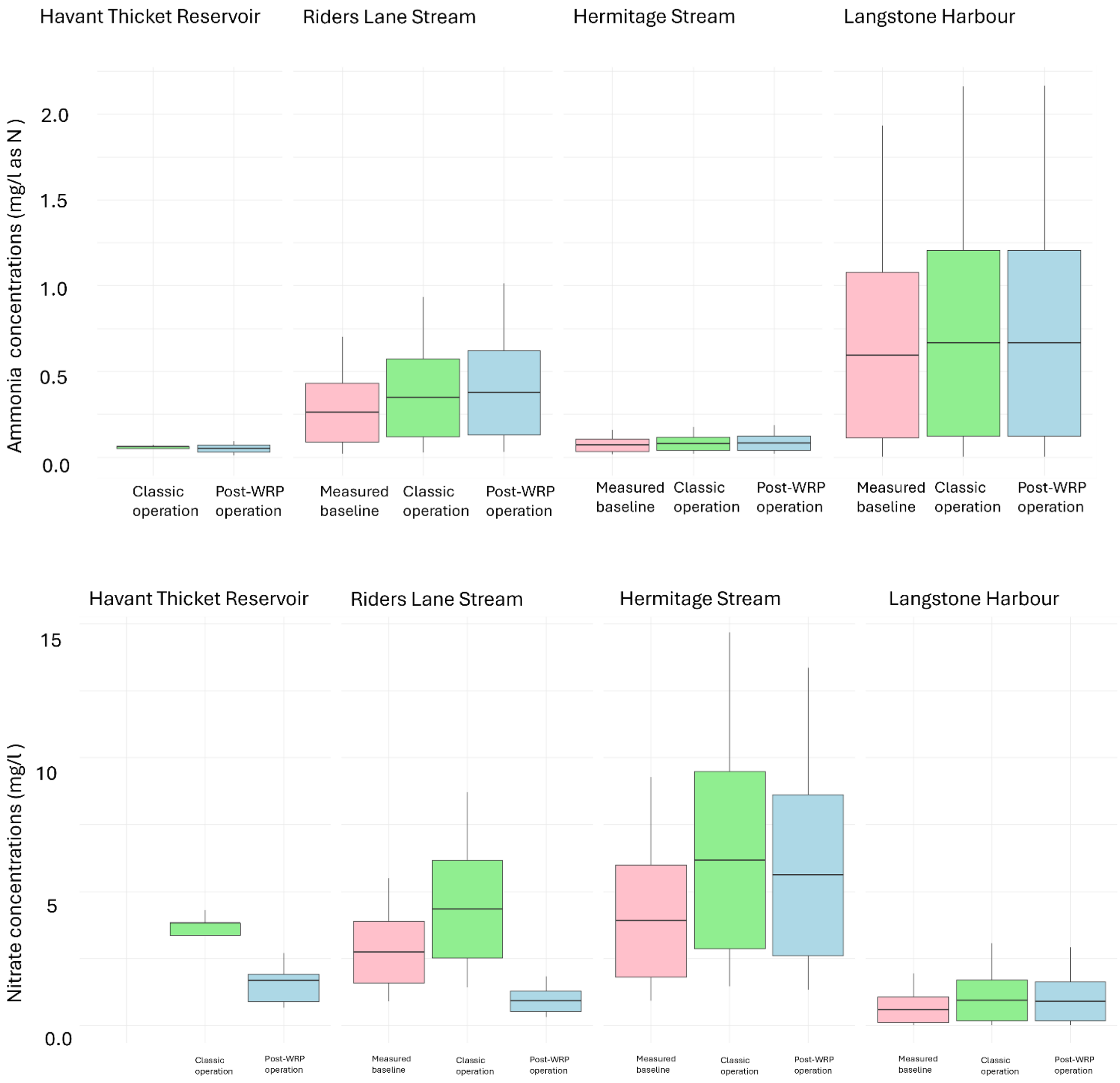


Figure 3-5 Comparison of baseline data and modelled outputs for ammonia and nitrate

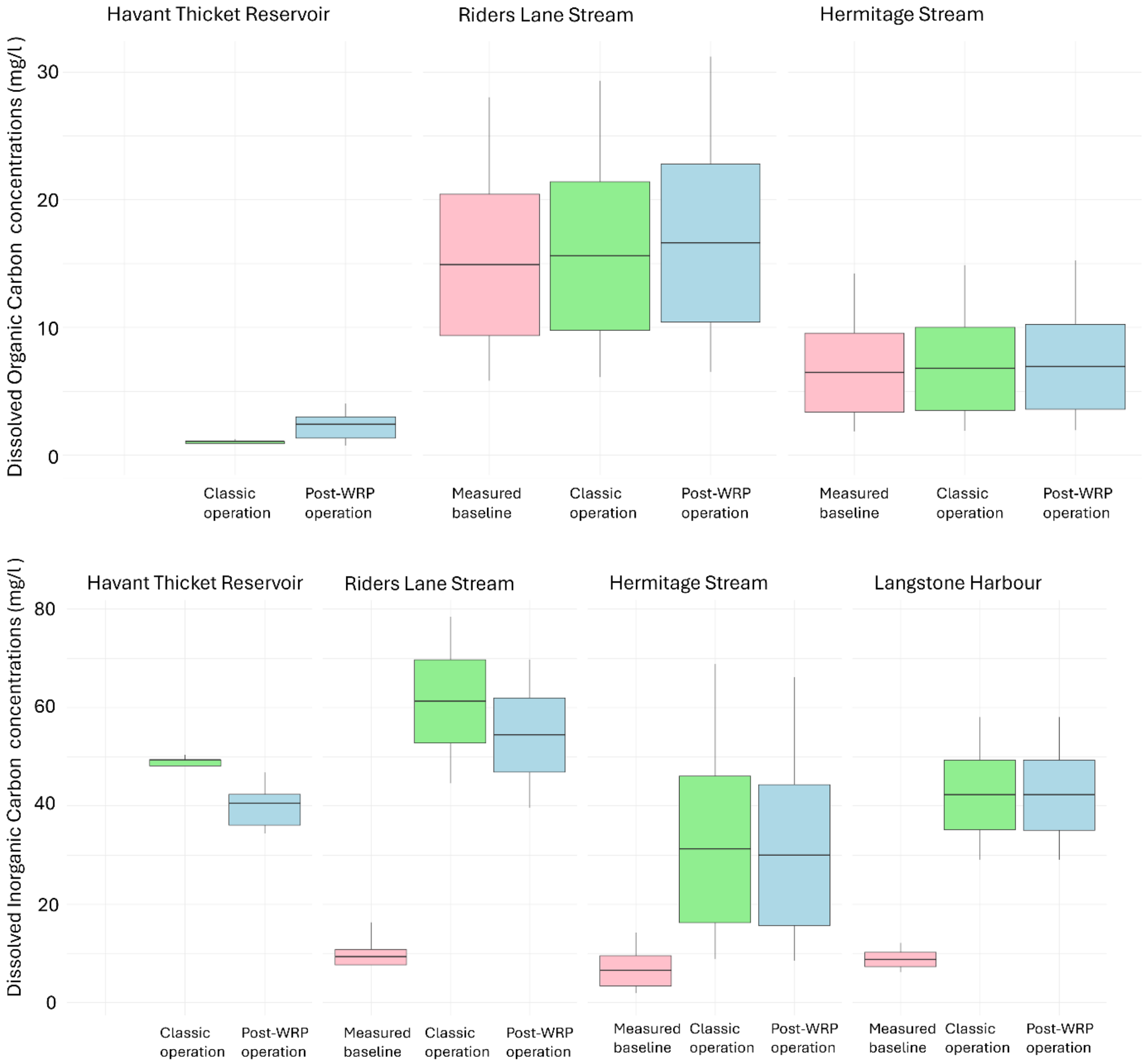


Carbon: Dissolved Organic Carbon and Dissolved Inorganic Carbon

3.2.31 In Havant Thicket Reservoir, DOC levels are predicted to increase from a median concentration of 1.1mg in the “classic” operation scenario to 2.4mg/l in the “post-WRP” operation scenario (Figure 3-6). Median concentrations of DOC are expected to increase from a baseline of 14.9mg/l to 15.6mg/l in Riders Lane Stream under the “classic” operation scenario, with slightly higher median concentrations in the “post-WRP” operation scenario of 16.6mg/l (Figure 3-6). Small increases in median DOC concentrations are predicted in the Hermitage Stream, from a baseline of 6.4mgl to 6.7mg/l under the “classic” scenario and 6.9mg/l under the “post-WRP” scenario.

3.2.32 The median concentration of DIC in Havant Thicket Reservoir is expected to decrease between the “classic” and “post-WRP” operation scenarios from 49mg/l to 40mg/l (Figure 3-6). The median concentration of DIC in Riders Lane Stream is expected to increase from the baseline of 9.2mg/l to 61.2mg/l under the “classic” operation scenario (Figure 3-6). The median DIC concentration in the “post-WRP” operation scenario in Riders Lane Stream is predicted to decrease the “classic” operation scenario to 54.0mg/l. In Hermitage Stream, mean DIC is expected to increase from 6.4mg/l to 31.1mg/l under the “classic operation”, and then decrease slightly to 29.9mg/l in the “post-WRP” operation scenario. In Langstone Harbour, median DIC concentrations increase from a baseline of 8.8mg/l to 42.2mg/l under both the “classic” and “post-WRP” operation scenarios (Figure 3-6).

Figure 3-6 Comparison of baseline data and modelled outputs for Dissolved Organic Carbon and Dissolved Inorganic Carbon



**Baseline data for DOC is not available for Langstone Harbour.*

Preliminary findings: degradation modelling

3.2.33 The preliminary results of the degradation modelling suggest that there are limited differences in the concentrations of each water quality parameter resulting from chemical and biological processes. Temperature variations can play an important role in chemical degradation and biological uptake, and as outlined earlier in this section, the degradation modelling has therefore considered both winter and summer temperatures.

3.2.34 The predicted changes in each parameter over winter and summer when compared to the changes predicted by the dispersion model are summarised in Table 3-1.

Table 3-1 Degradation model outputs - predicted concentration change in mg/l for DO, BOD, PO_4, NH_3 and NO_3 comparing "classic" and "post-WRP" operation scenarios

Parameter (mg/l)	Scenario	Concentration change between "classic" and "post-WRP" operation scenarios (mg/l)		
		Riders Lane Stream	Hermitage Stream	Langstone Harbour
Dissolved Oxygen (DO)	Winter	-0.023	-0.007	0.000
	Summer	0.102	0.012	0.000
	Dispersion	0.167	0.022	0.003
Biochemical Oxygen Demand (BOD)	Winter	3.007	0.395	0.035
	Summer	3.004	0.383	0.027
	Dispersion	3.010	0.406	0.048
Orthophosphate (PO_4)	Winter	0.012	0.002	0.001
	Summer	0.012	0.003	0.001
	Dispersion	0.012	0.002	0.000
Ammonia (NH_3)	Winter	0.018	0.003	0.002
	Summer	0.018	0.004	0.003
	Dispersion	0.018	0.002	0.000
Nitrate (NO_3)	Winter	-2.853	-0.391	-0.039
	Summer	-2.853	-0.387	-0.039
	Dispersion	-2.854	-0.385	-0.046

3.2.35 Further discussion on the potential environmental effects of the changes described in the remainder of this section is provided in sections 4, 5 and 6.

Dissolved Oxygen

3.2.36 In winter, the degradation modelling predicts that there would be a small decrease in DO concentration (0.023mg/l) between the "classic" and "post-WRP" scenarios in Riders Lane Stream (Table 3-1). This small decrease is likely to be attributable to an increase in the temperature of water released from the reservoir under the "post-WRP" scenario (6.03°C to 6.17°C), increasing respiration processes in the watercourse downstream. This pattern is also shown in Hermitage Stream, albeit with a smaller decrease that reflects the input of water from tributaries. DO concentrations in Langstone Harbour are not predicted to change under the "post-WRP" operation scenario, when compared to the "classic" operation scenario.

3.2.37 In summer, there is a decrease in the temperature of the water released from the reservoir (20.05°C to 19.53°C), which leads to an increase in DO concentrations in Riders Lane Stream and Hermitage Stream. DO concentrations in Langstone Harbour in the summer are not predicted to change under the "post-WRP" operation scenario, when compared to the "classic" operation scenario.

3.2.38 The differences between the degradation and dispersion modelling results are very small (-0.023mg/l to 0.167mg/l in Riders Lane Stream) when compared to the changes from measured baseline predicted in the dispersion modelling (a circa 10mg/l increase under both the "classic" scenario and "post-WRP" scenario in Riders Lane Stream).

Biochemical Oxygen Demand

3.2.39 The results of the preliminary degradation modelling indicate an increase in BOD between the "classic" and "post-WRP" scenarios (Table 3-1), with no significant difference between winter and summer seasons. The change is greatest in Riders Lane Stream, and this change decreases markedly in Hermitage Stream and again in Langstone Harbour.

3.2.40 Comparing the change in concentrations in Table 3-1, it is apparent that the dispersion model results, which do not consider decay processes, provide a slightly more conservative estimate of BOD concentrations within Riders Lane, Hermitage Stream and Langstone Harbour. The differences between the degradation and dispersion modelling results (3.004mg/l to 3.010mg/l in Riders Lane Stream) are similar to the changes from measured baseline predicted in the dispersion modelling under the "classic" scenario (an increase of 2.4mg/l under the "classic" scenario in Riders Lane Stream), but much smaller that the changes predicted under the "post-WRP" scenario (6.2mg/l in Riders Lane Stream).

Orthophosphate

3.2.41 The results of the degradation modelling (Table 3-1) indicate that orthophosphate concentrations would increase between the "classic" and "post-WRP" scenarios. As per other parameters, this change is greatest in Riders Lane Stream and is considerably lower in both Hermitage Stream and Langstone Harbour.

3.2.42 The magnitude of difference is slightly larger in summer than in winter. This is likely to be associated with additional BOD decay in warmer water during the summer. However, this difference in concentration is predicted to be <0.01mg/l.

Ammonia

3.2.43 The results of the degradation modelling of ammonia (Table 3-1) indicate an increase in concentrations between the "classic" and "post-WRP" scenarios. The magnitude of change is greatest in Riders Lane Stream and is considerably lower in both Hermitage Stream and Langstone Harbour.

3.2.44 During the summer season, the difference in ammonium concentrations between the “classic” and “post-WRP” scenarios is slightly larger than during the winter. This is likely to be attributable to additional BOD decay in warmer water during the summer. However, given that this difference in concentration is predicted to be <0.015mg/l, the seasonal difference is unlikely to be significant.

Nitrate

3.2.45 The results of the degradation modelling of nitrate (Table 3-1) indicate a reduction in concentrations between the “classic” and “post-WRP” scenarios, with no significant difference between winter and summer seasons. The predicted changes are greatest in Riders Lane Stream and are lower in both Hermitage Stream and Langstone Harbour.

3.3 Solent Eastney Long Sea Outfall

Initial screening assessment

3.3.1 Screening of the chemicals likely to be found in the release for both the existing scenario (i.e. Budds Farm WTW release, without the addition of WRP reject water) and the future scenario (i.e. Budds Farm WTW release, with the addition of WRP reject water at peak operation) has been undertaken in line with the Environment Agency’s guidance ‘Surface water pollution risk assessment for your environmental permit’ (Environment Agency, 2022). These screening tests check the potential risk from hazardous chemicals to the environment using Environmental Quality Standard (EQS) thresholds set out in the WFD Directions. If the screening tests identify a potential risk to the environment, then modelling is required.

3.3.2 There are three stages to screening:

- Step 1: Identify the pollutants released – this requires monitoring either of an existing discharge or equivalent discharge (for example a pilot plant).
- Step 2. Gather data on the pollutants – this requires monitoring of the environment into which the discharge would be made.
- Step 3: Carry out screening tests for coastal/estuarine waters.

3.3.3 These tests identified that the following seven parameters required modelling:

- Fluoranthene
- Hexabromocyclododecane (HBCDD)
- Lead and its compounds (dissolved)
- Perfluoro octane sulfonic acid and its salts (PFOS)
- Benzo(a)-pyrene (BaP)
- Terbutryn
- Zinc

Summary of ongoing assessment

3.3.4 The composition of the existing Budds Farm WTW wastewater release from the Eastney LSO is likely to change as a result of:

- A reduction in wastewater flow released via the Eastney LSO as a proportion would be diverted to the proposed WRP. The proportion of wastewater flows diverted to the proposed WRP depending on whether the WRP is operating at minimum, average or peak flow.
- The addition of reject water from the proposed water recycling process.

3.3.5 The reject water from the proposed WRP would be released into the existing Eastney Transfer Tunnel via a new connection, downstream of the existing release from Budds Farm WTW. No further physical changes are required to the Eastney LSO, connecting Pumping Station or Transfer Tunnel.

3.3.6 To assess this change at Eastney LSO, dispersion modelling has been undertaken which considers how reject water would disperse spatially in the marine environment. The modelling has been undertaken in two phases:

- The first phase considered the potential effects of the Project on currently consented parameters within the Budds Farm WTW Environmental Permit; iron, TSS, BOD, Chemical Oxygen Demand (COD) and TN. Salinity has also been considered as the removal of low salinity wastewater for water recycling could alter the salinity of reject water release in the future scenario. The results were reported as part of the PEI Report (PEI Report Appendix 19.6 Eastney Long Sea Outfall dispersion modelling, Volume II).
- The second stage, the preliminary results of which are reported in this Report, is required to meet the requirements of the Environment Agency's surface water risk assessment process. The assessment is underpinned by the screening assessment which screens whether chemical concentrations within the release are likely to be at levels with the potential to cause risks to aquatic flora or fauna in line with Environmental Quality Standards (EQS) set out in the WFD Directions. Each screening test progressively eliminates parameters as conditions are applied to narrow down the list so that only those considered to be a risk to EQS are included at the end of the screening assessment. These parameters are then carried forward for modelling.

3.3.7 To assess the potential changes associated with the screened in chemicals, modelling using a calibrated MIKE21 hydraulic model was undertaken for both neap and spring tides for the following scenarios:

- "Existing": this reflects wastewater dispersion as it occurs now (i.e. associated to the Budds Farm WTW release from Eastney LSO).
- "Future": this reflects wastewater dispersion in the future when the proposed WRP would operate at a peak operation of 60 Ml/d) (i.e. a combined release scenario).

3.3.8 These two scenarios reflect the maximum change which would only occur during a drought. At other times of the year flows through the proposed WRP are likely to be lower, thus bringing the effect of the "future" scenario release closer to the "existing" scenario release.

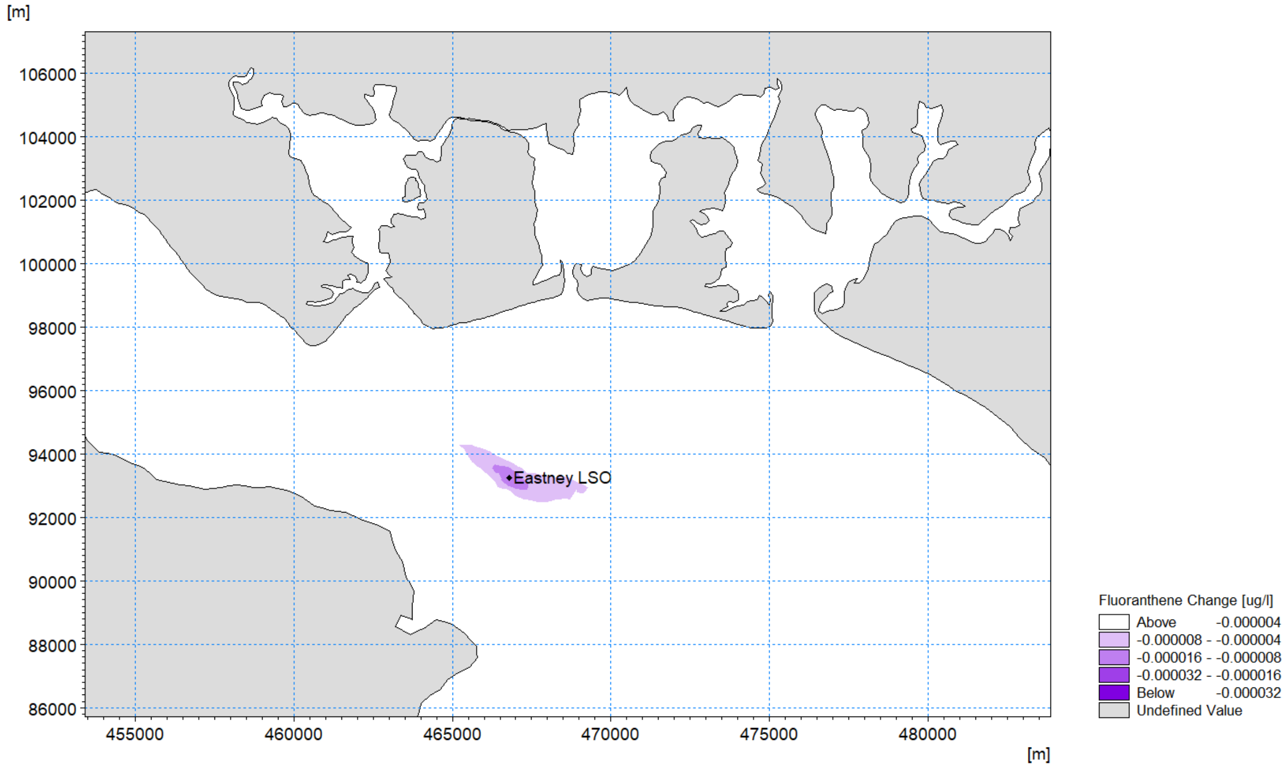
3.3.9 The surface water risk assessment screening assessment is due to be updated following further collation and analysis of marine water quality baseline sampling. This may change the parameters screened into the assessment. If this is the case, any changes would be assessed fully within the Environmental Statement and Environmental Permit application.

Preliminary findings

Fluoranthene

3.3.10 Figure 3-7 shows the predicted difference in fluoranthene concentration released from the Eastney LSO between the existing scenario and the future scenario. The results predict a decrease in fluoranthene concentration in the future scenario, when compared to the existing scenario (i.e. reflected as negative numbers in the legend). The predicted decrease in concentration is very small (0.000016µg/l), hence is considered to represent no change.

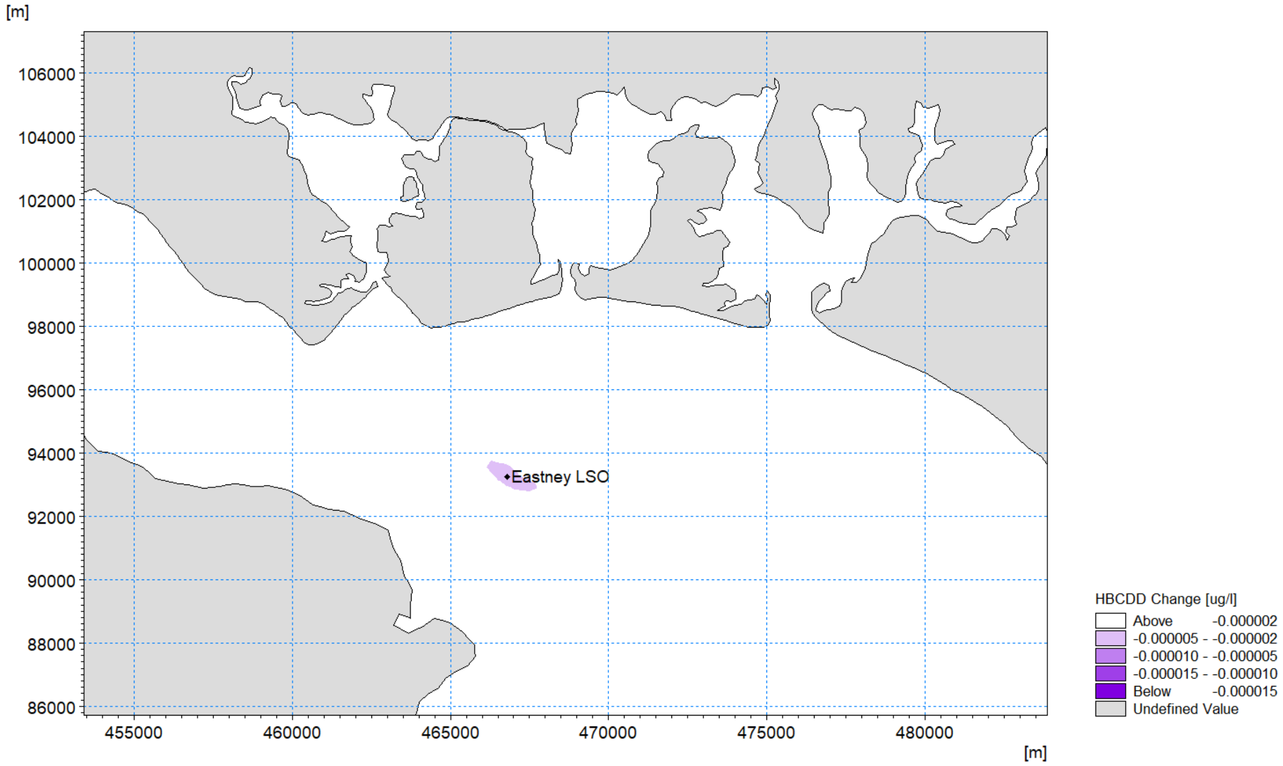
Figure 3-7 Change in fluoranthene concentration between the existing and future scenarios



Hexabromocyclododecane

3.3.11 Figure 3-8 shows the predicted difference in hexabromocyclododecane (HBCDD) concentration released from the Eastney LSO between the existing scenario and the future scenario. The results predict a slight decrease in HBCDD concentration in the future scenario, when compared to the existing scenario. The predicted decrease in concentration is very small (<0.000005µg/l), hence is considered to represent no change.

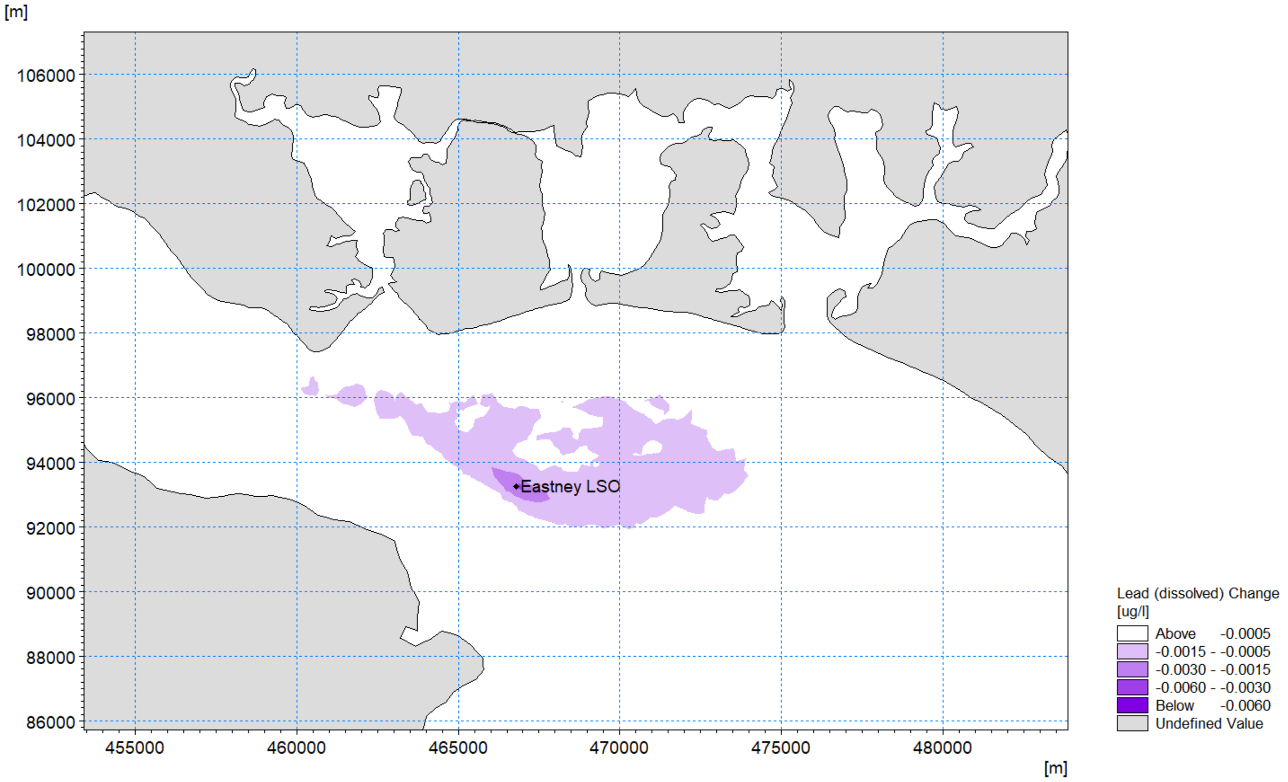
Figure 3-8 Change in Hexabromocyclododecane concentration between the existing and future scenarios



Lead

3.3.12 Figure 3-9 shows the predicted difference in lead concentrations released from the Eastney LSO between the existing scenario and the future scenario. The results predict a decrease in lead concentrations in the future scenario, when compared to the existing scenario. The predicted concentration reduction is very small and less than 0.006µg/l, hence is considered to represent no change.

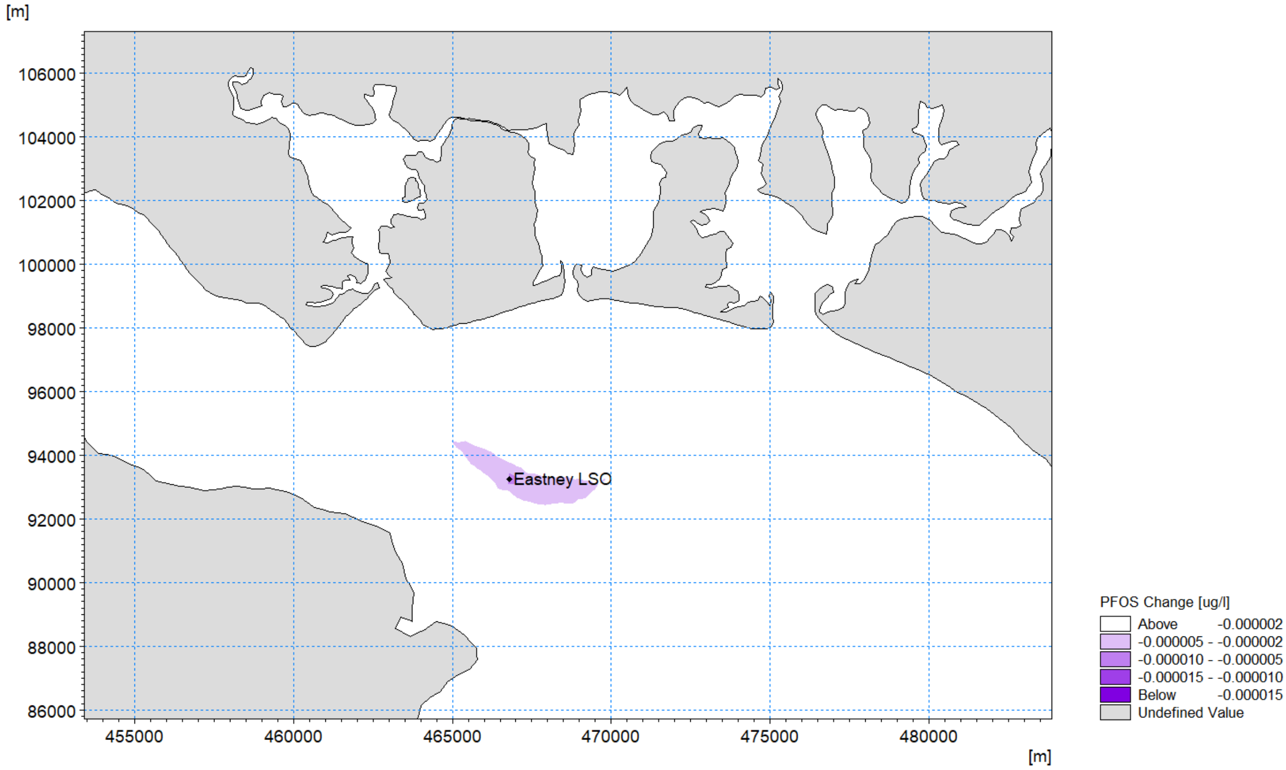
Figure 3-9 Change in Lead concentration between the existing and future scenarios



Perfluoro octane sulfonic acid and its salts

3.3.13 Figure 3-10 shows the predicted difference in perfluoro octane sulfonic acid and its salts (PFOS) concentrations released from the Eastney LSO between the existing scenario and the future scenario. The results predict a decrease in PFOS concentrations in the future scenario, when compared to the existing scenario. The predicted decrease in PFOS concentrations is very small, between -0.000002 and -0.000015µg/l, hence is considered to represent no change.

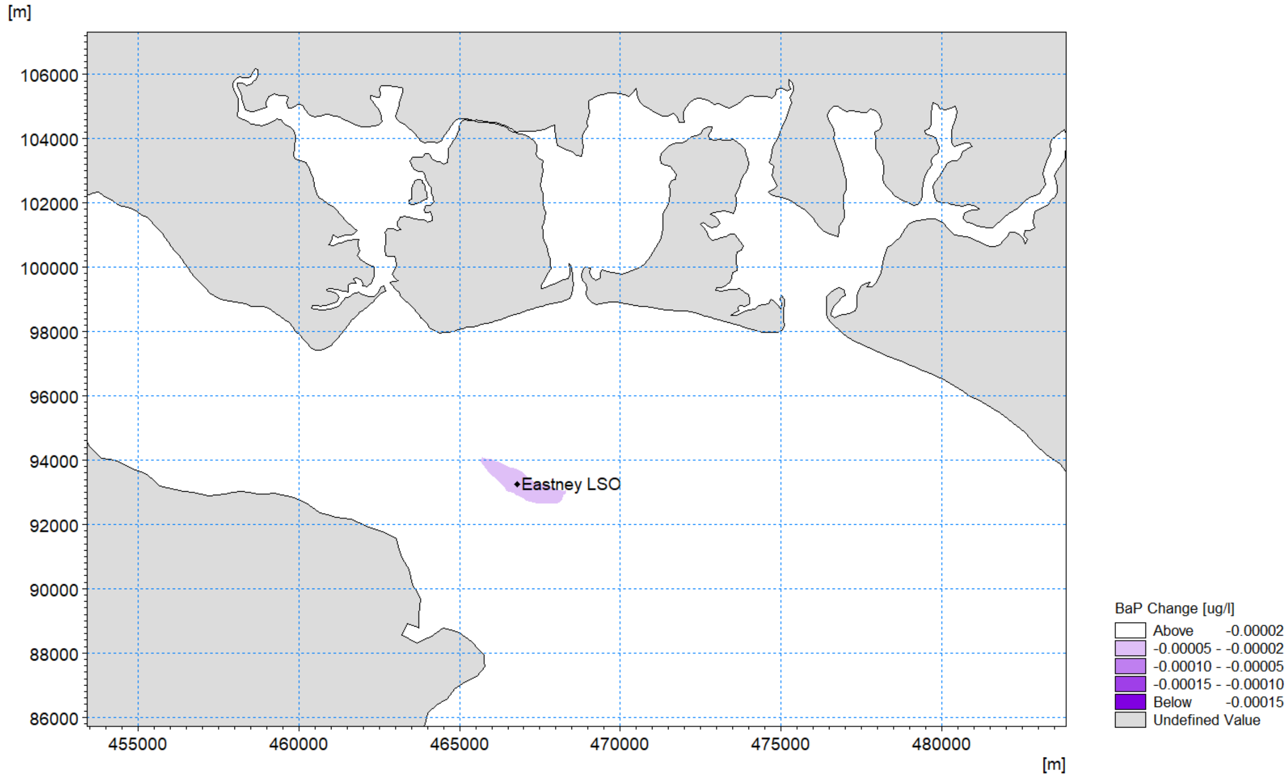
Figure 3-10 Change in Perfluoro octane sulfonic acid and its salts concentration between the existing and future scenarios



Benzo(a)-pyrene

3.3.14 Figure 3-11 shows the predicted difference in benzo(a)-pyrene (BaP) concentrations released from the Eastney LSO between the existing scenario and the future scenario. The results predict a slight decrease in BaP concentrations in the future scenario, when compared to the existing scenario. The concentration changes are very small, between -0.00002 and -0.0001µg/l, hence are considered to represent no change.

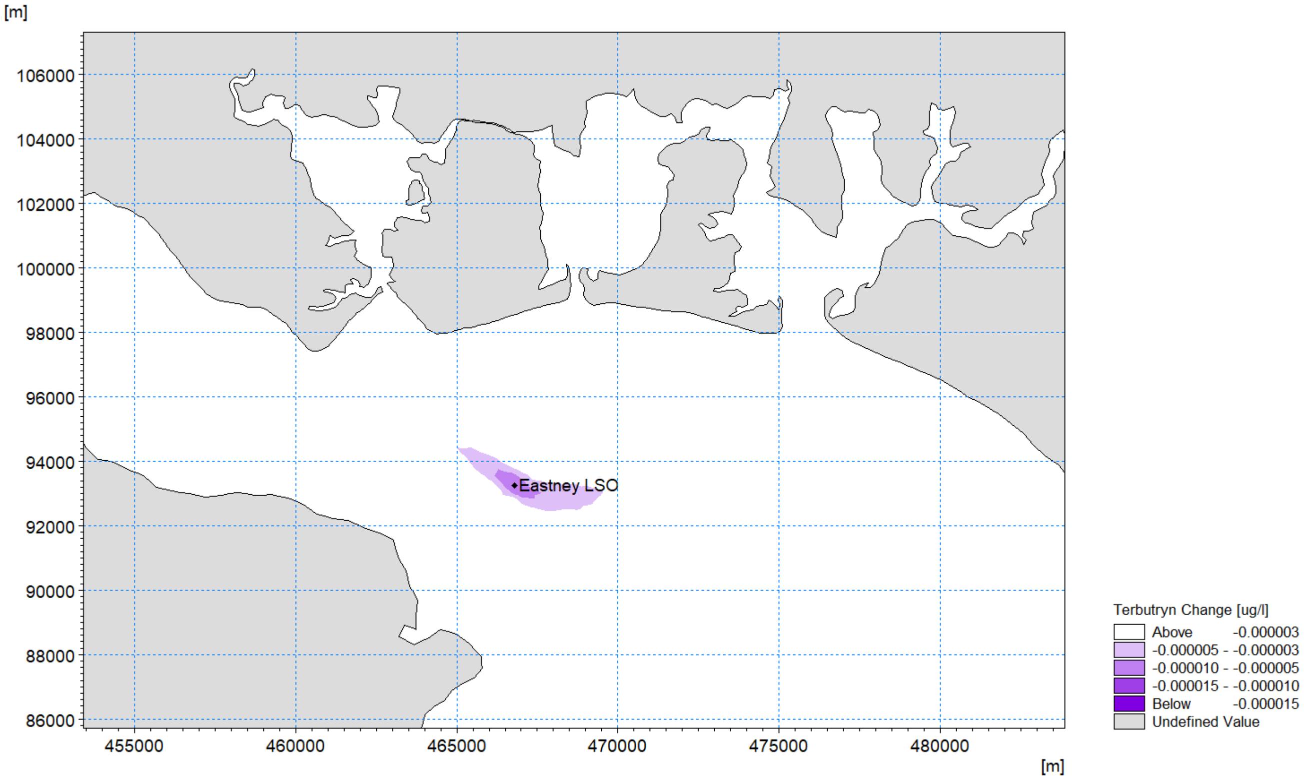
Figure 3-11 Change in Benzo(a)-pyrene concentration between the existing and future scenarios



Terbutryn

3.3.15 Figure 3-12 shows the predicted difference in terbutryn concentrations released from the Eastney LSO between the existing scenario and the future scenario. The results predict a decrease in terbutryn concentrations in the future scenario, when compared to the existing scenario. The predicted concentration changes are very small, between -0.000003 and -0.00001µg/l, hence are considered to represent no change.

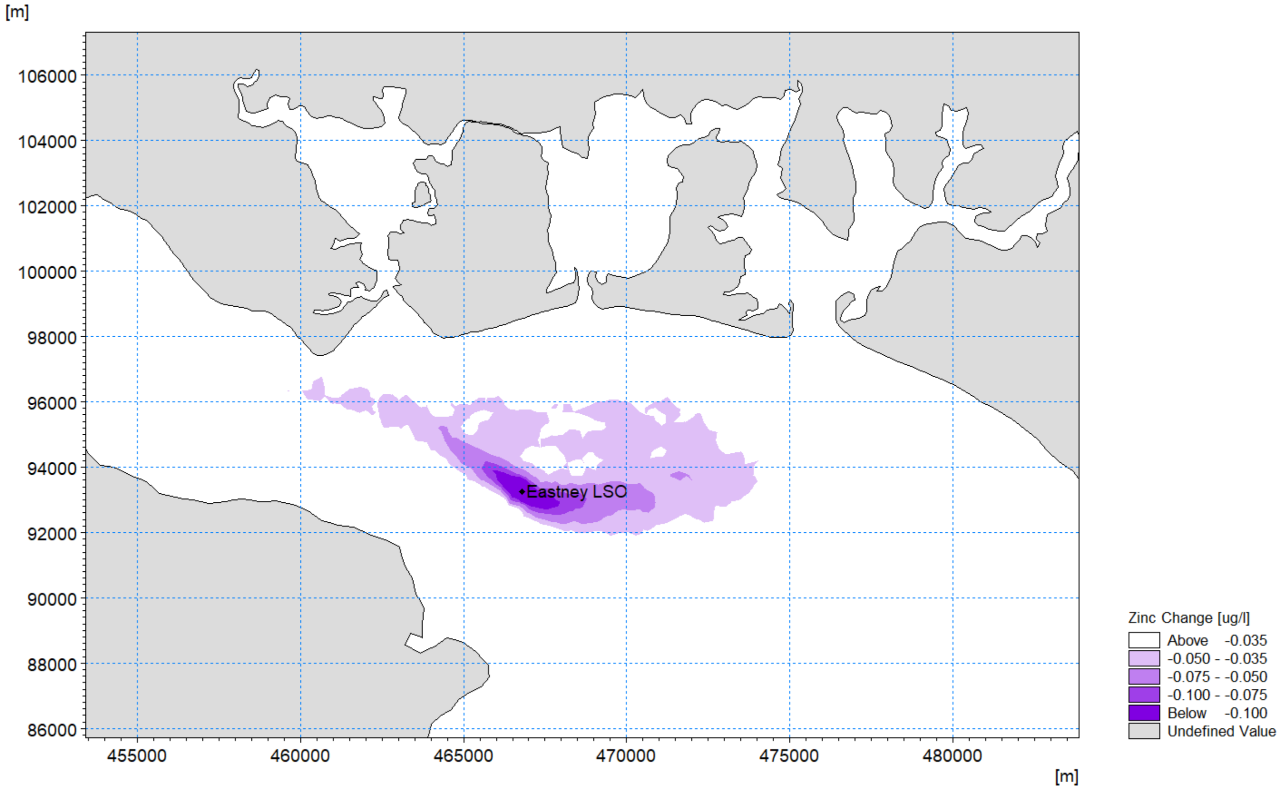
Figure 3-12 Change in terbutryn concentration between the existing and future scenarios



Zinc

3.3.16 Figure 3-13 shows the predicted difference in zinc concentrations released from the Eastney LSO between the existing scenario and future scenario. The results predict a decrease in zinc concentrations in the future scenario, when compared to the existing scenario The predicted concentration changes are very small, between -0.035 and -0.1µg/l, hence are considered to represent no change.

Figure 3-13 Change in zinc concentration between the existing and future scenarios



Summary

3.3.17 Given the very small changes for all seven parameters modelled, no significant impacts on water quality are predicted at this stage. Further discussion on the environmental significance of these small changes is provided in sections 4-6.

3.4 Proposed WRP Sustainable Drainage System outfall

Summary of ongoing assessment

3.4.1 An assessment is underway of potential water quality effects associated with releases from the proposed WRP SuDS. The emerging SuDS design includes a dedicated surface water collection system which would release to the lower reach of the Hermitage Stream via a new outfall downstream of Bedhampton Springs and the tidal limit of the watercourse. This reach of the Hermitage Stream, which flows along the eastern boundary of the proposed WRP into Langstone Harbour, is therefore tidally influenced. The proposed outfall would be located on the right (western) bank of Hermitage Stream upstream of the Harts Farm Way road bridge (as shown on Figure 3-14).

3.4.2 The SuDS design is still being developed in consultation with relevant regulators. However, it would include a range of control measures such as filter strips, swales and a detention basin, seeking to provide sufficient mitigation for reducing pollutant levels in the runoff. The SuDS design will include control measures suitable for the pollution hazard index. As such, no further consideration is therefore required, in terms of dispersion modelling, to assess the potential release of pollutants from the SuDS outfall.

3.4.3 Implementation of the SuDS outfall does however have the potential to reduce salinity within the Hermitage Stream. The SuDS will be designed to capture rainfall that already falls on the site, but the development at the WRP site would result in an increase in impermeable area and would concentrate surface water flows to a single point release. The proposed SuDS release would be at a lower salinity than that in the receiving brackish water in the Hermitage Stream given that it would largely be made up of rainfall.

3.4.4 To assess the potential changes associated with the release of surface water into the Hermitage Stream, modelling using a calibrated MIKE21 hydraulic model has been undertaken. The model simulated seven days of both the spring and neap tidal cycle, following the SuDS discharge in the first day of the simulation. The SuDS discharge timeseries was derived from modelled outputs of a two-year return period storm event. The 960-minute (16 hour) storm duration was adopted as a conservative approach, based on the highest volume of discharged water across the event.

Preliminary findings

3.4.5 Salinity model simulations demonstrate that the greatest change occurs in the main channel during the neap tide simulation, as natural variations in salinity are lower during this period due to the decreased tidal range (Figure 3-14). The lowest difference in minimum salinity during the neap simulation is -7PSU (Practical Salinity Unit) immediately upstream of the confluence with Brockhampton Stream.

3.4.6 During the spring tide simulation (Figure 3-15), the majority of the difference in minimum salinity occurs along the banks of the Hermitage Stream where the water level is shallow, this is down to -6PSU along the bank close to the outfall.

3.4.7 For both the neap and spring tide simulations the change in salinity due to the SuDS release is contained mostly downstream of the A27 road bridge, apart from small, localised areas >-1PSU where water depth may be shallow at some points of the simulation.

3.4.8 Overall, the change in salinity due to the SuDS release, compared with the natural fluctuations in ambient salinity levels throughout the tidal cycle, is small, as presented in Figure 3-14. This shows the maximum difference in salinity during the neap tide, in a conservative (worst case) scenario where a low river flow (Q95) is modelled alongside a high SuDS release event (two-year storm event).

3.4.9 The model simulations therefore show that the maximum difference in minimum salinity due to the SuDS outfall is typically very low (<0.1PSU), with greater differences confined to small areas of the tidal Hermitage Stream.

Figure 3-14 Difference in minimum salinity (PSU) neap tidal condition

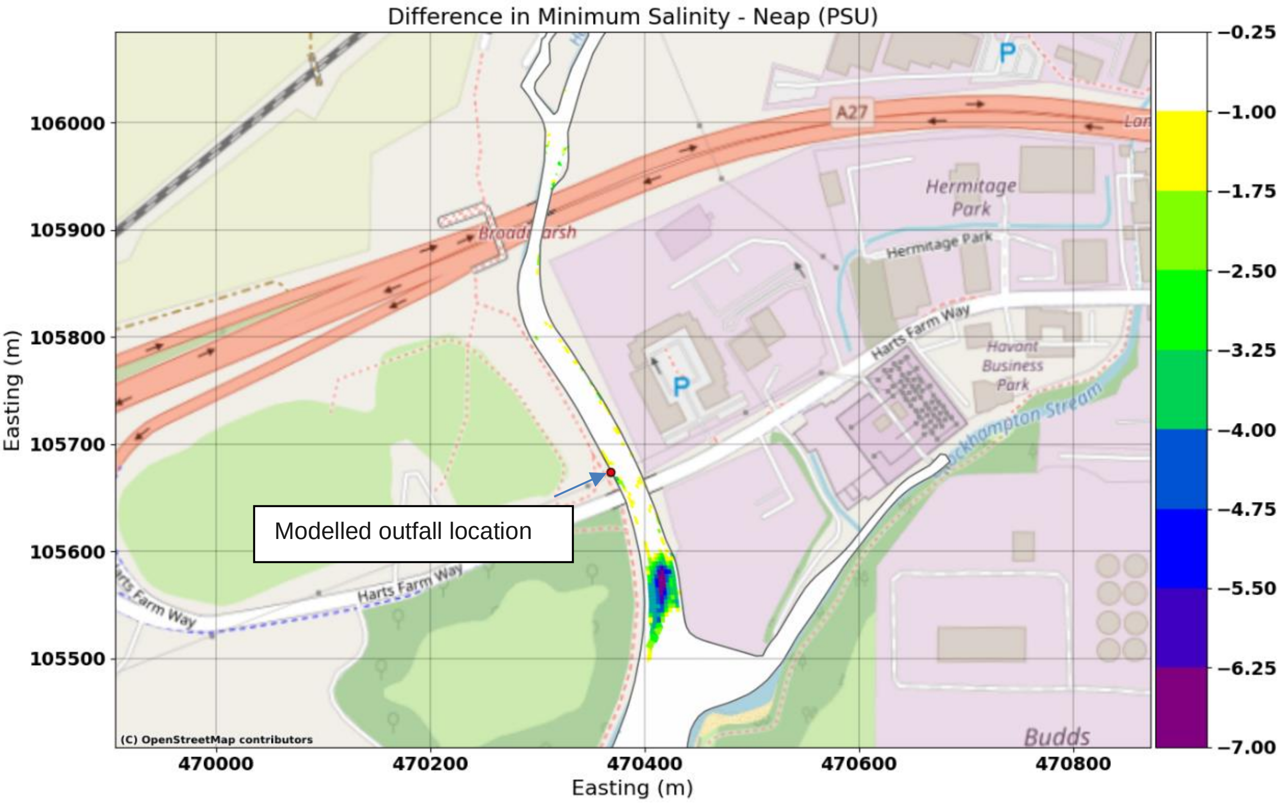
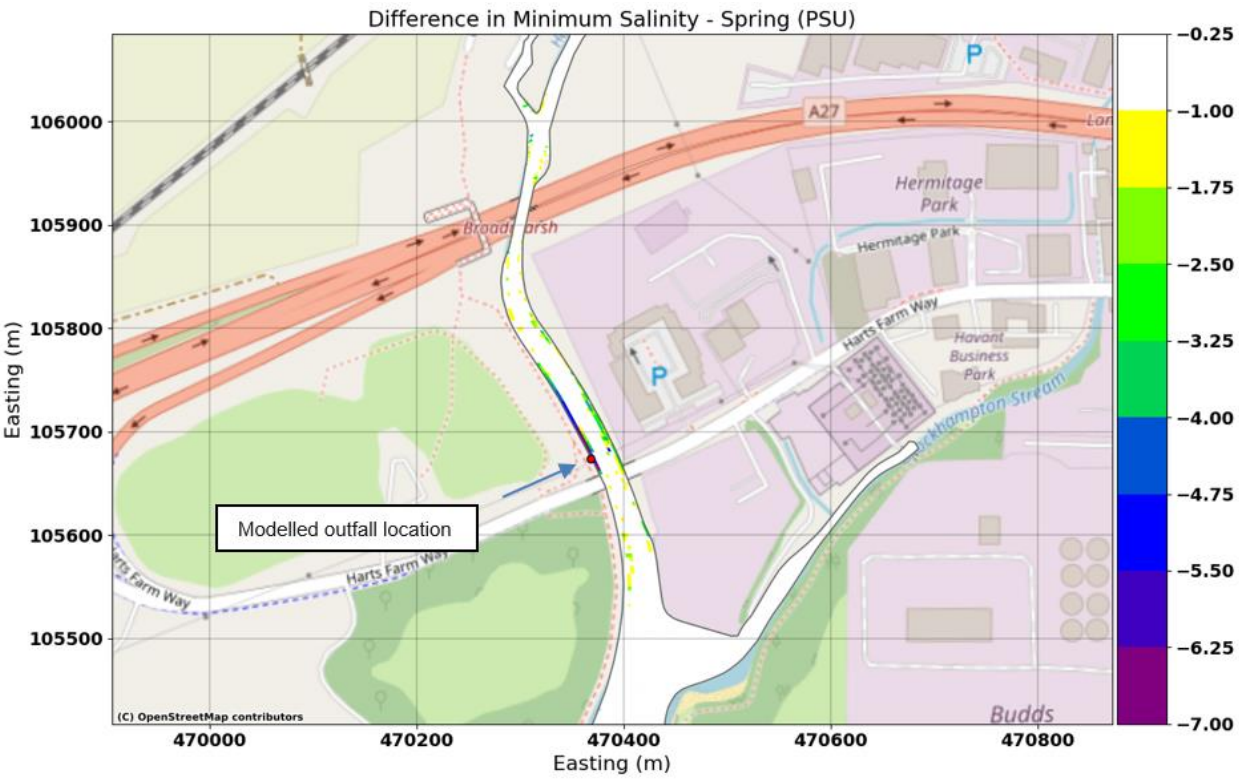


Figure 3-15 Difference in minimum salinity (PSU) spring tidal condition



4 Potential effects on the water environment

4.1 Introduction

4.1.1 Southern Water presented a preliminary assessment of likely significant effects from the construction, operation and decommissioning of the Project on the water environment in PEI Report Chapter 19: Water environment, Volume I, presented in the Summer 2024 Consultation.

4.1.2 The PEI Report included a qualitative, preliminary outline assessment of the potential effects of:

- Releases of recycled water from the proposed WRP into Havant Thicket Reservoir.
- Release of compensatory flows from the reservoir, once the proposed WRP is operational, into the Riders Lane Stream and subsequent downstream water bodies.
- Release of surface water runoff from the proposed WRP site into the lowermost tidal reach of Hermitage Stream and Langstone Harbour.
- Release of reject water from the proposed WRP into the Solent via the existing Eastney LSO.

4.1.3 Whilst the qualitative assessment presented in the PEI Report concluded that significant adverse effects resulting from these releases were unlikely, water quality modelling has now been undertaken to enable potential effects on water quality to be evaluated in more detail (see section 3 for further information on this modelling).

4.1.4 The remainder of this section provides an update on the likely implications of the four operational releases outlined above on water quality within Havant Thicket Reservoir, Riders Lane Stream, Hermitage Stream, Langstone Harbour and the Solent. This includes a preliminary comparison of the concentrations of the water quality parameters outlined in section 2 against the thresholds established in the WFD Directions.

4.1.5 The preliminary assessment presented in this Report will be further developed, and the results will be presented in the Environmental Statement and, WER Compliance Assessment and Habitats Regulations Assessment.

4.2 Preliminary consideration of potential environmental effects

Approach to assessment

4.2.1 In order to provide an initial indication of the potential implications of the changes in water quality that have been predicted by the modelling, the model outputs have been compared to the physico-chemical status thresholds set in the WFD Directions (Table 4-1 and Table 4-2) to help determine whether the level of change could result in any adverse impacts on ecosystem quality. The results of this process are presented as graphs in Figure 4-1 and Figure 4-2.

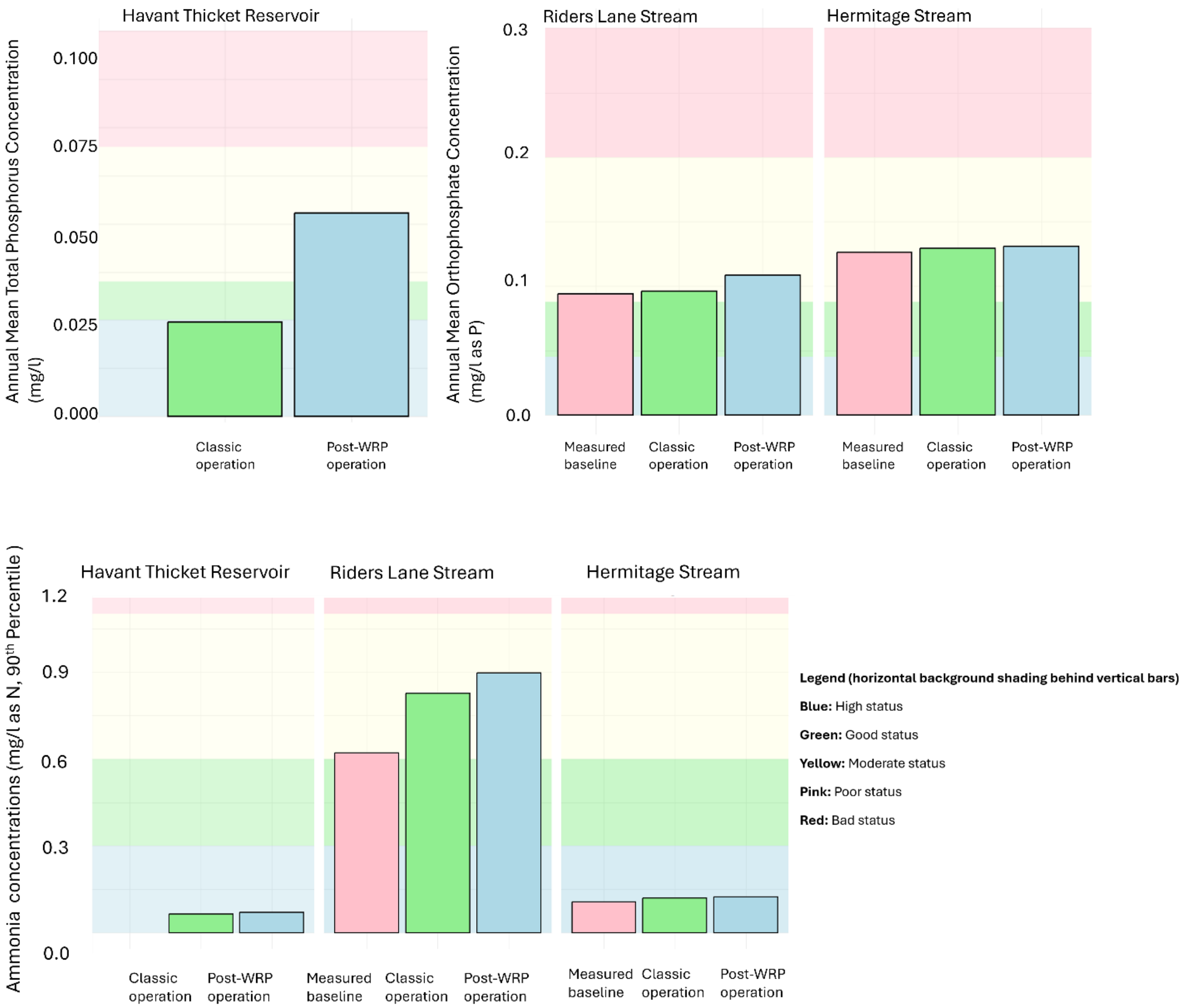
Table 4-1 Physico-chemical status thresholds from the WFD Directions 2015

Water body type	Parameter	High	Good	Moderate	Poor	Bad
Lake	Total Phosphorus (mg/l) Annual mean	<0.025	0.025 - 0.035	0.035 - 0.070	0.070 - 0.140	>0.140
	Total Ammonia (mg/l as N) 90th percentile	<0.3	0.3 - 0.6	6 - 1.1	1.1 - 2.5	>2.5
	Dissolved Oxygen (mg/l) Mean July-August	>8	6 - 8	4 - 6	1 - 4	<1
River	Orthophosphate (mg/l) Annual mean	<0.045	0.045 - 0.09	0.09 - 0.20	0.20 - 1.06	>1.06
	Ammonia (mg/l as N) 90th percentile	<0.3	0.3 - 0.6	0.6 - 1.1	1.1 - 2.5	>2.5
	Dissolved Oxygen (% saturation) 10th percentile	>70	60 - 70	54 - 60	45 – 54	<45
	BOD (mg/l) 90th percentile	<4	4 - 5	5 - 6.5	6.5 - 9	>9
Transitional and coastal	Dissolved Oxygen (mg/l) 5th percentile	>5.7	4.0 - 5.7	2.4 - 4.0	1.6 - 2.4	<1.6

Table 4-2 Comparison of modelled outputs against physico-chemical thresholds

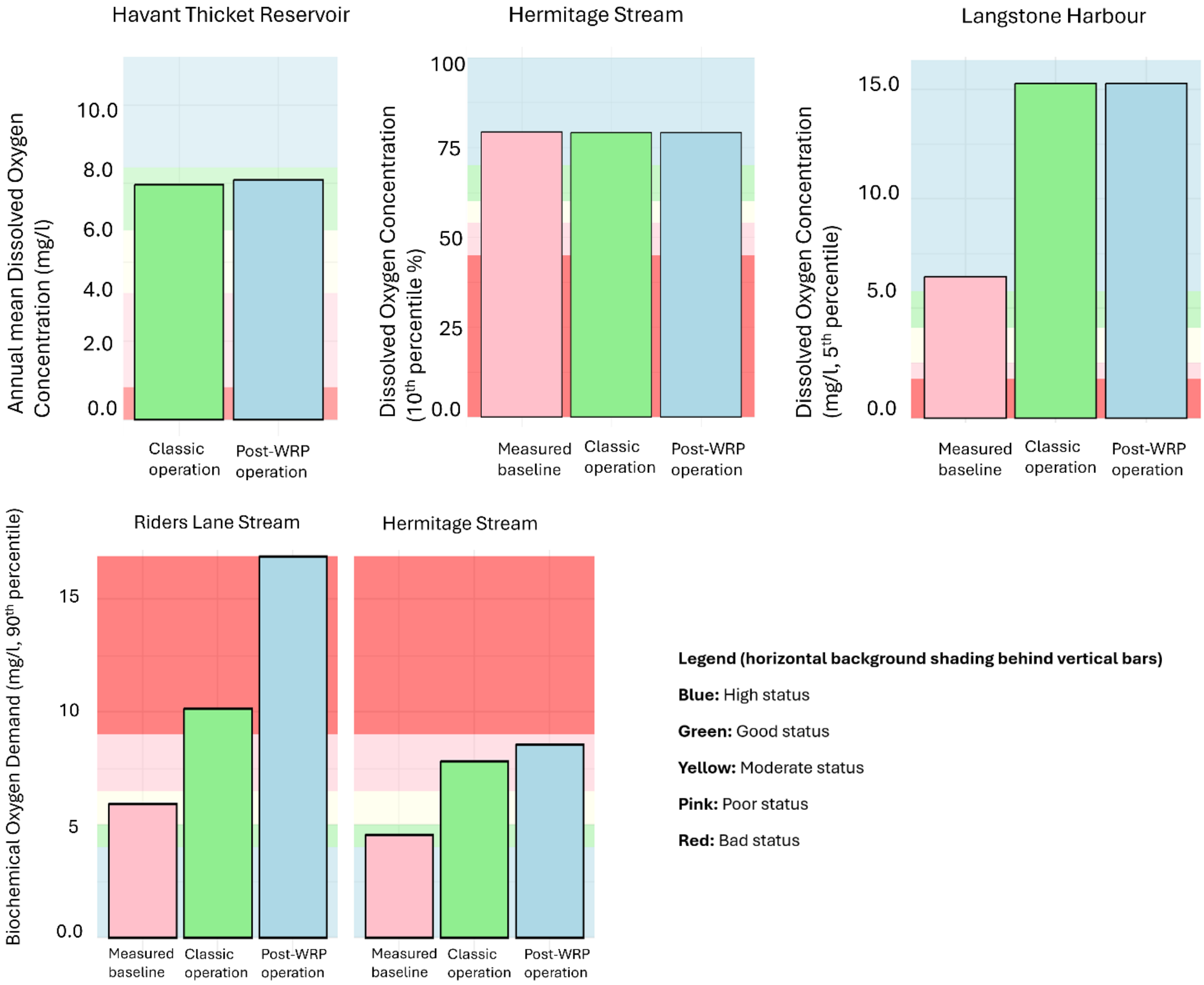
Parameter	Measured baseline	"Classic" operation	"Post-WRP" operation
Havant Thicket Reservoir			
Total Phosphorus (mg/l) Annual mean	-	0.024	0.052
Total Ammonia (mg/l as N) 90th percentile	-	0.065	0.070
Dissolved Oxygen (mg/l) Mean July-August	-	7.48	7.63
Riders Lane Stream			
Orthophosphate (mg/l) Annual mean	0.094	0.096	0.110
Ammonia (mg/l as N) 90th percentile	0.62	0.83	0.89
BOD (mg/l) 90th percentile	5.93	10.17	16.89
Hermitage Stream			
Orthophosphate (mg/l) Annual mean	0.12	0.13	0.13
Ammonia (mg/l as N) 90th percentile	0.10	0.12	0.12
Dissolved Oxygen (% saturation) 10th percentile	79	79	79
BOD (mg/l) 90th percentile	4.56	7.82	8.55
Langstone Harbour			
Dissolved Oxygen (mg/l) 5th percentile	6.42	15.2	15.2

Figure 4-1 Comparison of predicted water quality changes to status classification thresholds for Total Phosphorus, Orthophosphate and Ammonia



**Note that TP thresholds are only applicable to lakes, and PO_4 thresholds are only applicable to rivers. There are no TP, PO_4 or NH_3 thresholds for transitional or coastal waters.*

Figure 4-2 Comparison of predicted water quality changes to status classification thresholds for DO and BOD



**Note that there are no BOD thresholds for lakes, transitional or coastal waters. The baseline DO data for Riders Lane Stream is in mg/l, however the threshold for rivers is set for % saturation. Although conversion factors are available, these require accurate pressure and temperature measurements and have not been presented here.*

4.2.2 Although the preliminary interpretation of initial model results provides an indication of the potential impacts of the Project on the water environment, it does not provide a comprehensive assessment of the likely effects of construction-phase and operational impacts at this stage. This will be presented in the Environmental Statement and other supporting assessments as part of the DCO application.

Havant Thicket Reservoir

4.2.3 As Havant Thicket Reservoir is not yet operational, it is not possible to directly determine baseline water quality and as such any assessments of the potential changes in water quality in the reservoir are based on modelling. There is therefore an inherent degree of uncertainty associated with the modelled predictions of water quality in the reservoir and how it could potentially change as a result of the Project during operation.

4.2.4 These results indicate that, following an initial period of variation as the reservoir is filled with spring water, rainfall and surface runoff (from what are currently the headwaters of Riders Lane Stream), water quality would stabilise at the beginning of the "classic" operation phase. Water quality during this phase is likely to be good, although TP concentrations are predicted to increase very slightly during this period (from c.0.02mg/l to c.0.03mg/l) and then stabilise (Future Water, 2024; see section 5.2 for further discussion).

4.2.5 The addition of recycled water from the proposed WRP results in an increase in concentrations of phosphorus (from c.0.03mg/l to 0.06mg/l), which causes a corresponding increase in phytoplankton growth. Conversely, nitrogen concentrations decrease, but this does not result in a decrease in phytoplankton growth within the reservoir due to the concurrent increase in phosphorus.

4.2.6 The predicted change in phosphorus concentrations is sufficient to result in a change in water body status, from 'high' during the "classic" operation phase to 'moderate' during the post-WRP operation phase (Figure 4-1). This would result in a change of water body status under the WER. As such, additional measures would be required to ensure that the Project is compliant with the WER.

4.2.7 Southern Water is assessing several options for reducing the TP concentration in the recycled water released into Havant Thicket Reservoir. Potential methods for reducing TP concentrations include ferric dosing, enhanced biological phosphorus removal, higher rejection membranes, a second stage of reverse of osmosis at the WRP and ion exchange polishing. The selected treatment measure(s) will be set out within the DCO application and its associated Environmental Statement. Southern Water is working with the Environment Agency to determine how these measures are best introduced.

4.2.8 As discussed in section 3.1, the reservoir water quality modelling examined alternative scenarios in which the concentrations of phosphorus in the recycled water from the proposed WRP were reduced to represent different levels of treatment efficiency (Future Water, 2024). The results of these scenarios predict that WER compliance could be achieved within the reservoir (i.e. a change in status could be avoided) if TP concentrations in recycled water were to be reduced. As provision for further treatment measures to reduce TP concentrations in the recycled water will be included in the DCO, significant adverse effects to the water environment are therefore not anticipated.

4.2.9 The predicted changes in other parameters would not result in any changes in water body status within Havant Thicket Reservoir (Figure 4-1 and Figure 4-2). As described in section 3.1, the introduction of recycled water from the proposed WRP would result in a large decrease in concentrations of TN and nitrate in the reservoir and a smaller decrease in ammonia concentrations. This improved water quality is not, however, reflected in a change in water body status, because lake water quality for nitrogen compounds is only assessed on the basis of total ammonia under the WFD Directions and the other compounds are not considered.

4.2.10 BOD is not used to classify the status of lake water bodies and is not therefore discussed further in this section.

Riders Lane Stream and Hermitage Stream

Impacts of compensatory flows

4.2.11 A change in many parameters in Riders Lane Stream is predicted to occur during the Havant Thicket Reservoir "classic" operation scenario, before recycled water from the proposed WRP is introduced. Median alkalinity, pH, and concentrations of DO, ammonium and DOC would increase in Riders Lane Stream once the reservoir becomes operational. These parameters would each remain broadly similar or decrease slightly once recycled water from the proposed WRP is introduced to the reservoir. However, while median concentrations of orthophosphate and BOD are also predicted to increase over the baseline once the reservoir becomes operational, they are also predicted to increase further once recycled water from the proposed WRP is introduced. Median nitrate and DIC concentrations would also increase when the reservoir becomes operational, before decreasing once the spring water is diluted by recycled water from the WRP.

4.2.12 Concentrations of the water quality parameters in Hermitage Stream are predicted to be subject to a smaller change over the current baseline than those in Riders Lane Stream, reflecting the fact that the reservoir compensatory flows would represent a smaller proportion of the total flows in the larger watercourse. Once the reservoir is operational, the compensatory flows are predicted to result in an increase in median pH, alkalinity, DO, BOD, orthophosphate, ammonium, nitrate, DOC and DIC concentrations in Hermitage Stream. The introduction of recycled water from the proposed WRP into the reservoir is predicted to result in a decrease in median pH, alkalinity and nitrate (reflecting natural differences in water chemistry between the alkaline, nitrate-enriched groundwater and the more neutral recycled water with a lower nitrate content), and DIC. Median BOD and DOC would increase slightly more in Hermitage Stream, and all other water quality parameters would remain at very similar concentrations as during the "classic" operation phase.

4.2.13 The preliminary results of the water quality modelling therefore indicate that compensatory flows from the reservoir both before and after the introduction of recycled water are likely to result in greater changes in water quality in Riders Lane Stream than in Hermitage Stream.

4.2.14 The water quality changes described above for both the "classic" and "post-WRP" scenarios are compared to the status classification thresholds for physico-chemical quality elements set out in the WFD Directions in Figure 4-1 and Figure 4-2. The figures demonstrate that there would be slight changes for the majority of the water quality parameters, with slight increases in orthophosphate, ammonia and BOD.

4.2.15 The increases in orthophosphate in Riders Lane Stream and Hermitage Stream would not be sufficient to change the status class of the water body, which would remain at 'moderate' status. Similarly, ammonia concentrations are predicted to increase in both watercourses but would remain at 'high' status. Following the precedent established following the European Court of Justice ruling C-461/13 (2015) and set out in guidance published by the Environment Agency (2016), changes to water quality within a status class do not constitute deterioration in water quality and are therefore unlikely to result in adverse impacts on the aquatic environment, unless the quality element is at 'bad' status. Because orthophosphate would remain at 'moderate' status and ammonia at 'high' status, this means that the predicted changes are compliant with the WER.

4.2.16 Although the predicted increases in orthophosphate and ammonia concentrations would not result in a change in river water body status class, the increases could potentially result in a slight change in water quality in Riders Lane Stream. However, this change is very small in Hermitage Stream and is therefore considered unlikely to result in significant adverse impacts at water body scale.

4.2.17 The dispersion modelling suggests that BOD would increase in Riders Lane Stream and Hermitage Stream following the commissioning of the reservoir, and would increase further following the introduction of recycled water from the proposed WRP. The increase in BOD in the "classic" operational phase would cause a change in the status of the quality element from 'moderate' to 'bad' in Riders Lane Stream and 'good' to 'poor' in Hermitage Stream (noting that these predictions are based on the results of the dispersion modelling and therefore represent the worst-case scenario (refer to section 3.2)). Further increases in BOD following introduction of recycled water from the proposed WRP would not result in any further changes in status.

4.2.18 It is important to note that although the WFD Directions set out thresholds for BOD in rivers, these thresholds are not used to classify water body status (Table 2 in Schedule 3, Part 1, Section 1 of the WFD Directions explicitly states that 'BOD must not be used in classifying the status of water bodies.') and as such the change would not constitute deterioration in water body status. BOD increases need to be considered in the context of changes to DO in order to determine the extent of environmental effects that are likely to occur; if an increase in BOD results in a decrease in DO, aquatic organisms could be adversely impacted (refer to section 5.2). In this case, however, the predicted increase in BOD in Riders Lane Stream and Hermitage Stream is not accompanied by a significant decrease in DO concentrations (which are predicted to remain at 'high' status following the construction of the reservoir and following the addition of recycled water from the proposed WRP). Significant adverse impacts are therefore considered to be unlikely.

4.2.19 Furthermore, the model outputs presented in this section do not represent the outputs of the alternative phosphorus removal scenarios considered in the reservoir modelling. These demonstrate that the reservoir could achieve 'good' ecological status following introduction of recycled water from the WRP if additional phosphorus removal were to be included (Future Water, 2024; refer to section 3.1). Phosphorus compounds play an important role in controlling phytoplankton growth because they are an essential component in the formation of plant cells. This means that a reduction in phosphorus in the reservoir is likely to result in a reduction in the growth of phytoplankton. BOD represents the amount of DO consumed by bacteria while they decompose organic matter. When phytoplankton growth is high, BOD is typically also high as there is increased availability of organic matter (i.e. dead phytoplankton cells) for bacterial decomposition. Therefore, a reduction in phosphorus concentrations and phytoplankton growth should lead to a decrease in BOD, both in the reservoir and in compensatory flows to Riders Lane Stream and Hermitage Stream (refer to Table 2-1 and section 5.2

for further information). This will be considered in more detail in the Environmental Statement and supporting assessments.

Impacts of WRP SuDS outfall release

4.2.20 The modelled change in salinity due to the proposed WRP SuDS outfall release, when compared with the natural fluctuations in ambient salinity levels throughout the tidal cycle, is considered small. Significant water quality effects from the proposed WRP SuDS outfall are therefore not anticipated.

Langstone Harbour

Impacts of compensatory flows

4.2.21 The water quality modelling of the chemical parameters described in section 3.2 indicate that there are only very limited changes in water quality in Langstone Harbour from the modelled Havant Thicket Reservoir “classic” operation and “post-WRP” operation scenarios. Significant water quality effects from the compensatory flows are therefore not anticipated in Langstone Harbour.

Impacts of Eastney LSO and SuDS releases

4.2.22 As shown in section 3.3, modelled changes in water quality around the Eastney LSO do not extend into Langstone Harbour therefore no impacts to this water body have been identified.

4.2.23 Similarly, the releases from the WRP SuDS described in section 3.4 would result in highly localised changes in salinity in the lower tidal reach of the Hermitage Stream, and would not therefore affect Langstone Harbour. Significant water quality effects from the proposed WRP SuDS outfall are therefore not anticipated in Langstone Harbour.

Solent

Impacts of compensatory flows and SuDS release

4.2.24 Modelling associated with the compensatory flows to Riders Lane Stream and the SuDs release from the proposed WRP did not show any effect on the Solent as the plume extents were restricted to the north of Langstone Harbour. Significant water quality effects from these operational releases are therefore not anticipated in the Solent.

Impacts of Eastney LSO release

4.2.25 The preliminary surface water risk assessment, described in section 3.3, screened in seven parameters (fluoranthene, HBCDD, lead, PFOS, BaP, terbutryn and zinc) for further assessment. Modelling was therefore undertaken to determine the potential changes between the existing scenario and the future scenario on these parameters and illustrate the predicted changes between the two scenarios within the Solent. Further work requires the addition of baseline concentrations from ongoing marine water quality sampling to the modelled output, and a comparison of the results with the physico-chemical thresholds for the water body defined in the WFD Directions. However, given the very small changes in concentrations between the existing and future scenarios, significant water quality effects in the Solent are not anticipated.

5 Potential effects on freshwater biodiversity

5.1 Introduction

5.1.1 Southern Water presented an assessment of preliminary likely significant effects from the construction, operation and decommissioning of the Project on freshwater biodiversity in PEI Report Chapter 8: Terrestrial and freshwater biodiversity, Volume I, presented in the Summer 2024 Consultation and included reference to potential water quality changes due to the release of recycled water from the proposed WRP into Havant Thicket Reservoir. It was acknowledged in the PEI Report chapter that impacts would be assessed following completion of reservoir and downstream water quality modelling.

5.1.2 As a precautionary approach, the PEI Report Chapter 8: Terrestrial and freshwater biodiversity identified the potential for adverse effects on bird assemblages (which underpin a number of statutory nature conservation designations) in relation to potential releases from the Eastney LSO and associated water quality changes.

5.1.3 Since the Summer 2024 Consultation, the water quality modelling and assessment work undertaken has enabled further understanding of the potential effects of the Project on freshwater biodiversity. This modelling is detailed in section 3 and in summary has included:

- Modelling of Havant Thicket Reservoir water quality to assess the potential impacts of releasing recycled water into the reservoir.
- Water quality modelling of water bodies downstream of Havant Thicket Reservoir which will require the release of compensatory flows from Havant Thicket Reservoir to Riders Lane Stream and Hermitage Stream.
- Proposed WRP SuDS outfall modelling which assesses the potential water quality effects of the release of surface runoff from the proposed WRP SuDS via a new outfall into the Hermitage Stream.

5.1.4 The additional modelling work is considered in terms of freshwater biodiversity (specifically freshwater ecology) in the following section. The preliminary assessment presented in this report will be further developed, and the results will be presented in the Environmental Statement, WER Compliance Assessment and Habitats Regulation Assessment.

5.2 Preliminary consideration of potential environmental effects

5.2.1 The implications of the preliminary reservoir modelling (section 3.1), the compensatory flows modelling (section 3.2), and proposed WRP SuDS outfall modelling (section 3.4) on freshwater biodiversity are considered in the remainder of this section.

5.2.2 This preliminary interpretation of initial model results does not provide an assessment of the likely magnitude and significance of any impacts at this stage; this will be presented in the Environmental Statement and other supporting assessments (e.g. the HRA and WER Compliance Assessment).

5.2.3 Consideration of potential environmental effects associated with the proposed WRP reject water release from the Eastney LSO are provided in section 6. As the preliminary modelling does not predict water quality changes from this release in the Solent, no adverse effects on the national and internationally designated sites listed in section 2.4 are anticipated, including effects on the bird assemblages unpinning these designations.

Havant Thicket Reservoir

5.2.4 An assessment of ecological impacts on Havant Thicket Reservoir is currently underway, the key preliminary findings of which are presented here. The main objectives of the Havant Thicket Reservoir ecological impact assessment are:

- To determine whether a switch from the “classic” operation scenario (i.e. water levels predominantly maintained by surplus spring water) to the “post-WRP” operation scenario (i.e. levels maintained with the input of recycled water, in addition to spring water) would have an effect on the biodiversity potential of Havant Thicket Reservoir.
- To evaluate the sensitivity of the reservoir’s ecological condition during the “post-WRP” operation scenario to operational changes (i.e. use of a bubbler system).

5.2.5 The biodiversity of a standing water body is influenced by numerous environmental factors, including water quality variables, climatic conditions, habitat quality and hydrological processes. Although there is a great deal of variation in the relative importance of these factors both spatially (e.g. between water bodies) and temporally (e.g. seasonally and inter-annually), the scientific consensus is that nutrient availability, specifically the availability of phosphorus, is the major determining factor in many lake and reservoir ecosystems. Phosphorus is important as it is often the key controlling factor on phytoplankton growth in lakes and reservoirs. It is therefore considered appropriate that the assessment of reservoir ecological condition is primarily focussed on modelled in-reservoir nutrient concentrations.

5.2.6 Aquatic ecosystems can be classified by their degree of nutrient enrichment, also referred to as ‘trophic status’. One of the most widely used trophic status classification systems for lakes and reservoirs was developed by the Organisation for Economic Co-operation and Development (OECD). The OECD system assigns trophic status based on annual mean concentrations of TP and chlorophyll-a (a proxy for phytoplankton growth) in surface waters (OECD, 1982). Table 5-1 details how concentrations of these water quality parameters translate into trophic status and provides a description of the ecosystem conditions typically associated with each status class.

Table 5-1 Trophic status, TP and chlorophyll-a thresholds according to the Organisation for Economic Development classification system

Trophic status	TP (mg/l)	Chlorophyll-a (µg/l)	Typical ecological characteristics
Oligotrophic	<0.01	<2.5	Low level of primary productivity due to nutrient deficiency. Water is usually clear due to limited growth of phytoplankton. Typically inhabited by aquatic species that require cold, well-oxygenated water.
Mesotrophic	0.01 – 0.035	2.5 - 8	Intermediate level of primary productivity. Water is usually relatively clear and nutrient levels are sufficient to support the growth of submerged aquatic plants. Biodiversity is generally higher than in eutrophic waterbodies and the community comprises species of fish and invertebrates that require clear, well-oxygenated water and have a low tolerance for poor water quality.
Eutrophic	0.035 – 0.100	8 - 25	High level of primary productivity supported by relatively high nutrient levels. High phytoplankton growth increases water turbidity and consequently reduces light penetration through the water column, which in turn inhibits the growth of submerged macrophytes. Low oxygen concentrations develop at depth during periods of peak microbial decomposition. Biodiversity is generally low compared to mesotrophic waterbodies and the community comprises species of fish and invertebrates that are more tolerant of turbid, low-oxygen conditions.
Hypereutrophic	>0.100	>25	Extremely high level of primary productivity. Little transparency due to excessive phytoplankton growth. No submerged macrophytes and recession of marginal aquatic plant beds. Prolonged periods of anoxia or hypoxia in bottom waters. Insufficient oxygen to support fish of any species.

Source: OECD, 1982

5.2.7 Modelled TP and chlorophyll-a concentrations have been used to determine the trophic status of Havant Thicket Reservoir according to the OECD defined boundaries for annual mean concentrations. Additional modelled water quality parameters have been reviewed to provide further context to the assessment.

5.2.8 For both parameters, in the absence of further mitigation, the “post-WRP” annual mean concentrations are within the OECD eutrophic range (TP annual mean = 0.057mg/l; chlorophyll-a annual mean = 11.60µg/l). A description of typical ecological conditions in eutrophic lakes and reservoirs is provided in Table 5-1.

5.2.9 Time-series graphs of monthly mean TP concentration (Figure 5-1) and chlorophyll-a concentration (Figure 5-2) illustrate the change in these water quality parameters concurrent with the introduction of recycled water.

5.2.10 TP concentration increases from *c*. 0.03mg/l to *c*. 0.06mg/l in the two years following the introduction of recycled water to the reservoir. It then remains relatively stable and shows little seasonal variability throughout the “post-WRP” scenario, whereas chlorophyll-a concentration is more variable. As is commonly observed in lakes and reservoirs, the chlorophyll-a concentration is low during the winter when phytoplankton growth is limited by environmental factors other than nutrient availability (e.g. light and temperature) and higher in summer when environmental conditions allow phytoplankton to utilise available nutrients.

Figure 5-1 Time-series of surface water monthly mean TP concentration, with and without bubble plume destratification system

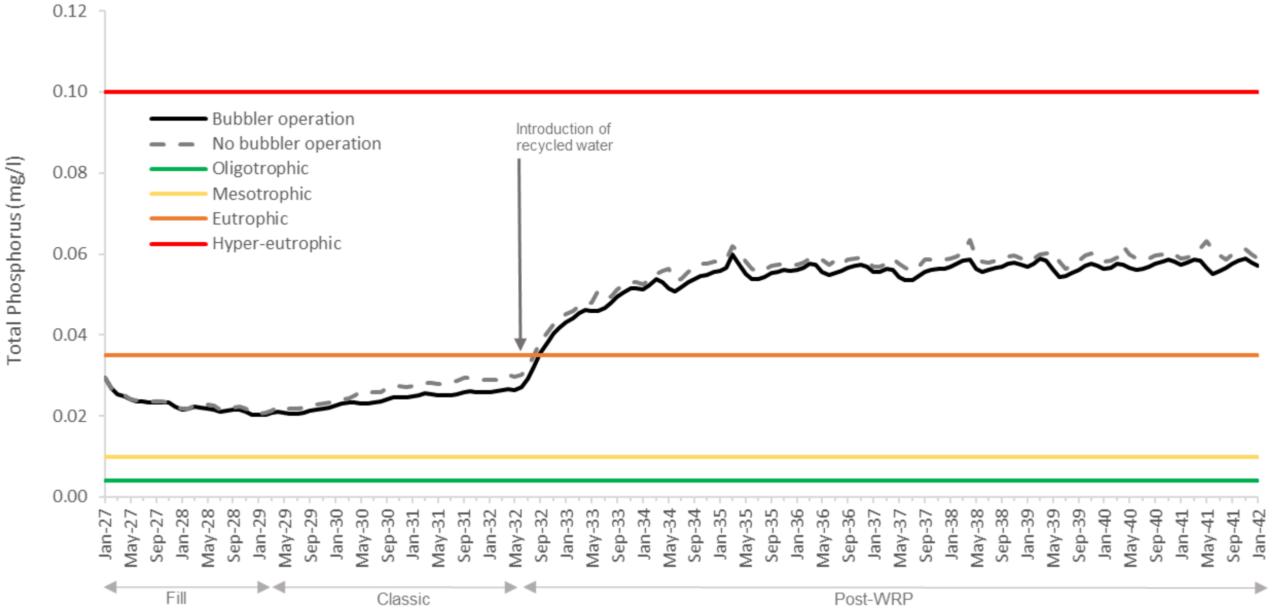
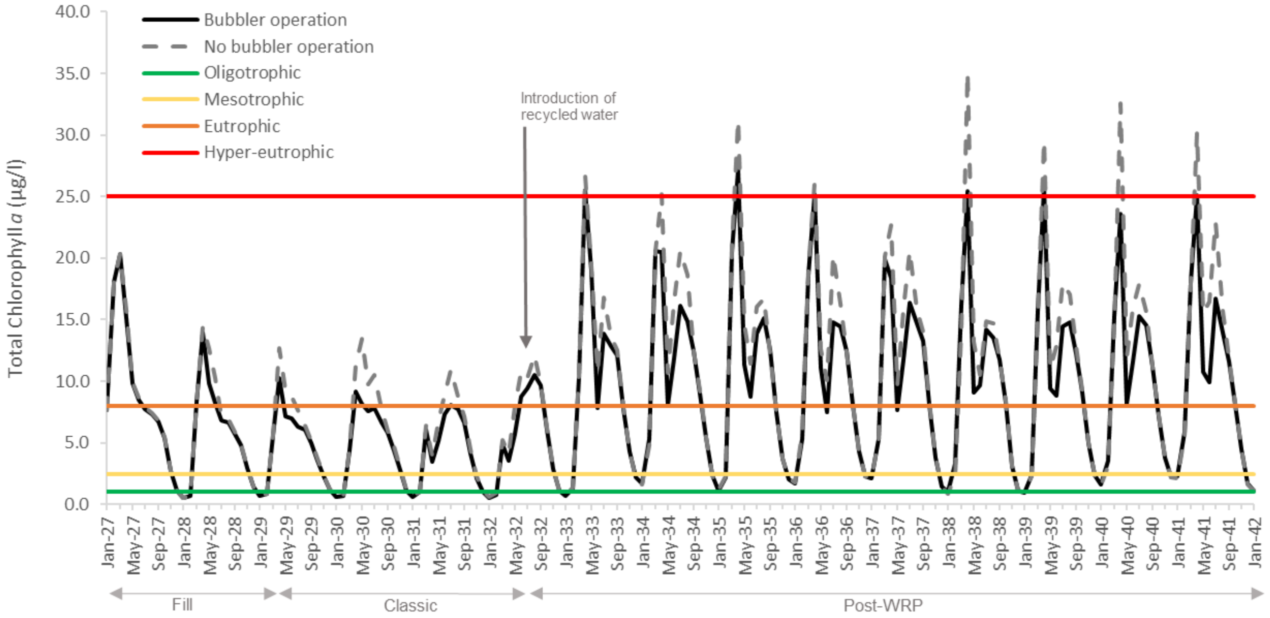


Figure 5-2 Time-series of surface water monthly mean chlorophyll-a concentration, with and without bubbler plume destratification system



5.2.11 It is proposed that a bubbler system is operational in the reservoir between April and August (i.e. during the typical seasonal stratification period) to prevent the development of bottom water anoxia (oxygen depletion) and maintain vertical homogenous water quality conditions year-round. Bottom water anoxia can develop in a eutrophic reservoir when dead phytoplankton cells and other organic matter reach the sediment surface, this increases the rate of microbial decomposition and consequently reduces DO concentrations (i.e. increased BOD). Stratification (thermal layering) of the water column during warmer periods exacerbates this issue as the bottom water is not replenished by mixing with DO-rich surface water.

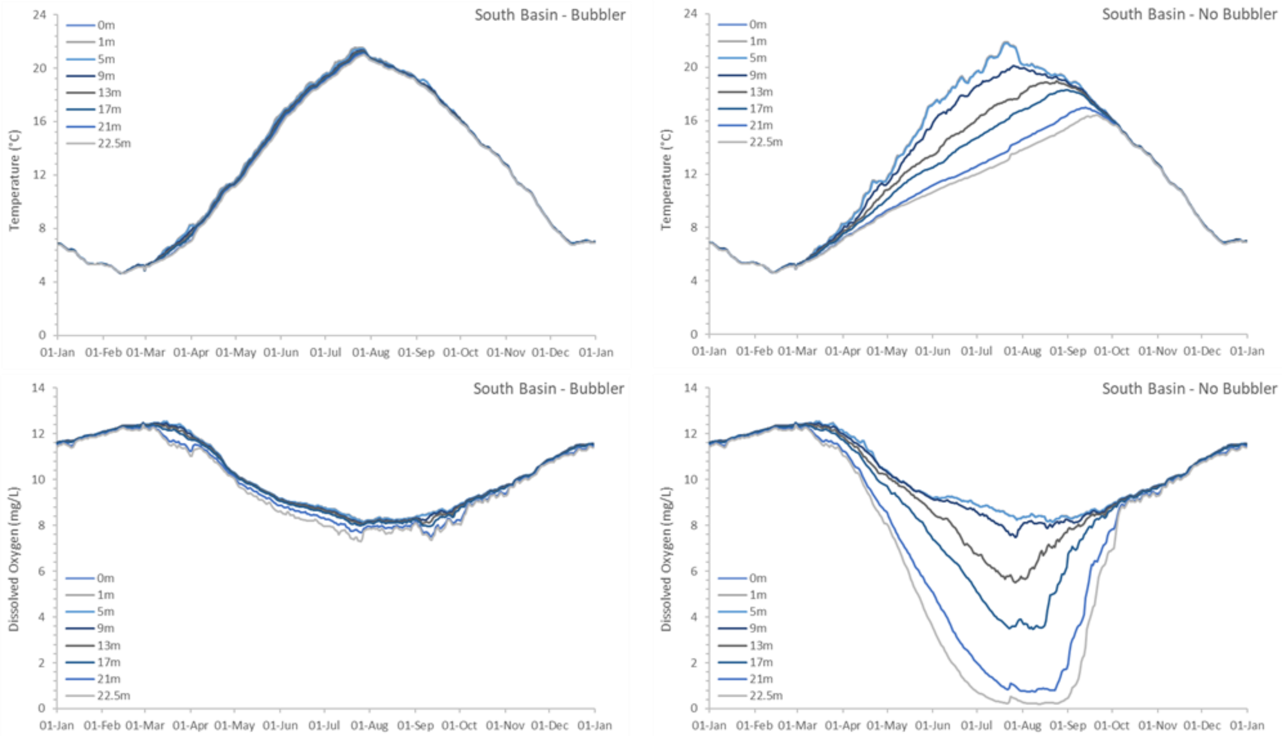
5.2.12 As Figure 5-1 and Figure 5-2 show, operation of the bubbler is predicted to have a moderately beneficial impact on surface water TP and chlorophyll-a concentrations in open water areas. Summer peak concentrations of chlorophyll-a are reduced during bubbler operation; however, the annual mean concentration of both parameters is still within the OECD eutrophic range (TP annual mean = 0.055mg/l; chlorophyll-a annual mean = 10.27 µg/l). Although these results indicate that the bubbler system would not result in a change in reservoir OECD trophic status, the bubbler is predicted to effectively mix the water column, preventing thermal stratification and the development of bottom water anoxia, as shown in Figure 5-3.

5.2.13 Maintenance of a well-mixed water column by the bubbler may yield the following ecological benefits for the reservoir:

- Cyanobacteria (a group of phytoplankton, also known as blue-green algae) are physiologically suited to calm, un-mixed waters. An effective bubbler largely eliminates their competitive advantage over other phytoplankton groups. A shift away from cyanobacteria dominance reduces the risk posed to human and animal health by the release of cyanotoxins.
- The development of anoxia has the potential to impact the distribution and health of fish and other aquatic organisms. A lack of oxygen in bottom waters can lead to their exclusion from the affected area. Maintenance of high bottom water oxygen levels by the bubbler system would avoid this.

5.2.14 The potential impact of the bubbler system on water column mixing and phytoplankton growth in marginal areas of the reservoir is unknown as the modelling exercise focussed on open water areas.

Figure 5-3 Temperature and DO water column depth profiles with and without nighttime bubbler system operation, average daily temperature and DO concentration, post-WRP phase (2033 - 2041)



5.2.15 To conclude, the preliminary results of the Havant Thicket Reservoir biodiversity assessment indicate that the reservoir may shift to a eutrophic state following the introduction of recycled water. Under such conditions, it is considered unlikely that an ecosystem comprising a diverse range of aquatic species would develop. It is more likely that the reservoir would lack submerged macrophyte growth and that bottom-feeding species, that are relatively tolerant of poor water quality (e.g. carp) would dominate the fish community. Operation of the bubbler system may reduce some of the undesirable consequences of eutrophication, e.g. cyanobacterial dominance of the phytoplankton community and the development of bottom water anoxia. However, a reduction in TP input would be required to improve the biodiversity potential of the reservoir.

5.2.16 The reservoir water quality modelling exercise includes scenarios where the TP concentration of recycled water input is reduced. This is predicted to improve the ecological potential of the reservoir closer to that predicted for the “classic” operational scenario under ‘mesotrophic’ conditions. As provision for further measures to reduce TP concentrations in the recycled water will be included in the DCO, significant adverse effects to freshwater biodiversity in the reservoir are not anticipated. Southern Water is working with the Environment Agency to determine how these measures are best introduced.

Riders Lane Stream, Hermitage Stream (freshwater reach)

Impacts of compensatory flows

5.2.17 The compensatory flows modelling has considered water quality effects at sample points on Riders Lane Stream (downstream of the reservoir and upstream of the culvert at Middle Park Way Road), and for Hermitage Stream above the tidal limit at the location of the Environment Agency water quality monitoring site, as shown in Figure 3-1.

5.2.18 The preliminary results indicate that compensatory flows from the reservoir after the introduction of recycled water are likely to result in greater changes in water quality in Riders Lane Stream than in Hermitage Stream, with median concentrations of orthophosphate and BOD predicted to increase. Median nitrate, alkalinity, pH and DIC concentrations would increase in Riders Lane Stream in the “classic” operation scenario, before decreasing once the spring water is diluted by recycled water in the “post-WRP” scenario. Predictions for BOD, DO concentration and orthophosphate concentration in Riders Lane Stream are considered to be the most important in terms of considering potential effects on freshwater biodiversity.

Orthophosphate

5.2.19 There is a slight increase in orthophosphate in Riders Lane Stream, from a median concentration of 0.167mg/l in the “classic” scenario to 0.187mg/l in the “post-WRP” scenario. An increase in orthophosphate would be expected to result in an increase in biological activity in Riders Lane Stream, thus there is potential for the photosynthetic activity of macrophytes and diatoms to increase, leading to an increase in BOD and reduced DO. However, in-stream vegetation is largely absent from Riders Lane Stream, with low macrophyte diversity present due to the lack of permanent aquatic habitats, constrained by intermittent flows. Therefore, the slight increase in orthophosphate is not likely to be significant in terms of its influence on BOD and DO (see below). In the Hermitage Stream, median orthophosphate concentrations are predicted to remain similar between the two operational scenarios.

BOD and DO

5.2.20 BOD is predicted to increase significantly, attributed to the increase in phytoplankton growth in Havant Thicket Reservoir following the introduction of recycled water in the "post-WRP" scenario. Whilst BOD is a useful indicator of the amount of oxygen consumed by biological processes, it needs to be considered in the context of potential effects on DO, which is the critical indicator of oxygen available to aquatic species, particularly for fish and macroinvertebrate communities which are sensitive to this water quality parameter. DO levels are predicted to increase significantly from measured baseline in both watercourses under both the "classic" and "post-WRP" operational scenarios.

5.2.21 For fish, the requirement for DO differs between species and their various life stages however generally DO concentrations of above 8mg/L are considered to support healthy growth (Bulbul et al., 2022), with adverse effects on fish health when DO concentrations drop below 5-6mg/L (Dong *et al.*, 2011). The modelling has predicted that measured baseline DO concentrations in the downstream watercourses is relatively low for fish (predicted to be 7.4mg/l in Riders Lane Stream and 6.5mg/l in Hermitage Stream). Therefore, both the "classic" and "post-WRP" operation scenarios are expected to result in a beneficial increase to the available DO in both the watercourses. However, some literature does suggest that DO concentrations as low as 2mg/l are satisfactory to moderately tolerant freshwater species (EIFAC, 1973), so the measured baseline DO concentrations may not necessarily be limiting fish populations. The fish species currently present in the downstream watercourses, namely bullhead and European eel do not require high levels of DO.

5.2.22 In Hermitage Stream, the predicted DO concentrations in the measured baseline, the "classic" and the "post-WRP" operational scenarios all fall well above any minimum requirements for DO for fish. However, significant populations of fish species are not currently present in this watercourse due to the presence of significant barriers to fish passage and lack of optimal habitat.

5.2.23 The macroinvertebrate communities present in the Riders Lane Stream and Hermitage Stream are also predicted to benefit from increased DO concentrations associated to the "classic" and "post-WRP" scenarios, with current communities showing a lack of diversity and tolerance of low DO. This is indicated by recorded Lotic-invertebrate Index for Flow Evaluation (LIFE) scores (Extence *et al.* (1999)), a scoring system used to determine to types of macroinvertebrate species present in different river flow systems.

5.2.24 Portsmouth Water's planned restoration works (required as part of the Havant Thicket Reservoir planning permission and WER Compliance Assessment) aim to improve the ecological condition of the Hermitage Stream catchment, with a more consistent flow expected (associated to compensatory flows), habitat restoration and barriers to fish passage improved. These improvements are expected to support greater diversity in terms of macrophyte, macroinvertebrate and fish species. Southern Water will continue to collaborate with Portsmouth Water to consider the impact these works may have on the future ecological condition of the catchment. This will be presented within the Environmental Statement.

Impacts of SuDS outfall release

5.2.25 From the proposed WRP SuDS modelling results, any indicated change in water quality is in proximity to the new outfall which is within the tidal reach of the Hermitage Stream. Consideration of potential environmental effects as a result of the WRP SuDS outfall are discussed in the marine biodiversity assessment for the Hermitage Stream (tidal reach) in section 6.2.

5.2.26 To conclude, the extent of water quality changes predicted in Riders Lane Stream and Hermitage Stream (freshwater reach) during the “post-WRP” operation scenario are very small for most water quality parameters and considered unlikely to result in significant adverse effects on freshwater biodiversity.

6 Potential effects on marine biodiversity

6.1 Introduction

6.1.1 Southern Water presented the assessment of likely significant effects from the construction, operation and decommissioning of the Project on marine biodiversity aspects in the PEI Report Chapter 9: Marine Biodiversity, Volume I, presented in the Summer 2024 Consultation. Potential effects on marine biodiversity due to changes in the proposed WRP reject water released from Eastney LSO were identified during the operation phase of the Project. Following the precautionary principle, there remained the potential for significant adverse effects on marine biodiversity in the PEI Report as the marine dispersion modelling and outputs were still being developed.

6.1.2 Since the Summer 2024 Consultation, the Solent dispersion modelling undertaken (section 3.3) has provided further information on the predicted changes in chemical composition in the Eastney LSO release to inform the extent of water quality influence. The result of a benthic ecology survey around the Eastney LSO is also now available to inform the baseline benthic habitats and communities in the area.

6.1.3 The compensatory flows water quality modelling (section 3.2) provided information on the predicted changes in water quality and chemical parameters due to the compensatory flow at the tidal limit of Hermitage Stream and northern end of Langstone Harbour that inform any effects on the intertidal communities in those areas.

6.1.4 The proposed WRP SuDS modelling undertaken (section 3.4) has predicted changes in water quality parameters to inform the potential effects of the SuDS release on the tidal section of the Hermitage Stream. A field survey was undertaken in September 2024 to understand the existing condition of habitats around the proposed outfall location.

6.1.5 This section of the Report summarises the updated baseline condition particularly in the study area relevant to the water quality modelling assessment since the Summer 2024 Consultation and preliminary consideration of potential effects of water quality changes on marine biodiversity.

6.2 Preliminary consideration of potential environmental effects

Approach to assessment

6.2.1 Potential implications of these water quality technical assessments mentioned in sections 3.2, 3.3 and 3.4 on marine biodiversity (including intertidal communities) are considered. Marine habitats and species that occur in the study areas are briefly reviewed with discussion of their sensitivity to the predicted water quality changes. Preliminary findings of this review are summarised below.

Hermitage Stream (tidal reach)

6.2.2 As set out in section 3.2, the extent of the water quality changes in the Hermitage Stream (tidal reach) resulting from the "post-WRP" operation scenario, when compared to the "classic" operation scenario, are predicted to be extremely small.

6.2.3 From the preliminary findings of the proposed WRP SuDS modelling, there would be a decrease in salinity down to -6PSU predicted along the bank of Hermitage Stream in proximity to the new outfall during spring tide and down to -7PSU predicted at the downstream channel during neap tide. The differences are confined to localised areas of the tidal Hermitage Stream and the overall change in salinity due to the SuDS release compared with the natural fluctuations in ambient salinity levels is small (refer to section 3.4). The habitats and species identified along the bank were artificial hard structures, littoral mud and estuary wrack, all of which are common in variable salinity. European eel recorded in the tidal Hermitage Stream is a euryhaline species adapted to salinity changes. Therefore, they are not sensitive to salinity decrease due to the SuDS release.

6.2.4 The potential effects of both the compensatory flows and proposed WRP SuDS release on water quality within the tidal reach of the Hermitage Stream are predicted to be very small. As such, significant effects to the biodiversity of the Hermitage Stream (tidal reach), are not anticipated.

Langstone Harbour

6.2.5 As set out in section 3.2, the preliminary compensatory flow modelling has predicted that within Langstone Harbour changes in water quality parameters are very small, when comparing the "classic" operation scenario with the "post-WRP" operation scenario. As such these changes are considered unlikely to influence the habitat and species in the harbour.

6.2.6 The proposed WRP SuDS modelling predicted that there would be no change in salinity in Langstone Harbour due to additional SuDS release.

6.2.7 There were no sensitive seagrass beds observed along the northern part of Langstone Harbour whilst the one migratory fish species recorded (European eel) is not likely to be sensitive to the small changes in water quality due to the compensatory flows. As such, significant effects to the biodiversity of Langstone Harbour are not anticipated.

Solent (Eastney Long Sea Outfall)

6.2.8 Based upon the preliminary Eastney LSO dispersion modelling, small decreases are predicted in the concentrations of the screened in chemical compounds releasing into the marine waters via the Eastney LSO.

6.2.9 Further work requires the addition of baseline concentrations from marine water quality sampling to the modelled output. However, given the very small changes in concentrations, it is unlikely that effects to marine statutory designated sites, marine habitats and species between the existing and future scenarios would be observed. No significant effects on marine biodiversity are therefore anticipated, however this will be fully assessed within the Environmental Statement and Habitats Regulations Assessment.

7 Summary and next steps

7.1.1 Abstraction licence reductions, climate change and population growth mean Southern Water is facing a shortfall of 200 million litres of water a day in Hampshire during a drought. As a result, the company is developing new sources of supply to make up this shortfall and maintain public supplies while protecting the county's chalk stream rivers. Southern Water is proposing to submit an application for a Development Consent Order (DCO) for the Hampshire Water Transfer and Water Recycling Project (the 'Project') under the Planning Act 2008. The Project sets out to create a new drought-resilient source of water that protects and enhances the environment, comprising a combination of both water transfer and water recycling technology that during drought conditions would play a major role in making up any shortfall in water supply across the Hampshire supply area. The Project would be operational throughout the year however peak operation would only occur during drought conditions.

7.1.2 The Project would use advanced treatment process to turn treated wastewater into recycled water at a proposed Water Recycling Plant (WRP), to be located south of Havant in the vicinity of Budds Farm Wastewater Treatment Works (WTW). A portion of the treated wastewater from Budds Farm WTW would be redirected for advanced treatment within the proposed WRP. This would produce recycled water for transfer to Havant Thicket Reservoir, where it would supplement the spring water that will be stored in the reservoir in accordance with Portsmouth Water's existing planning permission. The reject stream from this new treatment process would then be transferred back to the WTW by pipeline and released into the existing Eastney Transfer Tunnel downstream of the treated wastewater channel where it is to be blended with the unused treated wastewater from Budds Farm WTW and released to the Solent via the existing Long Sea Outfall (LSO) at Eastney. The proposed WRP site would also include an on-site surface water Sustainable Drainage System (SuDS) which includes a new outfall releasing to the tidal reach of the Hermitage Stream which flows into Langstone Harbour.

7.1.3 Under Portsmouth Water's existing planning permission, Havant Thicket Reservoir will release 'compensatory flows' to Riders Lane Stream, a Main River which flows south from the reservoir for 700m before joining the Hermitage Stream. The Hermitage Stream continues to flow south through Bedhampton and into Langstone Harbour. The purpose of these compensatory flows is to maintain and improve flows within these watercourses that would otherwise be reduced once the reservoir is operational. The addition of recycled water into the reservoir from the Project would not alter the compensatory flow volumes which has been agreed with the Environment Agency as part of the reservoir impoundment licence.

7.1.4 In parallel with the DCO application, Southern Water is seeking to apply for a new Environmental Permit from the Environment Agency for the release of recycled water into Havant Thicket Reservoir and the release of reject water from the proposed WRP into the Solent via the Eastney LSO.

7.1.5 Southern Water consulted on the Project in Summer 2022 and, more recently, in Summer 2024. During this Summer 2024 Consultation, the company actively sought feedback from consultees and stakeholders on its proposals.

7.1.6 Preliminary impacts and initial proposals for mitigation were set out in a Preliminary Environmental Information (PEI) Report published as part of the Summer 2024 Consultation.

7.1.7 Since the Summer 2024 Consultation, water quality modelling and assessment work undertaken by Southern Water and Portsmouth Water has enabled further understanding of the potential effects of the Project on the water environment, including consideration of how water quality changes may impact supported freshwater and marine flora and fauna.

7.1.8 This Report provides a summary of the predicted water quality effects of the Project based on current design information. This Spring 2025 Consultation provides an opportunity for consultees to provide feedback on the latest information summarised in this Report prior to this being developed further. Following feedback from the consultation process, the modelling and assessments will be refined, finalised and fully reported in the DCO application, alongside details of proposed monitoring and mitigation.

7.1.9 This Report has summarised the following four modelling and assessment workstreams:

- Water quality modelling within Havant Thicket Reservoir.
- Water quality modelling of water bodies downstream of Havant Thicket Reservoir receiving compensatory flows (Riders Lane Stream and Hermitage Stream).
- Dispersion modelling of reject water from the proposed WRP via the Eastney LSO in the Solent.
- Proposed WRP SuDS salinity modelling in the Hermitage Stream.

7.1.10 This Report summarises the outputs of this preliminary modelling in terms of the following topics (the full assessment of water quality modelling will be provided within these equivalent chapters of the Environmental Statement):

- Water environment. This section of the Report included a preliminary assessment of the Project in terms of the Water Environment (England and Wales) Regulations 2017 (WER).
- Freshwater biodiversity.
- Marine biodiversity.

7.1.11 The conclusions of the Report are summarised in the table below.

Water environment	Freshwater biodiversity	Marine biodiversity
Havant Thicket Reservoir water quality modelling		
Havant Thicket Reservoir The modelling predicts that following an initial period of variation as Havant Thicket Reservoir is filled with spring water, rainfall and flows from the Riders Lane Stream headwaters, water quality would stabilise prior to the implementation of the Project. The phase prior to the implementation of the Project is referred to as the "classic" operation scenario (i.e. as consented under Portsmouth Water's existing planning permission). The model predicts that following the addition of recycled water into the reservoir (referred to as the "post-WRP" scenario), concentrations of Total Phosphorus (TP), Biochemical Oxygen Demand (BOD) and carbon compounds would increase, resulting in an increase in phytoplankton growth. Concentrations of other water quality parameters would remain broadly similar, however nitrogen concentrations would reduce markedly, associated to lower concentrations present in the recycled water. This decrease is not predicted to prevent the increase in phytoplankton growth. The predicted change in phosphorus concentrations is sufficient to result in a change in water body status, from 'high' during the "classic" operation phase to 'moderate' during the post-WRP operation phase under the WER. This is predicted to result in a change in the status of the water body. As such, additional measures would be required to ensure that the Project is compliant with the WER. Provision for measures to reduce the TP concentration in the recycled water will therefore be included within the Project's DCO application. Southern Water is working with the Environment Agency to determine how these measures are best introduced.	*Havant Thicket Reservoir* The increase in TP and phytoplankton growth is predicted to change the trophic status of the reservoir to 'eutrophic' (i.e. meaning higher in nutrients). In these conditions, it is considered unlikely that an ecosystem comprising a diverse range of aquatic species would be supported. It is more likely that the reservoir would lack submerged plant growth and that bottom-feeding species (e.g. carp) would dominate the fish community. Operation of the bubbler system may reduce some of the undesirable consequences of eutrophication, including the dominance of cyanobacteria in the phytoplankton community and the development of a layer of water with low Dissolved Oxygen (DO) at the bottom of the reservoir. The modelling predicts that a reduction in the recycled water TP concentration would reduce the likelihood of the reservoir becoming eutrophic. This is predicted to improve the ecological potential of the reservoir closer to that predicted for the "classic" operational scenario under 'mesotrophic' conditions (i.e. with moderate nutrient levels and supporting a diverse range of aquatic species). As provision for measures to reduce TP in the recycled water will be included in the DCO, significant adverse effects on freshwater biodiversity in the reservoir are not anticipated.	N/A (this modelling includes parameters for the reservoir outflows which have been used as the inputs for the compensatory flows modelling).

Water environment	Freshwater biodiversity	Marine biodiversity
Confirming the Environmental Permit requirements is essential to informing these measures and ensuring the Project meets regulatory requirements while delivering best value for customers.		
Compensatory flows water quality modelling (Riders Lane Stream, Hermitage Stream, Langstone Harbour)		
Riders Lane Stream A change in a number of water quality parameters in Riders Lane Stream is predicted to occur during the "classic" operation scenario, prior to the "post-WRP" operation scenario. Alkalinity, pH, DO, BOD, ammonium, nitrate, orthophosphate and carbon compounds are predicted to increase. Although some of these parameters would remain broadly similar in the "post-WRP" operation scenario, pH, alkalinity and nitrate are predicted to decrease, reflecting the smaller proportion of groundwater in the reservoir following the introduction of recycled water. Concentrations of orthophosphate and BOD are both predicted to increase further during the "post-WRP" operation scenario. In terms of the WER, the Riders Lane Stream forms part of the Hermitage Stream water body and is therefore described at water body level in the following section of this table. *Hermitage Stream* Changes in water quality from measured baseline are predicted to be much smaller than those in Riders Lane Stream in both the "classic" and "post-WRP" scenarios. In the "classic" operation scenario, the compensatory flows are predicted to result in increases from measured baseline in pH, alkalinity, DO, BOD, orthophosphate, ammonium, nitrate and Dissolved Inorganic Carbon (DIC).	*Riders Lane Stream, Hermitage Stream (freshwater reach)* The extent of water quality changes predicted in Riders Lane Stream and Hermitage Stream during the "post-WRP" operation scenario are very small for most water quality parameters and considered unlikely to result in significant adverse effects on freshwater biodiversity. Whilst BOD and orthophosphate concentrations are predicted to increase from measured baseline in the "classic" scenario, with further increases predicted in the "post-WRP" scenario, significant adverse impacts to macrophytes, macroinvertebrates and fish are not anticipated. The increase in DO, predicted in both the "classic" and "post-WRP" scenarios is considered to be beneficial for freshwater biodiversity, including macroinvertebrates fish species present (bullhead and European eel). The current ecological community present in the Hermitage catchment is 'poor', with significant barriers to fish movement present, irregular low flow conditions and limited in-stream vegetation. The potential for the future ecological baseline of the Hermitage Stream catchment to improve as a result of Portsmouth Water's planned restoration works will be considered in the Environmental Statement.	*Hermitage Stream (tidal reach) and Langstone Harbour* The extent of the water quality changes in the Hermitage Stream (tidal reach) and Langstone Harbour resulting from the "post-WRP" operation scenario, when compared to the "classic" operation scenario, are predicted to be extremely small and considered unlikely to result in significant effects on marine biodiversity. *Solent* Modelled water quality changes resulting from the "post-WRP" operation scenario, when compared to the "classic" operation scenario, are not predicted to extend into the Solent. Significant effects on marine biodiversity are therefore not anticipated.

Water environment	Freshwater biodiversity	Marine biodiversity
Although many of these parameters would remain broadly similar in the “post-WRP” operation scenario, pH, alkalinity and nitrate would decrease, reflecting the smaller proportion of groundwater in the reservoir. Concentrations of orthophosphate and BOD are both predicted to increase further during the “post-WRP” operation scenario, although these increases are predicted to be small. Thresholds set out in the WFD Directions 2015 can be used as an indicator of the environmental significance of changes to water quality parameters. Changes that are insufficient to result in a change in water body ‘status’ (a term used to categorise water body condition under the WER) are unlikely to result in significant environmental effects, whilst changes in status could potentially be indicative of adverse effects. The predicted changes in most water quality parameters within Hermitage Stream are not sufficient to cross any of the status thresholds established under the WFD Directions. However, the increase in BOD in the “classic” operational phase is predicted to cause a change in the status of the quality element from 'moderate' to 'bad' in Riders Lane Stream and 'good' to 'poor' in Hermitage Stream. Further increases in BOD following introduction of recycled water from the proposed WRP would not result in any further changes in status in either watercourse. Although the WFD Directions sets out thresholds for BOD in rivers, these thresholds are not used to classify water body status. Furthermore, the predicted increase in BOD in Hermitage Stream is not accompanied by a decrease in DO concentrations, which are predicted to remain at ‘high’ status in the “classic” and “post-WRP” scenarios. This means that significant adverse effects on the aquatic ecosystem are unlikely, however this will be fully reported in with a WER		

Water environment	Freshwater biodiversity	Marine biodiversity
Compliance Assessment which will support the DCO application. *Langstone Harbour* When compared to measured baseline, the modelling predicts that water quality in Langstone Harbour would be subject to very small changes as a result of the compensatory flows, both in the "classic" and "post WRP" operation scenarios, however they would be confined to the northern part of the harbour, adjacent to the mouth of Hermitage Stream. *Solent* Modelled water quality changes resulting from the "post-WRP" operation scenario, when compared to the "classic" operation scenario, are not predicted to extend into the Solent, no water quality effects are therefore anticipated.		
Eastney LSO dispersion modelling (Solent, Langstone Harbour and Hermitage Stream)		
Solent The preliminary surface water pollution risk assessment of the release of reject water from the Eastney LSO, required to inform Southern Water's proposed application for an Environmental Permit from the Environment Agency (outside of the DCO process), identified seven parameters potentially at risk of failing their respective Environmental Quality Standard (EQS). These EQS parameters were therefore modelled. When comparing the "existing" scenario (i.e. without the proposed WRP in place) and "future" scenario (i.e. with the WRP reject water added to the existing release from Budds Farm WTW), modelled changes of the seven EQS parameters in the Solent are very small and not expected to result in significant adverse effects on water quality.	*Hermitage Stream (freshwater reach)* The predicted small water quality changes of the seven EQS parameters resulting from the "future" scenario, when compared with the "existing" scenario are limited to the Solent and would not impact the biodiversity of the Hermitage Stream (freshwater reach).	*Langstone Harbour / Hermitage Stream (tidal reach)* As described in the "Water environment" column of this table, modelled water quality changes of the seven EQS parameters resulting from the "future" scenario, when compared with the "existing" scenario are not predicted to extend into Langstone Harbour or the tidally influenced Hermitage Stream. Significant effects to marine biodiversity are therefore not anticipated. *Solent* When comparing the "existing" scenario (i.e. without the proposed WRP in place) and "future" scenario (i.e. with the WRP reject

Water environment	Freshwater biodiversity	Marine biodiversity
Langstone Harbour/Hermitage Stream (tidal section) Modelled water quality changes of the seven EQS parameters resulting from the "future" scenario, when compared with the "existing" scenario are not predicted to extend into Langstone Harbour or the tidally influenced Hermitage Stream. Water quality effects are therefore not anticipated.		water added to the existing release from Budds Farm WTW), modelled changes of the seven EQS parameters in the Solent are very small. These changes are not expected to result in significant adverse effects to marine biodiversity.
Proposed WRP SuDS salinity modelling (Hermitage Stream and Langstone Harbour)		
Hermitage Stream (tidal reach) and Langstone Harbour The proposed WRP surface water SuDS would include a range of control measures such as filter strips, swales and a detention basin, to provide sufficient mitigation for reducing any pollutants entering the surface water runoff. As such, no further modelling of pollutants from the SuDS outfall is required. Modelling has however been completed to assess the potential impacts of a change in salinity in the Hermitage Stream and Langstone Harbour. The change in salinity due to the SuDS outfall release, when compared with the natural fluctuations in ambient salinity levels throughout the tidal cycle, is predicted to be extremely small. Significant adverse effects to water quality are therefore not anticipated from releases from the proposed WRP SuDS outfall. *Solent* Modelled changes in salinity associated to the proposed WRP SuDS outfall do not extend into the Solent, therefore no water quality effects to this water body are anticipated.	*Hermitage Stream (freshwater reach)* Modelled changes in salinity as a result of the SuDS outfall are not predicted to extend upstream into the freshwater reach of the Hermitage Stream, therefore no effects on freshwater biodiversity are anticipated.	*Hermitage Stream (tidal reach) and Langstone Harbour* The change in salinity due to the SuDS outfall release, compared with the natural fluctuations in ambient salinity levels throughout the tidal cycle, is predicted to be extremely small. Effects on marine biodiversity receptors in the tidal reach of the Hermitage Stream and Langstone Harbour are therefore not anticipated. *Solent* Modelled changes in salinity associated to the proposed WRP SuDS outfall are not predicted to extend into the Solent, therefore no effects on marine biodiversity in the Solent are anticipated.

7.1.12 This Report has identified a number of next steps in relation to each modelling workstream, these are summarised below.

Havant Thicket Reservoir water quality modelling

Review model to ensure it reflects final design information

7.1.13 As the design of Havant Thicket Reservoir progresses, further water quality modelling will be undertaken to take account of changes in the design and operation of the reservoir. We will reflect this ongoing modelling work, where possible, in the Development Consent Order application.

Review of measures to reduce TP in recycled water

7.1.14 Southern Water is assessing several measures for reducing the TP concentration in the recycled water. These measures include ferric dosing, enhanced biological phosphorus removal, higher rejection membranes, a second stage of reverse of osmosis at the WRP and Ion exchange polishing. The selected treatment measure(s) will be set out within the DCO application and Environmental Statement. Southern Water is working with the Environment Agency to determine how these measures are best introduced.

Compensatory flows water quality modelling

Water quality monitoring within Riders Lane Stream and Hermitage Stream

7.1.15 To supplement the water quality monitoring undertaken by Portsmouth Water and the Environment Agency on the Riders Lane Stream and the Hermitage Stream, Southern Water is collecting additional monthly water quality monitoring data. This commenced in November 2024 and will continue through to the submission of the DCO application. The potential for further ongoing monitoring beyond this point will be discussed and agreed with the Environment Agency. The data collected prior to DCO submission will be used to support the assessment of water quality effects in the Environmental Statement and WER Compliance Assessment.

Eastney LSO dispersion modelling

Update of surface water risk assessment to include marine water quality sampling

7.1.16 The surface water pollution risk assessment screening assessment will be updated following collation and analysis of further marine water quality baseline sampling. This may change the parameters screened into the modelling assessment of releases from Eastney LSO in the Solent. If this is the case, any changes would be assessed fully within the Environmental Statement and Environmental Permit application.

Proposed WRP SuDS salinity modelling (Hermitage Stream)

Finalisation of emerging WRP SuDS design and agreement of control measures with regulators

7.1.17 The modelling presented in section 3.4 of this Report of the proposed WRP surface water SuDS outfall is based on an emerging SuDS design and associated pollution control measures which have yet to be finalised. The modelling outputs will be reviewed following finalisation of the outline SuDS design to ensure they remain valid.

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