Greater Parramatta and Olympic Peninsula Water Cycle Management

Surface Water and Geomorphology Impact Assessment

Prepared for Sydney Water

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Executive summary

Project overview

Sydney Water is proposing to build and operate a new water resource recovery facility (WRRF) at Camellia-Rosehill with associated infrastructure to provide wastewater services to the Greater Parramatta and Olympic Peninsula (GPOP) growth area (the project).

The project is needed to provide a water cycle management solution for the GPOP growth corridor that is efficient and cost effective for the community.

Key features of the project include:

- a new WRRF at Camellia-Rosehill
- upgrade the existing pumping station at Camellia (SP0067)
- a new wastewater transfer main from SP0067 to the WRRF
- a new brine pipeline from the WRRF to SP0067 and repurpose an existing pipeline to transfer brine from SP0067 to the Northern Suburbs Ocean outfall Sewer (NSOOS)
- install a river release pipeline from the WRRF to release high quality treated water into Parramatta River near Meadowbank via a river release structure underlain by a concrete mattress.

The project has been deemed State Significant Infrastructure (SSI) pursuant to State Environmental Planning Policy (Planning Systems) 2021 (the Planning Systems SEPP), and approval for the project is required under Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Sydney Water is preparing an Environmental Impact Statement (EIS) to support an application to the Minister for Planning and Public Spaces.

Assessment purpose and methodology

This report has been prepared to support the EIS for the project and addresses the Secretary's Environmental Assessment Requirements (SEARs) relating to surface water hydrology, water take and erosion processes. The primary objective of this report is to provide an assessment of the potential impacts that may arise from the construction and operation of the Project in relation to:

- Natural flow volumes, durations and velocities that contribute to environmental flows, supporting riverine and estuarine habitats
- Direct and indirect increases in erosion, siltation, loss of riverbank stability and riverbank vegetation
- Water take (direct or indirect) and sources of water discharged during construction and operation.

Sediment transport processes

The Sydney Harbour Estuary Process Study (Hedge et al., 2014) cites the primary mechanism for the spread of sediments from Homebush Bay as resuspension caused by high winds and flood events in combination with normal tides.

This includes resuspension of contaminated sediments from secondary deposition 'hot spots' in downstream locations, including from the northern Parramatta Riverbank opposite Homebush Bay, Meadowbank, which is the study area for this project.

The presence of dioxin and furan compounds in estuarine sediment has necessitated careful design of the proposed river release structure at Meadowbank.

As a result of prior land use, dioxin and other chemical by-products of the chemical manufacturing processes were discharged into wetlands and mangroves along the western Rhodes Peninsula foreshore until the 1970s. Over time the residual contaminated sediments have been remobilised by hydrodynamic processes and are now found to be distributed across large parts of Sydney estuary, both upstream and downstream of Homebush Bay (Lee and Birch, 2014; Birch et al., 2015).

Core sampling and chemical analysis confirms the presence of contaminants in the vicinity of the river release structure at Meadowbank including dioxin and furan compounds, metals, polycyclic aromatic hydrocarbons, various chlorinated phenols and benzenes, and solvents (Hedge et al., 2014).

Consideration of the potential cumulative impact of operating the river release structure to these processes has been considered in this impact assessment study.

Sediment chemistry

Fifteen sediment cores were analysed for size and chemistry *in Greater Parramatta and Olympic Peninsula Water Cycle Management - Sediment size and chemistry for cores retrieved from the John Whitton Bridge potential release site* (Birch and Batley, 2025). Cores were retrieved upstream and downstream of the John Whitton Bridge in September and October 2024. Samples were taken at three sedimentary depths from the upper (< 8 cm), mid (20 - 35 cm) and lower (> 50 cm) depths.

Chemical analysis of sediment samples confirmed that concentrations of metals, particularly zinc, dioxins and furans in sediment samples were found to exceed sediment quality guideline values (SQG-H) and for some sites the concentration of these chemicals greatly exceeds guideline values. The study authors recommend that sediment is not disturbed by pipe and diffusor installation and operation.

Bed material analysis

To assess the risk of sediment disturbance by the project, sediment transport criteria have been selected based on the physical characteristics of the sediment identified in the study area.

Sediment samples from all cores and at all core depths are similar and dominated by clay and mud-size particles indicating a mainly depositional environment of fine material. All samples showed an absence of sand-size particles. Analysis of samples shows bed material comprises fine clays typically 0.50 μm in size and a larger mode of approximately 6 to 9 μm.

Surface water assessment

Near-field hydraulic modelling was conducted using Computational Fluid Dynamics (CFD), focusing on the mixing zone extending 135 m upstream and 185 m downstream of the river release structure. The model incorporated detailed infrastructure and bathymetry, tested nozzle configurations and concrete mattress extent beneath release structures, aiming to optimize flow dynamics and minimize sediment disturbance beneath the John Whitton Bridge area.

The CFD analysis covered 12 scenarios reflecting common tidal and flow variations that represent ambient conditions at the project site. The scenarios test assessing velocities and bed shear stresses against sediment transport thresholds: bed shear stress > 0.05 N/m² for sediment movement, velocities between 0.1 – 0.2 m/s indicating potential resuspension risk, and > 0.2 m/s causing erosion. Results demonstrated that diffuser effects on bed velocity and shear stress are most notable during flood tides, but remain below critical levels outside the proposed concrete mattress area underlying the river release structure. Thus, the modelling demonstrates that the proposed structure and nozzle angle will minimizing sediment remobilisation risk due areas of elevated velocity and shear stress being limited to within the protective mattress.

Beyond the immediate mixing zone, a hydrodynamic assessment has been undertaken using a Water Quality Response Model (WQRM) simulating river and estuary hydrodynamics across varied tidal and river flow conditions, focusing on the release area between Charles Street Weir and Sydney Harbour heads. The model evaluated the influence of an additional 0.73 m^3/s river release on the range of ambient flow conditions in the Parramatta River. The model results showing only minor relative changes in flow conditions, particularly around slack tide where flow increased by about 10% near the release zone, but remained small compared to typical tidal and rainfall-driven flows.

The modelled effect of the released flow dispersed across the entire 75 m wide river release structure, shows higher velocities concentrated within 50 m of the river release structure to aid treated water mixing and dilution. Outside this mixing zone, velocity changes are minor — up to a 5% decrease upstream and a corresponding increase downstream — insufficient to notably alter sediment transport or deposition according to Hjulström curves, indicating no significant effect on erosion or sediment dynamics, or environmental flows under these flow changes.

Stormwater runoff from the WRRF

Surface water management at the WRRF will include first flush capture and stormwater filtration to ensure pollutants are isolated and removed from stormwater that is discharged to the Duck River. A water sensitive design approach is adopted to achieve the stormwater pollution load reduction targets that align with best practice. This approach will ensure that stormwater runoff from the project will contribute to water quality objectives being met in the Duck River and Parramatta River.

Findings

Results from this study have informed the design and refinement of the river release structure to minimise potential surface water and geomorphology impacts associated with the risk of disturbing contaminated sediments that have originated from Homebush Bay.

The near field (CFD) and far field model (WQRM) results indicate that the diffuser nozzles will cause mixing in the mid-channel, but turbulence at the channel bed will be limited to within the extents of the proposed concrete mattress. The concrete mattress will protect the underlying sediments from resuspension.

The impacts of mixing on sediment transport in the estuary will be predominantly neutral and there is therefore a low risk that the releases will exacerbate the background processes that transport contaminated sediment and dioxin through the estuary.

The assessment found that including the project mitigations results in a:

- Low risk of impacts to surface water during construction and operation of the WRRF
- Low risk of impacts to surface water from construction of the river release structure. This work will be short term, but will require careful construction management to avoid more moderate impacts of disturbing existing affected sediments
- Low risk of impacts from operation of the river release structure
- Low risk of impacts from the construction and operation of pipelines.

Conclusions

Implementation of stormwater management at the WRRF will ensure that the redevelopment of the site and the new facility will contribute to improved water quality entering the river and estuary.

The proposed construction method for the pipelines and river release structure will minimise the risk of sediment disturbance within the construction zone. The use of trenchless pipeline construction will reduce the extent of disturbed areas that can impact on surface water. Construction works within the Paramatta River floodplain and channel will require carefully placed protective measures including coffer dams, silt curtains and concrete mattresses to minimise the extent of disturbance to riverine sediments.

Once complete and operational, the angle of the diffuser nozzles and the extent of the underlying concrete mattress will sufficiently reduce the near bed shear velocities and minimise the chance of contaminated sediments being liberated from the release area.

Project specific flow and velocity criteria have been adopted which include numerical criteria sourced from sediment transport theory with consideration of the range of sediments recorded at the release area and the potential to contribute to increased shear stress and subsequent sediment transport factors identified by the Sydney Harbour Estuary Process Study (Hedge et al., 2014). The release of treated water at the outfall location through the proposed river release structure has a low risk of contributing to the natural erosion processes that mobilise sediment from the base of Parramatta River.

Beyond the immediate mixing zone of the river release structure, the release of treated water to the Parramatta River will affect flow volumes, durations and velocities to a very small degree. In the context of the ambient tidal flow conditions and variable storm flows from the upper catchment, modelling shows that the construction and operation of the river release structure will not disrupt environmental flows supporting riverine and estuarine habitats.

Glossary

Term	Definition
µm/s	Micrometre per second
µS/cm	Micro siemens per centimetre
AEP	Annual Exceedance Probability
ANZG	Australian and New Zealand's Guidelines for fresh and marine water quality
ANZECC	Australia and New Zealand Environment and Conservation Council
ASRIS	Atlas of Australian Soils
BoM	Bureau of Meteorology
CEC	Cation Exchange Capacity
CEMP	Construction Environmental Management Plan
DCP	Development Control Plan
DGV	Default Guideline Value
DPHI (previously DPE)	Department of Planning, Housing and Infrastructure (prior to 1st January 2024 this was the NSW Department of Planning and Environment)
dS/m	DeciSiemens per metre
EC	Electrical Conductivity
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPA	Environment Protection Authority
EPL	Environment Protection Licence
ESCP	Erosion and Sediment Control Plan
ESP	Exchangeable Sodium Percentage
FID	Final Investment Decision
GDE	Groundwater Dependent Ecosystem
GP	Gross Pollutants
GPOP	Greater Parramatta and Olympic Peninsula
HEVAE	High Ecological Value Aquatic Ecosystem
HGL	Hydrogeological Landscape
KFH	Key Fish Habitat
kg/year	Kilograms per year
km	Kilometre
L	Litres
LEP	Local Environmental Plan
LGA	Local Government Area
m^2/d	Metres squared per day
m AHD	Metres Australian Height Datum
m bgl	Metres below ground level
m/d	Metres per day
meq/100g	Milliequivalent per 100 grams

Term	Definition
ML	Megalitres
ML/d	Megalitres/day
mg/kg	Milligram per kilogram
mg/L	Milligrams per Litre
ML/d	Megalitres per day
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
n.d	No date
NARCliM	NSW and ACT Regional Climate Modelling
NGIS	National Groundwater Information
NorBE	Neutral or Beneficial Effect
NSOOS	Northern Suburbs Ocean Outfall sewer
NSW	New South Wales
NTU	Nephelometric Turbidity Units
NWQMS	National Water Quality Management Strategy
OSD	On-site stormwater detention basin
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSI	State Significant Infrastructure
SWMP	Soil and Water Management Plan
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WM Act	*Water Management Act 2000*
WRRF	Water Resource Recovery Facility
WQO	Water Quality Objectives

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1 Introduction

1.1 Project overview

Sydney Water is proposing to build and operate a new water resource recovery facility (WRRF) at Camellia-Rosehill. The new WRRF is needed to provide additional wastewater capacity to support growth across the northern suburbs of Sydney, and in the Greater Parramatta and Olympic Peninsula (GPOP) growth corridor. The WRRF and associated infrastructure together form the GPOP Water Cycle Management project (the project).

The additional growth would place pressure on the existing northern suburbs wastewater network, which includes the Northern Suburbs Ocean Outfall Sewer (NSOOS) and the North Head WRRF. These critical assets provide wastewater services to around 1.7 million people, and with current growth projections would reach capacity by 2031.

The project has been designed to be efficient, sustainable, and cost effective for the community, as well as resilient and adaptable for future water uses.

The main elements of the project include:

- a new WRRF at Camellia-Rosehill to treat wastewater to produce advanced treated water
- upgrades to the existing pumping station at Camellia
- a new wastewater transfer pipeline from Camellia pumping station to the WRRF
- a new and repurposed brine pipeline to transfer brine from the WRRF to the NSOOS
- a new river release pipeline to transfer advanced treated water from the WRRF to a release structure in Parramatta River at Meadowbank.

The location of main elements of the project is provided in Figure 1-1.

The project is State significant infrastructure and Sydney Water is preparing an Environmental Impact Statement (EIS) to support an application to the Minister for Planning and Public Spaces.

1.2 Project description

An overview of the location of the proposed infrastructure is presented in Figure 1-1. Further details regarding the project are provided below.

1.2.1 Camellia-Rosehill WRRF

The WRRF would have capacity to treat 70 megalitres per day (ML/d). The WRRF would produce advanced treated water to minimise impacts on receiving waterways. The reverse osmosis (RO) treatment process within the WRRF would generate brine as a by-product.

The main components of the WRRF include:

- inlet works
- primary, secondary and tertiary wastewater treatment process units

- advanced treatment processes involving reverse osmosis
- disinfection systems
- biosolids handling facilities
- odour control facilities.

The WRRF would require a range of process infrastructure such as tanks, bioreactors and digestors. The operation of the WRRF would also require ancillary facilities such as an administration building and associated car park, chemical storage and stormwater infrastructure.

1.2.2 Transfer pipeline

The transfer pipeline is about 2.2 km in length and would transfer wastewater from the Camellia pumping station to the WRRF.

1.2.3 River release pipeline and release structure

The river release pipeline is about 7.6 kilometres in length commencing at the WRRF and within the suburbs of Silverwater, Newington, Sydney Olympic Park and Meadowbank. The river release pipeline would discharge advanced treated water into the Parramatta River at Meadowbank.

Above ground infrastructure includes two concrete bridge-style aerial crossings over minor waterways in Meadowbank Park, and an approximately 8 metre (m) high barometric loop located in Memorial Park.

The river release structure involves eight smaller pipelines that extend out underneath the sandstone sea wall and along the riverbed of the Parramatta River. The pipelines would vary in length, with the longest extending about 130 m. Diffusers would release water to enable mixing.

Construction of the river release structure would involve:

- constructing a cofferdam (or similar temporary structure) at the riverbank to connect the upstream ends of the pipelines to the sections of the river release structure. This would require removal of the existing sandstone seawall, which would be reconstructed once the pipelines are connected. The cofferdam would be sealed off from the river to minimise river water ingress.
- removing cofferdam and temporary sandbags
- laying geotextile mattress on top of the riverbed at the location of the river release
- using barges, tugs and divers to position sections of pipe on top of the geotextile mattress
- using a land or barge-based crane to anchor the pipeline protection system (i.e. concrete mattress) on top of the pipelines.

1.2.4 Brine pipeline

The brine pipeline is about 5.2 kilometres in length and would transfer brine from the WRRF to the NSOOS for treatment and offshore discharge at North Head WRRF. A new pipeline would be constructed between the WRRF and Camellia pumping station, along the same alignment as the transfer pipeline. Between the Camellia pumping station and the NSOOS, the brine pipeline would repurpose an existing pipeline.

1.2.5 Camellia pumping station upgrades

The existing Camellia pumping station would be upgraded to divert wastewater to the WRRF. Upgrades would include the installation of new pumps to deliver wastewater flows to the new WRRF while remaining pumps would pump excess existing flows and brine produced by the WRRF to the NSOOS via existing pressure mains. New connections would be installed to divert the wastewater into the transfer pipeline. The existing site sheds would be replaced with a new electrical switch room along the eastern boundary of the site.

An overview of the project is provided in Figure 1-1.

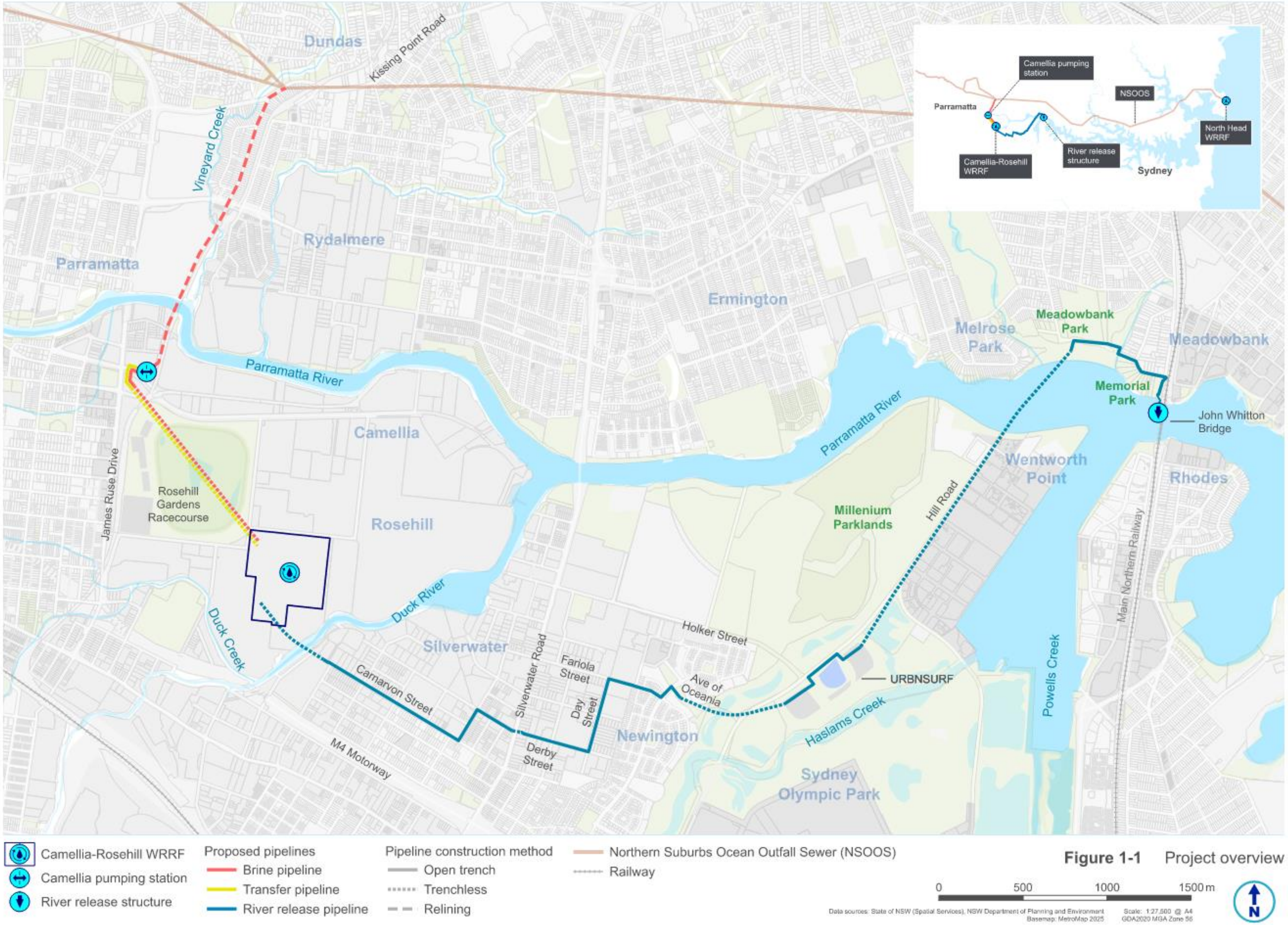

Figure 1-1 Project overview

1.3 Study objectives

The primary objective of this report is to provide an assessment of the potential geomorphic and hydrologic impacts that may arise from the treated water releases and from stormwater management at the proposed WRRF.

This report has been prepared to support the EIS for the project and addresses the Secretary's Environmental Assessment Requirements (SEARs) relating to surface water hydrology and geomorphology. It provides a focused assessment on the potential for resuspension and transport of contaminated sediments at the release site.

In addition to this standalone report, the results and interpretation from the assessment have been provided to other specialist studies relating to the potential water quality impacts of contaminated sediment resuspension and mobilisation. These studies and an overview of the extent of their associated considerations are presented in

Figure 1-2.

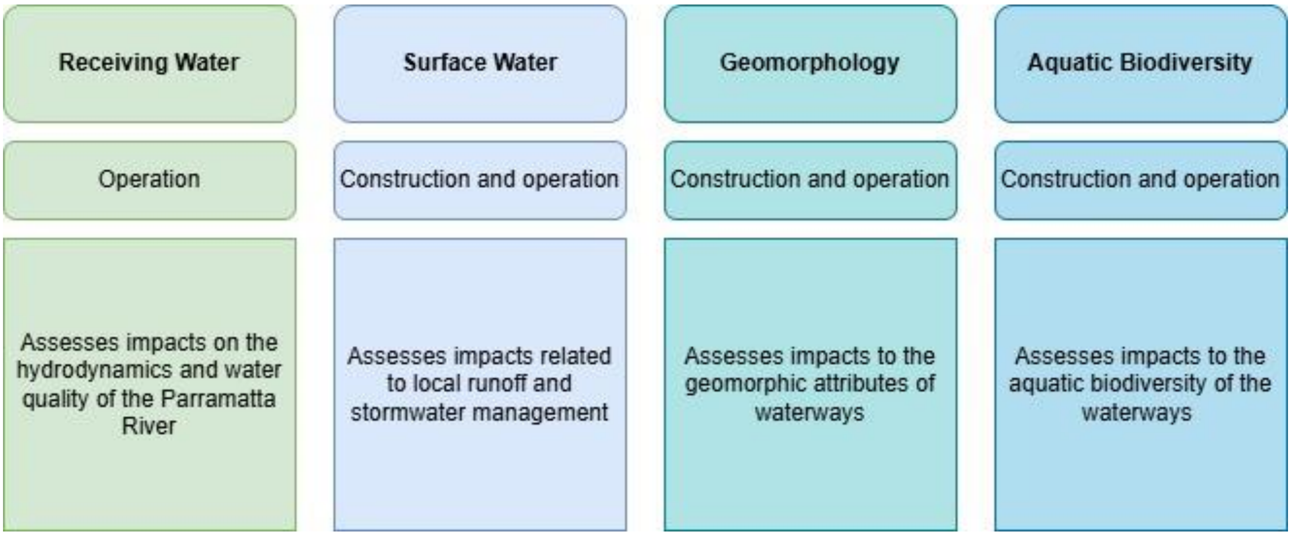

Figure 1-2 Studies overview

2 Legislative and policy content

This section identifies the current legislation, policies and guidelines relevant to this assessment.

2.1 Legislation

Table 2-1 identifies the legislation and environmental planning instruments that are relevant to this assessment.

Table 2-1. Legislation relevant to this assessment

Document	Relevance to this assessment	How legislation has been considered in this assessment
Environmental Planning and Assessment Act 1979	The EP&A Act provides a framework for environmental planning and assessment in NSW. The project is classified as SSI in accordance with Division 5.2, Part 5 of the EP&A Act and requires approval from the NSW Minister for Planning and Public Spaces. In accordance with Section 5.16 of the EP&A Act, the SEARs were issued for the project on 24 September 2024 with matters to be addressed in the project EIS. The SEARs require that the EIS consider potential impacts to surface water, groundwater, hydrology and water quality associated with construction and operation of the project	The SEARs relevant to this assessment are included in Section 3 of this assessment and each of the SEARs is addressed in turn.
State Environmental Planning Policy (Biodiversity and Conservation) 2021	The State Environmental Planning Policy (Biodiversity and Conservation) sets out the requirements for water quality management within the Sydney Harbour catchment. This SEPP is planning legislation even though it is called a policy. Part 6.2 of the act requires that water quality is considered in new development proposal and whether the water quality management approach will have a neutral or beneficial effect on the quality of water of Sydney Harbour.	Surface water quality impacts associated with sediment management and ongoing operation of the proposed WRRF and river release structure are provided in Section 6 and Section 7.2.2 respectively
State Environmental Planning Policy (Resilience and Hazards) 2021	The State Environmental Planning Policy (Resilience and Hazards) sets out the requirements for industry that my impact on human health or the biophysical environment. This includes redevelopment or change in land use on land known to be contaminated.	Surface water quality impacts associated with sediment management and ongoing operation of the WRRF and river release structure are provided in Section 6 and Section 7.2.2 respectively

Document	Relevance to this assessment	How legislation has been considered in this assessment
Coastal Management Act 2016	The objective of this act is to protect and enhance the natural coastal processes and coastal environmental values including the biological diversity and ecosystem integrity.	An assessment of how the proposal impacts on the natural estuarine sediment transport processes is provided in Section 7.1.4
Water Act 1912, Water Management Act 2000, and Water Management (General) Regulation 2018	The *Water Management Act 2000* (WM Act) establishes a framework for managing water in NSW. Section 91 of the WM Act discusses activity approvals and notes that there are two types of approvals, namely controlled activity approvals and aquifer interference approvals. The WM Act specifies certain activities as controlled activities when carried out on waterfront land. This is defined as within 40 m of the banks of a river, lake or estuary. Licences, permits and approvals such as a water management work approval under section 90, or an activity approval under section 91 of the *Water Management Act 2000* do not apply to a state significant development Project in accordance with sections 1.7 and 4.41 of the EP&A Act.	Consideration of works on waterfront lands is provided in Section 6 and 7. Despite the provision for not needing a controlled activity approval under the EP&A Act, an aquifer interference approval (NSW Aquifer interference Policy (DPI, 2013) discussed below) is still required if the works have potential to impact a groundwater aquifer. For further information, refer to the Groundwater Impact Assessment.
Protection of the Environment Operations Act 1997 (POEO Act)	The *Protection of the Environment Operations Act 1997* (POEO Act) establishes the procedures for issuing licences for environmental protection. An Environment Protection Licence (EPL) is required under Section 3 of POEO Act to undertake a scheduled activity or scheduled development work. Under Part 5.3 of the POEO Act, it is an offence to pollute waters unless an EPL is held and the conditions of any discharge in the EPL are met. Schedule 1 of the POEO Act provides a list of activities that require an EPL.	It is anticipated that, if approved, the project will operate under the provisions of an existing EPL 378 for the Northern Suburbs Sewage Treatment System including operation of the North Head WRRF and Camellia pumping station. As the project will be connected to this system, Sydney Water proposes to incorporate the project into the existing EPL. Such a licence will specify environmental performance requirements, such as the likely impact of the activity on the environment including the receiving waterways.
Fisheries Management Act 1994 (FM Act)	Key Fish Habitat (KFH) are defined under the FM Act (NSW). The presence of KFHs is an indication of ecological value of the watercourse. Duck and Parramatta Rivers are mapped as KFH.	Consideration of works around key fish habitat are provided in Section 6 and 7. For further information, refer to Aquatic Biodiversity Impact Assessment.

2.2 Policies and guidelines

Table 2-2 identifies the relevant policies and guidelines for this assessment.

Table 2-2 Policies and guidelines

Document	Relevance to this assessment
National Water Quality Management Strategy (NWQMS) (WQA, 2018)	The NWQMS provides a nationally consistent approach to water quality management and the information and tools to help water resource managers, planning and management agencies, regulatory agencies and community groups manage and protect their water resources. Construction and operational phases of the proposal have the potential to impact water quality in the Parramatta River. As such, construction and operational phases should integrate water quality management strategies (consistent with NWQMS) such that the environmental values of the sensitive receiving waterways are not adversely impacted. These should be included in the construction and operational environmental management plans.
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ (2000)	These water quality guidelines were prepared as part of Australia's National Water Quality Management Strategy which aims to achieve the sustainable use of Australia's and New Zealand's water resources by protecting and enhancing their quality. This has been superseded by Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018). However, certain guideline values are still relevant where ANZG 2018 have not been updated for certain analytes. The NSW Water Quality Objectives are described and impacts assessed in the Hydrodynamic and Water Quality Impact Assessment.
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)	ANZG (2018) provides an update to the ANZECC (2000) default guideline values (DGVs). Given the absence of site-specific guideline values, ANZG (2018) give directions to adopt default guideline values (DGVs) for a range of stressors relevant to different community values, such as aquatic ecosystems, human health and primary industries. The NSW Water Quality Objectives are described and impacts assessed in the Hydrodynamic and Water Quality Impact Assessment.
Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2023	This water sharing plans (WSPs) are defined under the *WM Act 2000*, to protect water source and its dependent ecosystems and basic landholder rights. They are also required to promote sustainable use of water resources, and reserve water for the overall health of the water source and to protect specific ecosystems that depend on water, such as wetlands The Project lies within the Greater Metropolitan Region for unregulated River water. This WSP are relevant to this location for water usage by the Project during construction and operation.
Controlled activities guidelines for: • instream works on waterfront land • laying pipes and cables in watercourses on waterfront land • outlet structures on waterfront land	These guidelines provide guidance for the design and construction of works within a watercourse or on waterfront land, which will apply to the works through the 1st order and 4th order watercourses. Although controlled activity approvals are not required for state significant infrastructure, it is industry practice to take into consideration the controlled activity guidelines when undertaking works within waterfront land.

Document	Relevance to this assessment
Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom, 2004) and Volume 2A (DECC, 2008a) and Volume 2C (DECC, 2008b)	Managing Urban Stormwater – Soils and Construction, referred commonly as the 'Blue Book', guides local councils and development industry on stormwater management, particularly erosion and sediment control during the construction phase of the development. Better stormwater management will: • reduce pollution to downstream areas and receiving waterways • reduce land degradation • raise awareness and application of ecologically sustainable development principles • improve health, ecology and amenity of urban waterways.
Policy and Guidelines for Fish Habitat Conservation and Management (DPI Fisheries, 2013)	The policy provides guidance on designs of instream structures to maintain fish passage and is applicable to planning and development proposals and other activities that affect freshwater ecosystems in NSW. There are KFHs located within and around the Project area, see Section 5.2.4. For further information, refer to Aquatic Biodiversity Impact Assessment.
DUBA, BUDU, BARRA – Ten Steps to a Living River – The Parramatta River Masterplan (Parramatta River Catchment Group, 2018)	The Parramatta River Catchment Group (PRCG) also identify opportunities to work with local and state government agencies on improvements to stormwater and sewer management, water sensitive urban design (WSUD) and land-use planning to improve swim-ability of the waterway for community.
Framework for Biodiversity Assessment	This framework underpins the Biodiversity Offsets Policy for major projects. The framework outlines the assessment methodology to be followed to describe the impacts and guidance for offsets that may be relevant for the major project. This framework is not directly relevant for this hydrology surface water assessment, however this framework has been used to define the Strahler stream orders as per the method outlined in this framework, as advised by the SEARS.
Biodiversity Assessment Method (BAM)	The BAM is part of the Biodiversity Offsets Scheme which is a legislated framework for addressing impacts on terrestrial biodiversity from development and clearing. The BAM is not directly relevant for this assessment, however the mapping of rivers, streams, estuaries, and wetlands has been undertaken as advised by the SEARS. This method outlines and approach to identify and map these landscape features.
Ryde Council Local Strategic Planning Statement 2020 Parramatta Council Local Strategic Planning Statement 2020	The LSPS states that public swim sites within the Parramatta River are a target of the strategy and calls for the implementation of the Parramatta River Masterplan and activation of at least one swim sites in the Parramatta River by 2025.

3 Relevant SEARs

The Secretary's Environmental Assessment Requirements (SEARs) for the project that have been addressed as part of this report are identified in Table 3-1.

Where SEARs have been addressed in the Groundwater Impact Assessment (Jacobs, 2025) or the Hydrodynamics and Water Quality Impact Assessment (Sydney Water, 2025), this is noted.

Table 3-1 SEARS for the project

Key issues	SEARs to be addressed by the study	Where addressed in this report
Water - Hydrology	Describe the existing hydrological regime for surface and groundwater resources (including reliance by users and for ecological purposes) likely to be impacted by the project, including stream orders, as per the Framework for Biodiversity Assessment. This must include a description of groundwater levels across the site under a range of wet and dry conditions	The existing hydrological regime and surface water resources are discussed in Section 5.2. Groundwater resources are addressed in the Groundwater Impact Assessment
	Map the following features: a) rivers, streams, estuaries, and wetlands (as described in section 3.1.3 of the BAM) b) groundwater c) groundwater dependent ecosystems d) proposed discharge locations	a) Refer to Section 5.2 b) Addressed in Groundwater Impact Assessment. c) Addressed in Groundwater Impact Assessment. d) Refer to Section 4.1
	A description of works / activities that may intercept, interfere, extract, use divert or receive surface water and groundwater on a temporary or permanent basis during construction and operation.	Refer to Section 1.2 for a description of the project, Section 6 for a description of construction activities influencing surface waters and Section 7 for description of operational activities influencing surface waters. Refer to Groundwater Impact Assessment for activities impacting groundwater.
	Identify any relevant Water Sharing Plans that may potentially be impacted by the project	Refer to Section 2.
	Provide a detailed water balance for ground and surface water resources.	Refer to Section 6.1.3, 6.2.2 and 6.3.2 and for construction water balance. Refer to Section 7.4 for operational water balance.
	Surface and groundwater hydrology impacts (both quality and source) of the construction and operation of the project and any ancillary facilities (both built elements and discharges) in accordance with the current guidelines, including:	

Key issues	SEARs to be addressed by the study	Where addressed in this report
	a) natural processes within rivers, wetlands, estuaries, marine waters and floodplains that affect the health of the fluvial, riparian, estuarine or marine system and landscape health (such as modified discharge volumes, durations and velocities), aquatic connectivity and access to habitat for spawning and refuge	Refer to Section 4.5 for a summary of previous estuarine processes. Refer to Section 5 for a description of the existing environment and associated processes.
	b) effects to upstream and downstream rivers, wetlands, estuaries, marine waters, floodplain areas and water-dependant fauna and flora (including groundwater dependant ecosystems)	Refer to Section 6 for impacts to surface waters during construction and Section 7 for operational impacts. Refer to Groundwater Impact Assessment for impacts to groundwater.
	c) impacts from permanent and temporary interruption or interference of groundwater flow, including the extent of drawdown, barriers to flows, implications for groundwater dependent surface flows, ecosystems and species, groundwater users and the potential for geotechnical settlement associated with surface water bodies	Refer to Section 6 for impacts to surface waters during construction and Section 7 for operational impacts. Refer to Groundwater Impact Assessment for impacts to groundwater.
	d) changes to environmental water availability and flows, both regulated/licensed and unregulated/rules-based sources	Refer to Section 6 for impacts to surface waters during construction and Section 7 for operational impacts.
	e) direct or indirect increases in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses	Refer to Section 6 for impacts to surface waters during construction and Section 7 for operational impacts.
	f) methods for minimising the effects of proposed stormwater and wastewater management during construction and operation on natural hydrological attributes (such as volumes, flow rates, management methods and re-use options) and on the conveyance capacity of existing stormwater systems where discharges are proposed through such systems	Refer to Section 7.2.2 for stormwater management and impacts. Refer to Section 6.1 and the Hydrodynamic and Water Quality Impact Assessment for wastewater related impacts.
	g) water take (direct or indirect) from all surface and groundwater sources with estimates of annual volumes during construction and operation.	Refer to Section s 6.1.3, 6.2.2 and 6.3.2 and Section 7.2 for water use. No surface water take is proposed.

Key issues	SEARs to be addressed by the study	Where addressed in this report
	h) details of the proposed surface and groundwater monitoring to identify construction and operational hydrological impacts, including changes to groundwater levels	Refer to Section 8.
Water quality	Water Quality (surface and groundwater) impacts on waterways potentially impacted by the project, including but not limited to the Parramatta River, Homebush Bay and Haslams Creek, including:	
	a) existing background levels	Refer to Hydrodynamic and Water Quality Impact Assessment
	b) details on the ambient NSW Water Quality Objectives (NSW WQO) and environmental values for the receiving waters relevant to the project, including the indicators and associated trigger values or criteria for the identified environmental values	Refer to Hydrodynamic and Water Quality Impact Assessment.
	c) identification and estimation of the quality and quantity of pollutants that may be introduced into the water cycle by source and discharge point and describe the nature and degree of impact that any discharge(s) may have on the receiving environment, including consideration of all pollutants that pose a risk of non-trivial harm to human health and the environment	Refer to Hydrodynamic and Water Quality Impact Assessment for operational impacts. Refer to Section 6 for construction impacts.
	d) results of water quality modelling and analysis including descriptions under the full range of operating scenarios, including average or typical through to worse case for any proposed discharge point, including but not limited to the full range of weather conditions, bypasses, and 'off-spec' effluent scenarios	Refer to Hydrodynamic and Water Quality Impact Assessment.
	e) outline impacts from the proposal on existing sewage infrastructure including any potential impacts on dry weather and wet weather overflows from the existing reticulation network and any impacts on North Head Water Resource Recovery Facility concentrations and loads discharged and hydraulic and treatment capacity	Refer to Hydrodynamic and Water Quality Impact Assessment.
	f) Details on the rainfall event that the water quality protection measures will be designed to cope with	Refer to Hydrodynamic and Water Quality Impact Assessment.

Key issues	SEARs to be addressed by the study	Where addressed in this report
	g) The significance of any identified impacts including consideration of the relevant ambient water quality outcomes	Refer to Hydrodynamic and Water Quality Impact Assessment for operational impacts. Refer to Section 6 for construction impacts to water quality
	h) Details on how construction and operation of the project will, to the extent the project can influence, ensure that: (i) Where the NSW WQOs for receiving waters are currently being met they will continue to be protected (ii) Where the NSW WQOs are not currently being met activities will work toward their achievement over time (iii) The objectives of making the Parramatta River swimmable can be met (iv) Migration of contamination is considered and how it will be managed and minimised	Refer to Hydrodynamic and Water Quality Impact Assessment for assessment of operational impacts with consideration to the NSW WQOs Refer to Section 6 for construction impacts to water quality and Section 6.1.4 for how this may affect the NSW WQOs and making the Parramatta River swimmable.
	i) Justification for, if required, why the WQOs cannot be maintained or achieved over time	Refer to Hydrodynamic and Water Quality Impact Assessment for assessment of operational impacts with consideration to the NSW WQOs Refer to Section 6 for construction impacts to water quality and Section 6.1.4 for how this may affect the NSW WQOs
	j) Demonstration that all practical measures to avoid or minimise water pollution and protect human health and the environment from harm are investigated and implemented. This also includes consideration and management of frac out from the temporary loss of drilling fluids and inappropriate storage of chemicals and fuels.	Refer to Hydrodynamic and Water Quality Impact Assessment for assessment of operational water quality impacts and proposed mitigation. Refer to Section 6 for construction impacts to water quality and the effect of control measures in protecting water quality. Further details on construction mitigation and controls are provided within Section 8.2.
	k) Identification of sensitive receiving environments (which may include estuarine and marine waters downstream) and develop a strategy to avoid or minimise impacts on these environments	Refer to Section 5.2.4 for sensitive receiving environments and Section 6 and 8.2 for construction control measures for protecting the sensitive receiving environments.
	l) Proposed water quality monitoring programs, including monitoring locations, monitoring frequency and the parameters that will be monitored pre-construction, during construction and during operation, including justification for these.	Refer to Hydrodynamic and Water Quality Impact Assessment for operational water quality monitoring

4 Assessment Methodology

This study has been prepared to assess the risk of long-term impacts of the construction and operation of the project on surface water hydrology including consideration of project structures, water take and discharges on:

- Natural flow volumes, durations and velocities that contribute to environmental flows, supporting riverine and estuarine habitats
- Direct and indirect increases in erosion, siltation, loss of riverbank stability and riverbank vegetation.
- Water take (direct or indirect) and sources of water discharged during construction and operation.

Proposed mitigation measures and monitoring is provided in Section 875.

4.1 Study area

The study area is presented in Figure 4-1 for this assessment includes:

- Pipeline crossings at Subiaco Creek, Vineyard Creek, Haslams Creek, Duck River and Parramatta River
- WRRF works including earthworks and stormwater drainage network
- River release structure in Parramatta River at Meadowbank.

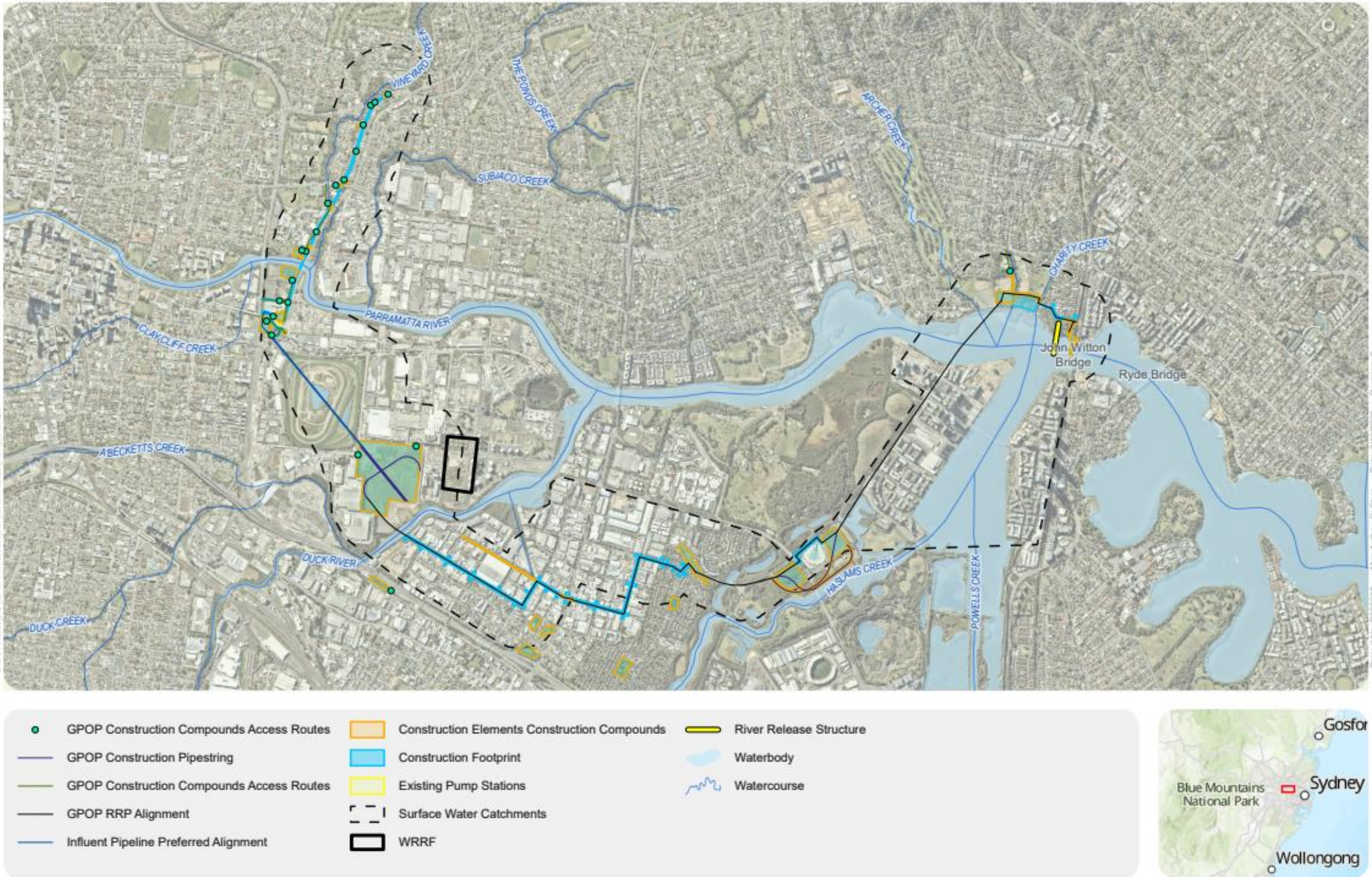

Figure 4-1 Study area and discharge locations

4.2 Assessment approach

The surface water and geomorphology assessment involved the following tasks:

- Desktop review of documents and data including:
  - review of project description and design information
  - legislation, policy and guidelines
  - review and analysis of hydrodynamic modelling provided in two studies:
    - Computational fluid dynamics modelling carried out by Jacobs for Sydney Water as part of the nozzle diffuser design and testing (Jacobs, 2025)
    - nearfield hydrodynamic modelling carried out by Sydney Water as part of the Hydrodynamics and Water Quality Impact Assessment (Sydney Water, 2025)
  - sediment and particle size analysis for sample cores retrieved near the John Whitton Bridge, release site (Birch and Batley, 2025)
  - publicly available reports and data on Parramatta River and Sydney Harbour processes.
- Description of the climate, topography, land use, soils, geology and existing surface water environments and dependent ecosystems based on the desktop review.
- Water demand and supply assessment including an estimate of water demands during construction and operation, identification and preliminary assessment of the availability and reliability of surface water sources of supply, in addition to functional and legislative constraints for use.
- Analysis of Parramatta River hydrodynamic modelling to inform qualitative and quantitative assessment of surface water flows, velocity and waterway stability, geomorphology during construction and operation.
- Quantitative stormwater pollutant load modelling to assess the effects of proposed stormwater management at the WRRF
- The residual significance and risk of each impact was assessed based on the criteria listed in Section 4.3 with consideration of the proposed management or mitigation measures.
- Description of management or mitigation measures to eliminate or reduce the identified potential impacts.

4.3 Criteria adopted

A qualitative assessment of the significance of any potential project impact on surface water has been undertaken by considering the sensitivity of the environment and expected magnitude of the impact. The resultant matrix of significance is shown in Table 4-1.

The *Sensitivity of Environment* evaluation is influence by the following criteria:

- Condition of the environmental value, i.e. how far is it understood to have already been changed from its original natural form or state?

- How unique or rare is the condition or value or it's dependant ecological receptors?
- How sensitive are the dependant receptors to changes?

The scale of sensitivity was determined as follows:

- **Low**: Heavily modified catchment and/or waterway which has limited environmental or human value.
- **Moderate:** Slightly to moderately disturbed waterway which retains a moderate level of ecological value and / or key fish habitat and/or is used for secondary and primary recreation
- **High**: High conservation waterway that is located within a predominantly undisturbed catchment, contains rare or unique ecological receptors.

The *Magnitude of Impact* evaluation is influence by the following criteria:

- Expected degree of change from pre-development conditions
- Expected extent of impact: Local (impacts the local reach of the receiving waterway only) vs. widespread (impacts multiple reaches of the receiving waterway or downstream waterways)
- Expected duration of impact: short term (less than 1 week), long-lasting (weeks to months) or permanent

The scale of magnitude was determined as follows:

- **Low**: Localised impact that results in minimal degree of change from pre-development conditions and only occurs for a short period of time (less than 1 week).
- **Moderate:** Localised impact that results in a moderate to large degree of change or more widespread impact that results in a minimal degree of change from pre-development conditions. The duration of impact could be short term to permanent.
- **High**: Any widespread impact that results in a moderate to large degree of change from pre-development conditions. Localised impacts that result in a large degree of change that are permanent.

Table 4-1 Impact significance matrix

Magnitude of Impact	Sensitivity of Environmental Values		
	High	Moderate	Low
High	Severe	Major	Moderate
Moderate	Major	Moderate	Minor
Low	Moderate	Minor	Negligible

The likelihood has been assessed based on a general definition and frequency as indicated in Table 4-2.

Table 4-2 Likelihood Ratings Definition

Likelihood Ratings	General Definition	Frequency
Almost Certain	Is expected in most circumstances; inevitable	Could occur once pr week
Likely	Will probably occur in most circumstances	Could occur once per month
Possible	Might occur at some time	Could occur once per year
Unlikely	Doubtful that it will occur	Could occur once in 10 years
Rare	Could occur in exceptional circumstances	Could occur once in 100 years

A qualitative risk assessment of potential impacts (considering impact significance and likelihood) was undertaken as per the following scale:

- **Low**: Potential adverse impact could result in a minimal/not noticeable decline in the resource/quality of a surface water in the study area.
- **Medium**: Potential adverse impact could result in a decline in the resource/quality of a surface water in the study area. Impact can often be managed through standard safeguards.
- **High**: Potential adverse impact could result in a decline in resource/quality of a surface water to lower than-baseline/worse-than-baseline. Impacts would require specific management as impact could have major community/environmental issues.
- **Very high**: Potential adverse impact could result in significant decline in the resource/quality of a surface water resource to significantly lower-than-baseline/worse-than-baseline condition. Impacts would require specific management as impact would have significant community/environmental consequences.

This scale is displayed in a risk assessment matrix in Table 4-3 below.

Table 4-3 Qualitative risk assessment

Risk Assessment		Significance				
		Negligible	Minor	Moderate	Major	Severe
Likelihood	Almost Certain	Low	Medium	High	Very high	Very high
	Likely	Low	Medium	High	High	Very high
	Possible	Low	Low	Medium	High	High
	Unlikely	Low	Low	Low	Medium	High
	Rare	Low	Low	Low	Medium	Medium

4.4 Key assumptions, limitations and uncertainty

This assessment has been conducted based on a reference design for the WRRF. As such, more detailed design elements have not been considered including depth of excavation, depths of proposed infrastructure and a drainage design.

Key surface water and geomorphology limitations are as follows:

- Geomorphic analysis has been based on classical Hjulström curves
- No additional numerical modelling has been carried out as part of this study.

4.5 Previous studies

Previous studies completed regarding sediment sizes and bathymetry within Parramatta River near the study area have been reviewed. A summary of the previous studies is discussed in the sections below.

4.5.1 Parramatta River Estuary Processes Study – Foreshore erosion

AECOM (2010) undertook a condition assessment of the foreshore along Parramatta River following identification in Cardno (2008) that there was a lack of more recent assessments of bank erosion and the need for erosion assessments to be undertaken.

The scope of works undertaken for the study included:

- Identify all foreshore areas that are undergoing erosion (both active and past) and the likely causes of the erosion
- Map the locations of erosion at the local scale and document the severity of the erosion (including extent/dimensions, type, causes) and capacity to contribute to ongoing environmental and recreational problems such as water quality pollution, smothering of seagrasses, and foreshore amenity and access
- Develop management actions to rehabilitate eroding areas and prioritise these actions for the whole estuary and for each LGA
- Provide potential options to manage the mangrove undermining and erosion caused by the wake of the River Cat along the section of foreshore from Silverwater Bridge upstream to the Charles Street weir.

Foreshore condition assessments classified sites as good, poor or failed condition. Sites identified in the AECOM (2010) study that are within 1.5 km downstream of the river release structure are considered as part of this assessment. The results of this study are further discussed in Section 5.3.

4.5.2 Parramatta River Estuary Data Compilation and Review Study

Cardno (2008) identified complex interactions of freshwater inflows, tides, winds, and waves that drive sediment transport, contaminant distribution, and water quality in the Upper Parramatta River Estuary.

The study described stormwater runoff typical of a highly urbanised catchment with multiple tributaries featuring modified drainage systems; varied geological substrates and limited vegetative cover. Urbanisation has increased stormwater runoff volumes and velocity, leading to heightened erosion, sediment transport, and degrading water quality in the estuary.

Stormwater carries contaminants including heavy metals, organic compounds, and other pollutants into the estuary. Over time, the implementation of stormwater management and Water Sensitive Urban Design (WSUD) initiatives will progressively mitigate these impacts of stormwater runoff.

Tidal flushing processes are significant hydrodynamic drivers that influence sediment and contaminant transport. Tidal exchange helps to disperse pollutants and maintain water quality, but effectiveness varies with estuary morphology and hydrodynamic conditions. The main channels of the Upper Parramatta River estuary are relatively deep, supporting efficient flushing, while shallower embayment experience sediment accumulation and reduced flushing efficiency.

4.5.3 Sydney Harbour Estuary Process Study

The Sydney Harbour Estuary Process Study (Hedge et al., 2014) collates the then-available biophysical scientific research regarding Sydney Harbour estuary, as a guide to the state of knowledge of the harbour.

It identifies the configuration of the Sydney estuary catchment drainage system and the orientation of bays and shorelines as controlled by geologic structure. The study also defines Sydney Harbour estuary as a drowned river valley, with sea level rise depositing sediment and forming a flood tide delta during interglacial periods, and eroded sediment transported by rivers were deposited in the upper parts of the estuary as fluvial deltas during periods of uplift. For the majority of the last 135,000 years, sea level was below present levels by 20 - 70 m and therefore erosion of estuaries was more pronounced than deposition.

The study cites the primary mechanism for the spread of sediments from Homebush Bay as resuspension caused by high winds and flood events in combination with normal tides.

High-resolution 3D modelling of tide, fluvial and wind-wave processes, coupled with a sediment transport model indicates that the highest volumes of dioxin are transported out of Homebush Bay during strong southerly wind events associated with high ebb tidal currents.

The accumulation of contaminated sediment in secondary deposition zones in downstream locations was also noted as a mechanism for potential resuspension and continued spread throughout Sydney Harbour during high wind events. Secondary deposition ‘hot spots’ have been listed as the northern Parramatta Riverbank opposite Homebush Bay, Meadowbank, which is the study area for this project. Other hot spots identified were Brays Bay, Rhodes, and Majors Bay, Concord.

Resuspension of bed sediments and associated dioxins from Homebush Bay and secondary deposition zones (Meadowbank) would occur when the bottom shear stress exceeds sediment cohesion. The study concluded that high winds and flood events in combination with normal tides have the potential to resuspend and then transport the sediments outside Homebush Bay into surrounding bays and also listed the following processes as potential causes of shear stress and subsequent sediment transport:

- Tidal oscillations
- Wind driven wave-induced currents
- Flood currents
- Vessel movements.

Consideration of the potential cumulative impact of the nozzle releases to these processes is provided in further detail below.

4.6 Studies undertaken to support the project

4.6.1 Report on sediment size and chemistry for cores retrieved from the John Whitton Bridge potential release site

In September and October 2024, fifteen sediment cores were collected from the John Whitton Bridge area to assess the suitability of estuarine sediment in the area for release of advanced treated water. Samples were taken to assess the potential for surface resuspension, possible deeper disturbance, and local contamination.

The 45 samples recovered were analysed for sediment size, 10 metals, 20 polycyclic aromatic hydrocarbons (PAHs) and dioxins and furans.

The analysis revealed that all sediment cores predominantly consisted of mud-size particles, indicative of a fine material depositional environment. While most metal concentrations exceeded lower sediment quality guidelines values (SQGVs), notable exceedances of the high guideline values were observed for lead (Pb) in five cores and zinc (Zn) in thirteen cores.

At least a third of the PAH samples surpassed the lower SQGVs, with only one sample exceeding high guidelines. Additionally, the average concentration of dioxins and furans across all sediment samples greatly exceeds guideline values, highlighting significant environmental concerns in the vicinity of the release site. Sediment concentrations of Zn and dioxins and furans raised concerns regarding ongoing ecological impacts, particularly due to potential sediment remobilisation dynamics from the proposed diffuser installation.

The size distribution of surficial samples from all 15 locations were similar, as was samples from the intermediate and deeper sediment sampling depths. Two sediment size modes were distinctly evident. A fine fraction with a mode of approximately 0.50 μm and a range from 0.30 μm to 2.0 μm and a second larger mode of approximately 6 μm to 9 μm with a range from 2.0 μm to 60 μm.

Given the elevated concentrations of contaminants, recommendations advised against disturbing the sediment, with caution regarding any construction or installation activities nearby.

4.6.2 Data collection in Parramatta River

Marine and Earth Sciences Pty Ltd (MES) was commissioned by Sydney Water to undertake bathymetric and geophysical and studies in the Parramatta River. A Digital Elevation Model (DEM) was created to show continuous elevation model.

The study collected data that will help in determining key site-specific hydrodynamic and water quality conditions as well as mapping riverbed levels and characteristics and the nature of shallow geological conditions at the site. The site, centred around Rhodes Point, is adjacent to and downstream of a previous phase of investigations at Wentworth Point. The results from both phases have been integrated to extend the understanding of the waterway over the broader area.

The riverbed levels over the site show a main channel centred generally toward the northern bank with two localised deeper areas surrounding the road and rail bridges with water depths extending to -6.3 m AHD. These deeper areas are expected to be related to the effect of scouring from the concentration of currents around bridge piers.

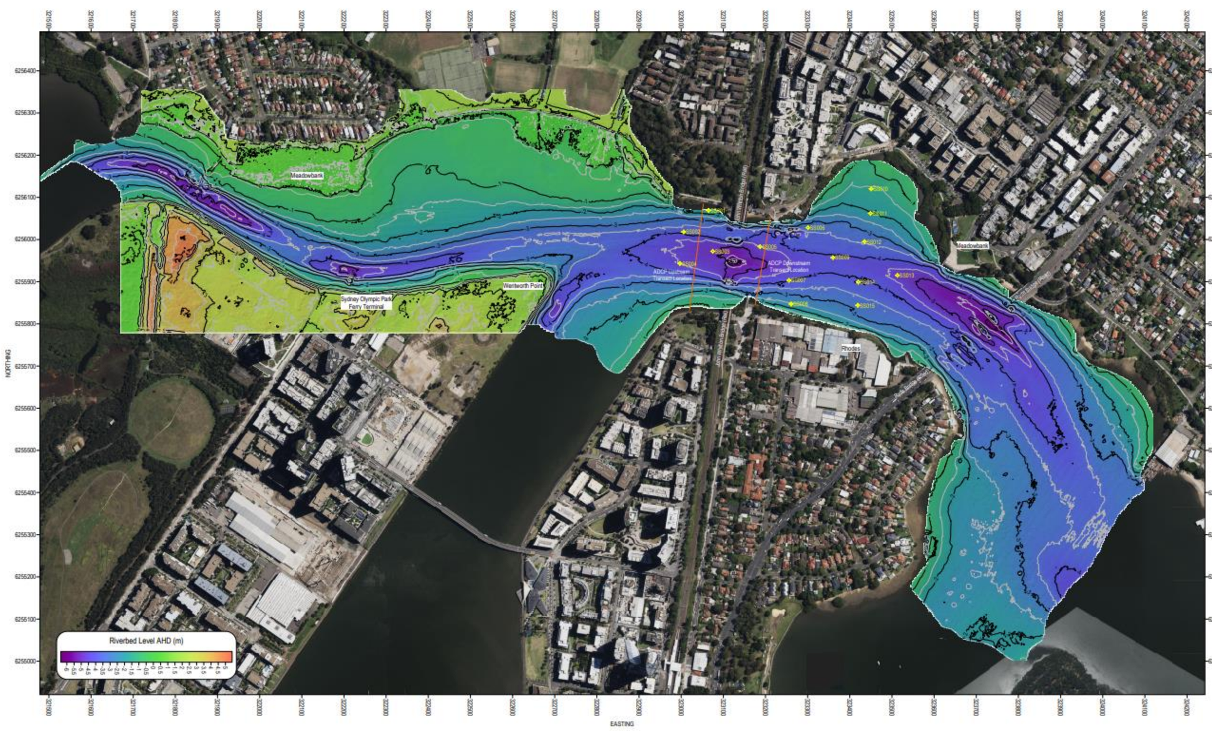

Figure 4-2 Bathymetric survey

4.6.3 Hydrodynamic and Water Quality Impact Assessment

To support the current EIS, Sydney Water has undertaken hydrodynamic and water quality modelling.

The modelling was calibrated and validated against a diverse suite of data collected between 2012 and 2024 to provide background hydrology and hydraulics of the Paramatta River, and allows for comparison of river flows at 100 m and 200 m intervals upstream and downstream of the release area.

The modelling provides a representative approximation of flood and ebb tide flows and velocities along the entire Parramatta River estuary from the Charles Street Weir to the heads of Sydney Harbour. The modelling has not been used to quantify the ongoing movement of sediments in the Parramatta River and the Harbour but instead indicate the risk that the proposed river release would contribute to or increase the sediment transport potential of the background ambient flow conditions in the Parramatta River. This modelling, referred to as a water quality response model (WQRM), has incorporated catchment runoff, wastewater overflows, hydrodynamic forcing from riverine and tidal mechanisms and various receiving water quality models.

Following calibration, the WQRM was used to simulate continuous river flow and tide cycles under a range of release scenarios which provides a basis for assessing the hydrologic impacts of the WRRF releases under representative conditions at several locations in the upper estuary, both upstream and downstream of the proposed releases.

The study uses flexible mesh modelling (MIKE 3 Flow Model) for hydrodynamics and incorporates sediment dynamics (MIKE Mud) and water quality (MIKE Ecolab) dispersion modelling. The modelling incorporates continuous simulation of tides, flow, sediment and contaminant transport in the Parramatta River estuary.

The model extends from the upstream Charles Street Weir in Parramatta to the ocean boundary at the Sydney Harbour heads. The model was calibrated against field measurements to ensure accuracy and reliability, reflecting site-specific hydrodynamic, sediment, and water quality conditions.

Scenario-based simulations were then undertaken using multiple scenario runs including baseline (years 2024 and 2025), future catchment conditions without the Camellia-Rosehill WRRF operation (circa 2056), and impact scenarios with the WRRF operation (circa 2056). For each scenario, modelling included evaluation of nutrient and pathogen loads and the resulting water quality concentrations throughout the surrounding estuary.

4.6.4 Computational Fluid Dynamics Modelling

Sydney Water has undertaken detailed hydrodynamic modelling using Computational Fluid Dynamics (CFD) for the river release in Parramatta River. This modelling considers the near field mixing and hydraulics in a range of tide, river flow and release simulations. The modelling combined detailed geometric and hydraulic modelling under ambient flow scenarios to assess the risk of hydraulic conditions forming that would cause changes in the rate of sediment resuspension and transport.

The model uses the Reynolds-averaged Navier-Stokes equations solved via the finite volume method to analyse fluid flow and shear stresses through the water column and at the riverbed.

The model geometry of the river was constructed from scanned bathymetry data and structural profiles of the John Whitton Bridge, incorporating the proposed pipeline and nozzle designs.

The computational domain covered approximately 320 m along the river (135 m upstream and 185 m downstream from the release structure), discretized into about 21 million tetrahedral elements converted to ~6 million polyhedral cells, with mesh refinements near critical areas (pipelines, nozzles and riverbed) and prism layers for accurate boundary layer resolution.

The discharge nozzles modelled were DN200 duckbill check valves oriented at a 30° angle to the bed. This angle was tested and adopted to balance the risk of sediment scouring and achieving good mixing of water released from the nozzles.

Multiple flow conditions were modelled a combination of flood and ebb tidal states for commonly experienced flow events that represented the lower, middle and higher flow velocities under ambient conditions. The resulting flow velocities at the riverbed were modelled with and without river releases. The relative changes in velocity were measured and mapped.

Results were analysed to identify zones of increased shear stress and potential scouring.

This modelling was used to test and refine the reference design. Through this process, the orientation and number of nozzles was selected to reduce the risk of scour velocities occurring as a result of nozzle releases. This modelling also informed the placement of geosynthetic concrete mattresses around the nozzles to cap contaminated sediment and protect riverbed sediments from exposure to elevated velocities.

The modelled velocity and scour results are utilised in this geomorphology investigation.

5 Existing environment

5.1 Climate

The nearest Bureau of Meteorology (BoM) station selected with sufficient coverage of rainfall data is located at Sydney Olympic Park AWS (Archery Centre) (BoM station ID: 066212). The weather station is approximately 3.4 km east of the proposed WRRF and 2.1 km south-west of the river release structure.

Rainfall values were calculated from records from 2011 to 2025. Key monthly statistics are captured in Table 5-1. Comparing monthly media shows evidence of wetter summers (October to March) and drier winters (April to September). Additionally, the climate zone is characterised as mild to warm summers and cold winters (BoM, 2025).

Table 5-1 Key monthly statistics at BOM weather station 066212

Statistic	Jan (mm)	Feb (mm)	Mar (mm)	Apr (mm)	May (mm)	Jun (mm)	Jul (mm)	Aug (mm)	Sep (mm)	Oct (mm)	Nov (mm)	Dec (mm)	Annual (mm)
Mean	25.1	140.8	177.3	92.6	45.3	112.0	56.7	59.1	47.0	61.9	79.4	72.9	1141.1
Lowest	18.4	6.2	23.8	9.4	4.8	1.6	0.4	8.0	0.4	14.2	25.6	1.4	721.4
10th %ile	31.8	62.9	50.0	15.2	9.4	15.7	5.2	10.8	26.5	18.1	30.7	30.7	828.3
Median	134.8	87.7	117.3	42.3	22.2	72.4	20.2	36.0	40.1	40.1	50.7	64.9	1051.6
90th %ile	178.6	274.1	360.9	186.5	102.2	245.8	119.7	124.3	90.8	124.5	163.4	122.0	1425.4
Highest	343.6	487.0	550.6	412.8	116.8	327.0	343.0	257.2	93.0	222.8	171.6	224.2	1911.8

5.2 Surface water

5.2.1 Catchment overview and land use

The Parramatta River catchment encompasses an area of approximately 252.4 square kilometres and is comprised of 29 sub-catchments, including the Duck River at Silverwater and Charity Creek at Meadowbank. The Parramatta River flows from the confluence of Toongabbie Creek and Darling Mills Creek in North Parramatta to the Sydney Harbour heads at its ocean boundary. The river is tidal to Charles Street Weir in Parramatta, approximately 30 km upstream from Sydney Heads. It is generally divided into the Upper and Lower Parramatta River.

Over time, the majority of the drainage lines flowing to the Parramatta River have been straightened, narrowed and concrete lined, which increases the rapid response time of the catchment to rainfall. Flooding of the Parramatta River occurs on a periodic basis as a result of intense rainfall events in the catchment.

The upstream waters are controlled by a series of four weirs, including Kiosk Weir and Upstream Weir in Parramatta Park, and Marsden Street Weir and the Charles Street Weir in the Parramatta CBD. The weirs were originally constructed to provide freshwater for farmers.

The Project is located in the Lower Parramatta River catchment, which has been largely urbanised and comprises a mix of land uses including education, commercial, residential, public open spaces and industrial. The catchment has a long history of industrial development around the project, which has included oil refining, a tannery, a meat works, a lumber yard and facilities manufacturing asbestos products, plasterboard, bricks, roof tiles, chrome chemicals, chlorinated hydrocarbons, bitumen, rubber tyres, paints, arsenic-based herbicides, food products, paints, plastic pipes, and pharmaceuticals. Other industries have included solid and liquid waste storage, recycling and treatment, and concrete recycling operations.

Former industrial sites including those around Homebush have heavily impacted the waterways, which has resulted in contaminated sediments, with high concentrations typically associated with point sources (e.g. former industrial sites at Homebush Bay) or where creeks and stormwater outlets enter the estuary in the upper reaches of embayments (Cardno, 2008). Many of these industrial facilities have been, or are, subject to Environment Protection Licences issued by the New South Wales Environment Protection Authority (EPA). In addition to contaminated sediments, there are areas that have a high probability of occurrence for acid sulfate soils throughout the catchment.

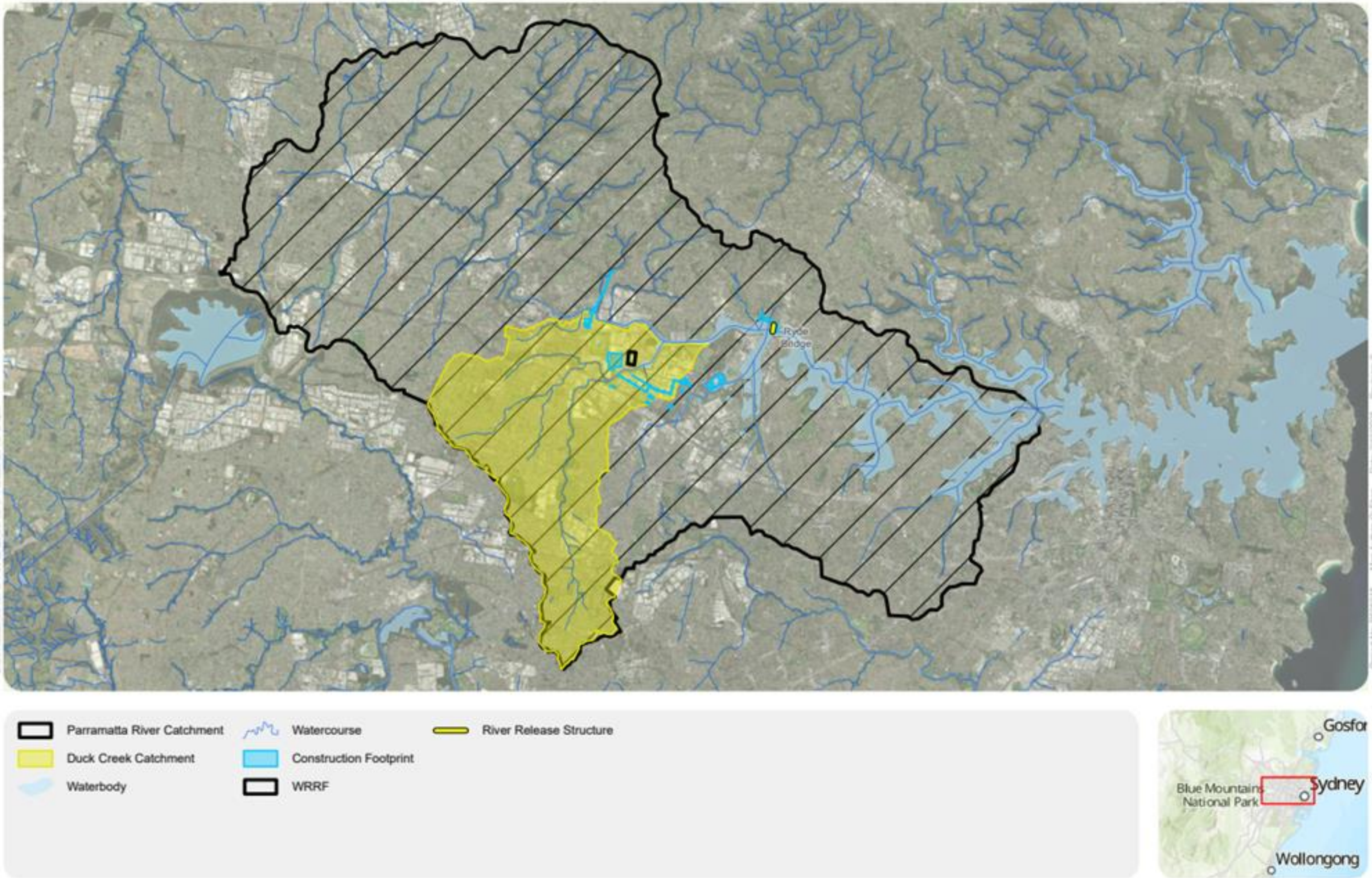

Figure 5-1 Parramatta River and Duck River catchment

5.2.2 Camellia-Rosehill WRRF

Review of historical aerial photos shows the proposed WRRF site on the northern shore of the Duck River was formerly an industrial liquid storage site and 'tank farm' that comprised extensive pavement, roads, bunding, buildings and above ground tanks.

5.2.3 Local surface water features

Several watercourses and waterbodies are intercepted and directly impacted by the project. The ultimate receiving waterway for the project is the Parramatta River. Parramatta River is a 4th Strahler order stream, which flows easterly and is a major tributary to the Sydney Harbour. The portion of the Parramatta River impacted by the project is entirely tidally affected, up to Charles Street Weir, approximately 8.2 km upstream of the release point.

The NSW riverine High Ecological Value Aquatic Ecosystem (HEVAE) Instream Value spatial (NSW DCCEEW, 2024) define a range of instream values and levels of importance for freshwater river reaches. The instream value is calculated based on a combination of four criterions: naturalness, diversity, distinctiveness and vital habitat. All the freshwater waterways were deemed to have low HEVAE instream value. This mostly attributed to ranking very low and low in diversity and naturalness, due to the highly urbanised nature of the Lower Parramatta River catchment. The HEVAE layer does not apply to tidal waterways (i.e. the Parramatta River).

The Narawang Wetland is 1.6 km in length and acts as a floodplain, absorbing floodwater from Haslams Creek during very high tides, and runoff from surrounding areas after heavy rain. The 22 habitat ponds surrounding the irrigation storage ponds provide breeding habitat for many frog species, including endangered species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The Strahler order, tidal influence, HEVAE instream value and interface with the project are captured in Table 5-2.

Table 5-2 Relevant waterways and waterbodies impacted by the project

Water feature	Strahler order	Perenniality and tidal influence	HEVAE Instream value	Relationship to project
Unnamed waterway	1	Ephemeral	Low	• Proximity to construction compounds (C30)
Charity Creek	1	Ephemeral	Low	• Crossed by river release pipeline. • Unlikely to be impacted
Duck River	3	Perennial - estuarine	Low	• Receiving waterway for existing stormwater system • Downstream from construction of WRRF

Water feature	Strahler order	Perenniality and tidal influence	HEVAE Instream value	Relationship to project
Vineyard Creek	2	Perennial	Low	• Proximity to construction compounds (C2, C3, C8), associated access tracks and relined existing pipeline from WRRF to existing wastewater system (NSOOS) • Downstream from construction compounds C1 to C11 • Unlikely to be impacted
Haslams Creek	2	Perennial - estuarine	Low	• Downstream from indicative construction compound (C27) for the river release pipeline in Olympic Park. • Unlikely to be impacted
Parramatta River	4	Perennial - estuarine	Low (perennial)	• Location of proposed river release structure • Crossed by pipelines from WRRF to existing wastewater system (NSOOS) • Construction compounds (C11, C12, C28, C29, C30, and C31) on waterfront lands • Receiving waters for treated water
Constructed ponds at Rosehill Gardens Racecourse	-	Constructed	NA	• Crossed by the transfer and Brine pipelines between Camellia-Rosehill WRRF and existing pumps station SP0067. • Unlikely to be impacted
Narawang Wetlands	-	Perennial	Low	• Downstream of indicative construction compounds (C25, C26, C27) • Unlikely to be impacted

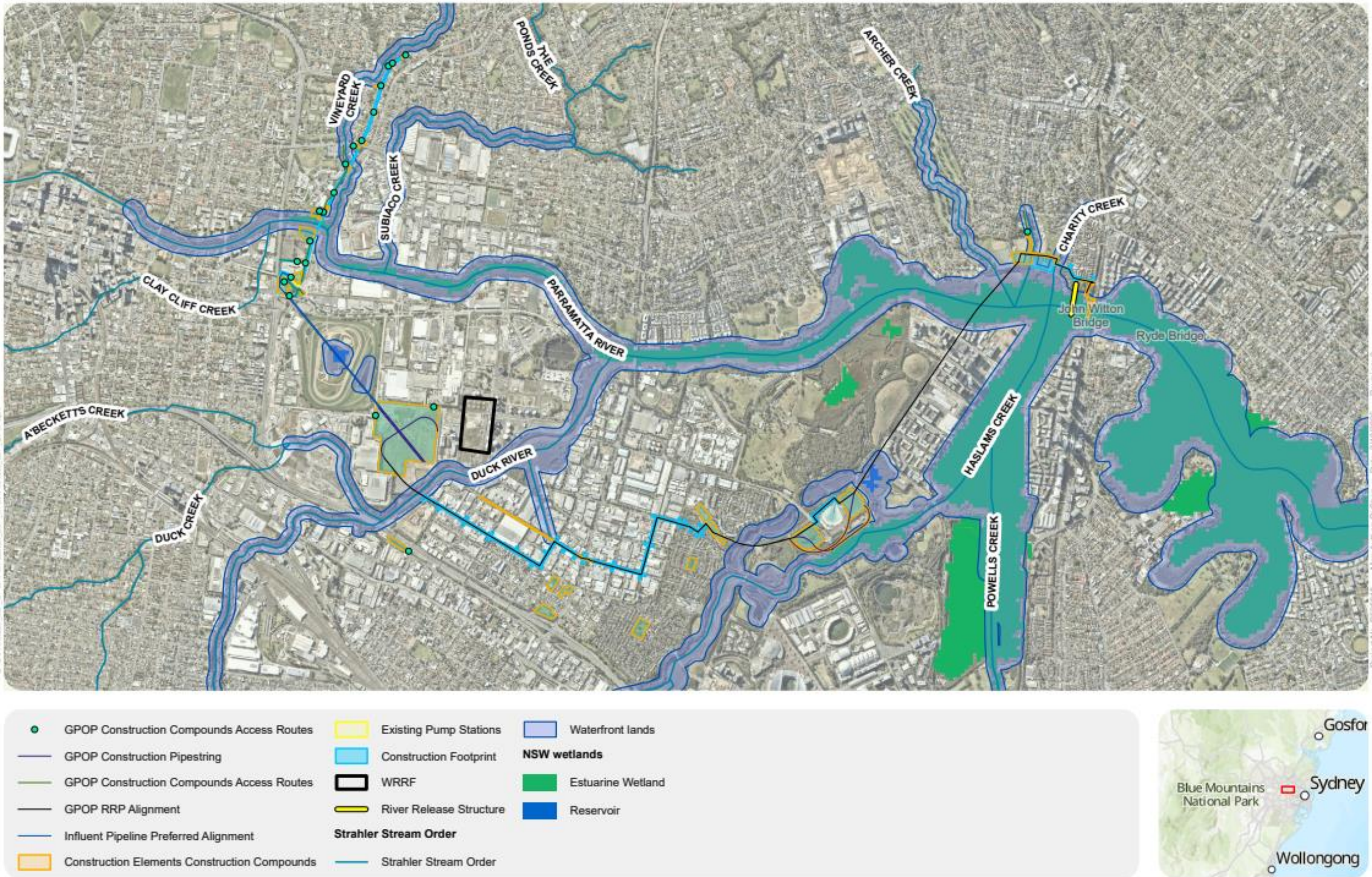

Figure 5-2 Local and regional waterways

5.2.4 Sensitive receiving environments

Protected wetlands

An assessment of Ramsar wetlands was undertaken through the NSW Sharing and Enabling Environmental Data (SEED) portal. No Ramsar or Nationally Important Wetlands were identified downstream or within the vicinity of site.

The Parramatta River, intersected by the project, is identified as an estuarine wetland, based on the NSW Wetland geospatial dataset (DCCEEW, 2010).

Additionally, the Narawang Wetlands have been identified as floodplain wetlands (DCCEEW, 2010).

Key fish habitat

The *Fisheries Management Act* 1994 defines Key Fish Habitats as aquatic habitats that are important to the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally, and the survival and recovery of threatened aquatic species.

A review of the Fisheries NSW Spatial Data Portal (NSW DPIRD, 2024) identified KFHs within the study area. Waterways with stream orders greater than 3 have been designated as KFHs. This includes Duck River and Parramatta River. Additionally, Haslams Creek and Narawang Wetlands were identified as KFHs.

The KFH within the Duck River and Parramatta River relates to a freshwater fish community which is identified as having a fair and poor condition status respectively.

The sensitive receiving surface water environments are presented in Figure 5-3.

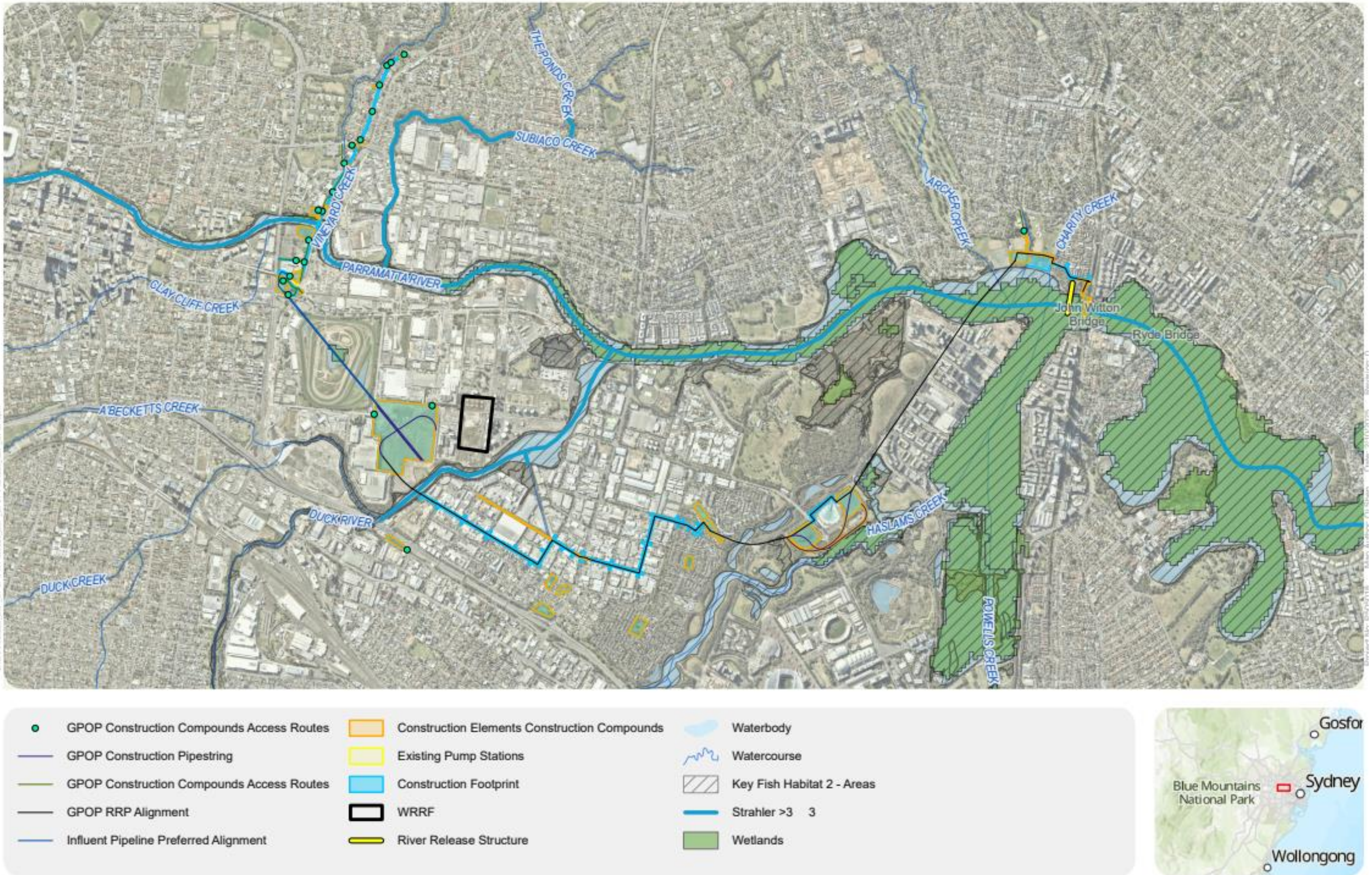

Figure 5-3 Sensitive receiving environment

5.3 Geomorphology

River geomorphology is the study of the characteristics, origin and evolution of riverine landscapes. It includes analysis of sediment transport, vegetation, water flow and erosion, and how these processes shape and form rivers.

The River Styles Framework (DCCEEW, 2023) is a system for understanding and managing rivers in all their diverse geomorphic characteristics and behaviours. Developed at Macquarie University, the framework is a method for classifying river character, behaviour, condition, and recovery potential. The recovery potential refers to the likelihood that a river reach will improve its geomorphic condition over management timeframes, from the construction and operational impacts from new developments. Table 5-3 provides river styles of the waterways in the study area. For completion, all waterways are listed, however, some minor waterways do not have an associated water style.

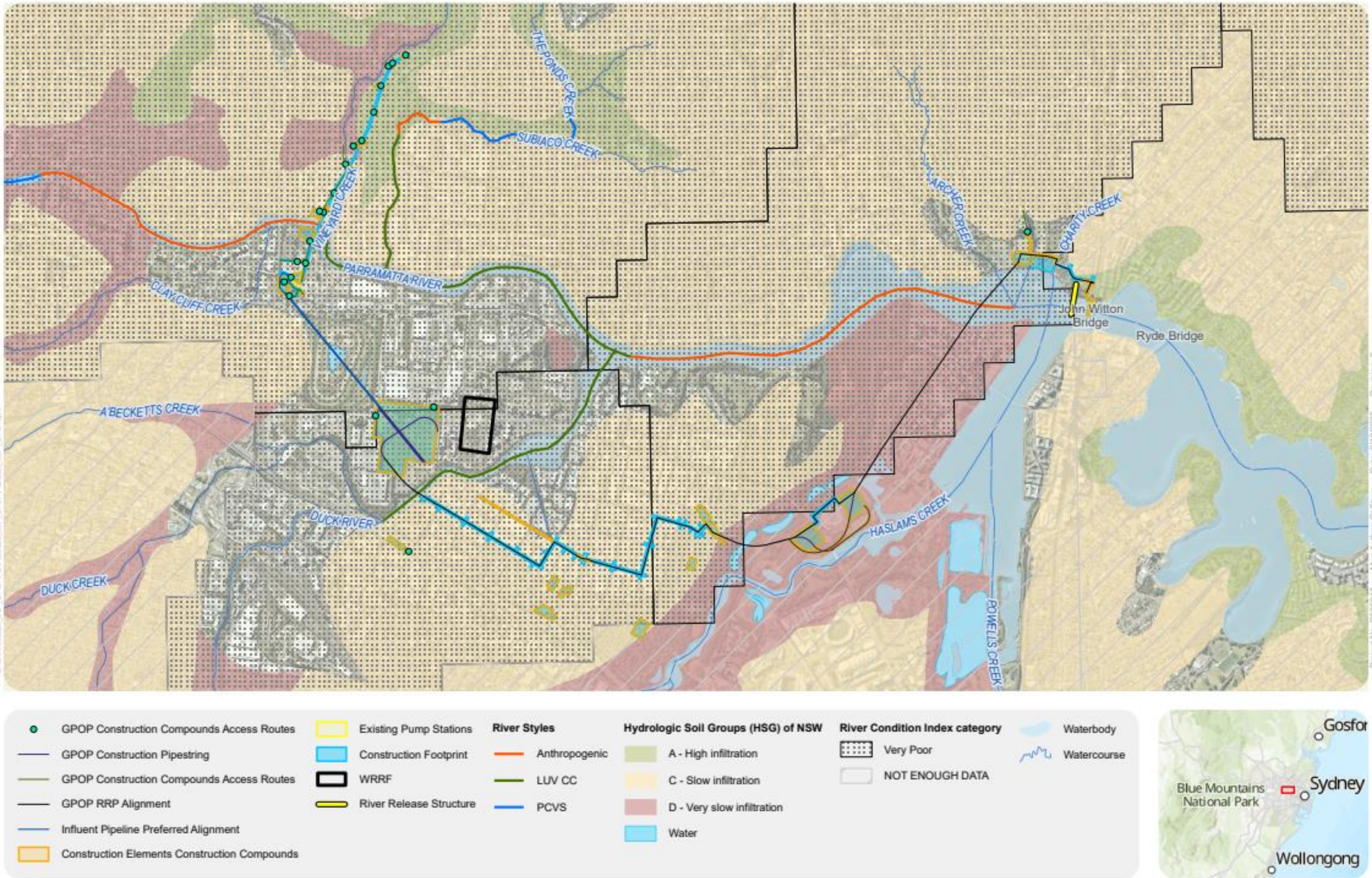

Figure 5-4 River styles map

Table 5-3 River styles of waterways within proximity of project

Waterway	River Style	Geomorphic Stream Condition	Fragility	Recovery Potential	Rehabilitation priority	Potential for Project Impacts
Parramatta River	Laterally unconfined, continuous channel, low sinuosity, (tidal), fine-grained bed	Poor	Moderate	Low	Low	For assessment
Duck River	laterally unconfined, continuous channel, low sinuosity and fine-grained bed	Poor	Moderate	Low	Low	For assessment
Haslams Creek	Anthropogenic, bedrock margin-controlled, urban watercourse, bedrock bed	Poor	Low	Low	Low	No impact
Vineyard Creek	Partly confined, bedrock margin-controlled, low sinuosity, discontinuous floodplain, fine-grained bed	Poor	Moderate	Moderate	Medium	No impact
Charity Creek	N/A	N/A	N/A	N/A	N/A	For assessment
Unnamed tributary to Parramatta River	N/A	N/A	N/A	N/A	N/A	For assessment
Narawang Wetlands	N/A	N/A	N/A	N/A	N/A	For assessment
Constructed ponds at Rosehill Gardens Racecourse	N/A	N/A	N/A	N/A	N/A	For assessment

The Parramatta River Estuary Processes Study (AECOM, 2010) provided a condition assessment of the foreshore along Parramatta River. The paper identified and rated the areas that had experienced erosion, both active and past, and likely causes. The foreshore erosion conditions were rated based on Table 5-4.

Table 5-4 Condition assessment categories of Parramatta River foreshore

Condition	Description
Good	▪ Minor erosion scarp observed ▪ Minor shoreline recession observed ▪ Minor loss of fine sediments from between pneumatophores where mangroves are present
Poor	▪ Moderate erosion scarp observed ▪ Moderate shoreline recession observed ▪ Where mangroves are present, fine sediment has been lost from between pneumatophores
Failed	▪ Large erosion scarp observed ▪ Extensive shoreline recession observed ▪ All fine material has been lost from between pneumatophores where mangroves are present causing severe undermining and collapse of mangroves

The foreshore locations within 1.5 km downstream from the project were assessed to be in poor condition. This included:

- At river release structure at Meadowbank, and adjacent to rail bridge
- Settlers Park, Putney
- Kissing Point Park, Putney
- Adjacent to Ryde and Concord Sailing Club, Putney.

They were deemed to be medium to high priority for mitigation and rehabilitation works, except for adjacent to Ryde and Concord Sailing Club (Putney), which was deemed low priority.

5.4 Sediments and Chemistry

5.4.1 Contaminated sediments

The presence of dioxin and furan compounds in estuarine sediment has necessitated careful design of the proposed river release structure at Meadowbank. Dioxins found in Meadowbank and the Homebush Bay area include the most chemicals known to science (2, 3, 7, 8-TCDD) which cause cancer and a range of very severe health and reproductive issues in humans. Various other toxic contaminants are found at the site and include metals, polycyclic aromatic hydrocarbons, various chlorinated phenols and benzenes, solvents and furans (Hedge et al., 2014). The toxicity from accumulated dioxins in the Homebush Bay area are responsible for permanent bans placed on fishing and trawling in the Sydney estuary from February 2006 (Birch et al., 2007).

Previous activities including land reclamation and chemical manufacturing along the western Rhodes Peninsula foreshore has resulted in dioxins and other chemical by-products accumulating in local waterways which were partially remediated between 2006 and 2011, where sediments with the highest dioxin and furan concentrations were removed along the eastern side of the Homebush Bay (Hedge et al., 2014).

Contaminated sediments have persisted in the local waterways have become remobilised by hydrodynamic processes and these chemical are now found to be distributed across large parts of Sydney estuary, both upstream and downstream of Homebush Bay (Lee and Birch, 2014; Birch et al., 2015).

Core sampling and chemical analysis undertaken for the project confirms the presence of compounds at elevated concentrations in the vicinity of the Meadowbank release site.

5.4.2 Sediment transport processes

As detailed in Section 4.5.3, the Sydney Harbour Estuary Process Study (Hedge et al., 2014) identified the primary mechanism for the spread of sediments from Homebush Bay into surrounding bays as resuspension caused by high winds and flood events in combination with normal tides.

This includes resuspension of contaminated sediments from secondary deposition 'hot spots' in downstream locations, including from the northern Parramatta Riverbank opposite Homebush Bay, Meadowbank, which is the study area for this project.

Consideration of the potential cumulative impact of the nozzle releases to these processes is provided in further detail Section 6 and 7.

5.4.3 Sediment chemistry

Cores were retrieved upstream and downstream of the John Whitton Bridge in September and October 2024. Samples were taken at three sedimentary depths from the upper (< 8 cm), mid (20 - 35 cm) and lower (> 50 cm) depths.

Chemical analysis of sediment samples confirmed that concentrations of metals, particularly zinc, dioxins and furans in sediment samples were found to exceed sediment quality guideline values (SQG-H) and for some sites the concentration of these chemicals greatly exceeds guideline values. The study authors recommend that sediment disturbance is minimised by the river release structure.

5.4.4 Bed material analysis

For this study (Birch and Batley, 2025), sediment transport criteria have been selected based on the physical characteristics of the sediment identified in the study area.

Sediment samples from all cores and at all core depths are similar and dominated by clay and silt-size particles indicating a mainly depositional environment of fine material. All samples showed an absence of sand-size particles. Samples show two sediment size modes:

- A fine, clay material fraction with a typical particle size of approximately 0.50 μm and a range from 0.30 μm to 2.0 μm
- A larger mode of approximately 6 μm to 9 μm with a range from 2.0 μm to 60 μm.

The study notes that the sediment sizing laboratory process includes a chemical disaggregation process that may result in sediments being measured as finer than they would occur in-situ. The authors also note that fine clay- and silt-sized particles are probably present in the environment as flocs of larger sizes in the water column and as cohesive material when deposited.

Notwithstanding this, the sediment sizing undertaken in this study has been adopted here to characterise the sediment size and inform the sediment transport assessment.

By adopting potentially finer sediment characteristics than may occur in situ, there is a potential to be appropriately conservative in predicting the risk that the project will contribute to the sediment and dioxin remobilisation and transportation to secondary deposition locations.

6 Construction impact assessment

The construction impact assessment is structured in terms of the potential impacts to

- Natural flow volumes, durations and velocities that contribute to environmental flows, supporting riverine and estuarine habitats
- Direct and indirect increases in erosion, siltation, loss of riverbank stability and riverbank vegetation
- Water take (direct or indirect) and sources of water discharged during construction and operation.

The impacts are assessed for the following key construction activities:

- Upgrades to the existing pumping station at Camellia
- Construction works at the WRRF site
- Constructing the brine, transfer and river release pipelines
- Constructing the pipelines and river release structure.

An assessment of the residual impact’s magnitude, duration and risk is provided in Section 6.5.

6.1 River release structure

6.1.1 Construction methodology

The pipelines vary in length and connect to the multiport diffuser that will release water upstream and between the first and third piers of the John Whitton Bridge. The pipelines and river release structure will be underlain by a flexible geotextile mattress and then anchored in place with sections of a similar concrete mattress.

The geotextile mattress is intended to act as a mitigation measure to minimise the disturbance or resuspension of sediment during placement of the pipes and river release structure.

The release structure at Parramatta River would take about 12 months to construct.

The construction activities associated with the construction of the pipelines and river release structure includes the following activities:

- constructing a cofferdam (or similar temporary structure) at the riverbank to connect the upstream ends of the pipelines to the sections of the river release structure. This would require removal of the existing sandstone seawall, which would be reconstructed once the pipelines are connected. The cofferdam would be sealed off from the river to minimise river water ingress.
- removing cofferdam and temporary sandbags
- laying geotextile mattress on top of the riverbed at the location of the river release
- using barges, tugs and divers to position sections of pipe on top of the geotextile mattress
- using a land or barge-based crane to anchor the pipeline protection system (i.e. concrete mattress) on top of the pipelines.

The existing sandstone headwall at the riverbank would be deconstructed to allow trenched installation of pipelines to the edge of the Parramatta River. The grout and concrete mattresses (or similar form of underwater pipeline protection) would be fabricated offsite and transported to the construction work area either via barge or heavy vehicles, dependent on the location of the supplier. Geotextile fabric or mattress (or similar) would be laid on top of the riverbed sediment at the location of the river release. Sections of pipe would then be floated into position by barge, then flooded and guided into place by tugs and divers. A crane (either land-based or barge-based) would be used to place the pipeline protection system.

When floating these pipelines into position, the upstream ends of the pipelines would be floated into a flooded cofferdam or other temporary structure. Once secured in place, the cofferdam would be sealed off from the river, possibly using temporary large sandbags. The cofferdam would then be dewatered and the upstream ends of these pipelines connected to a common manifold with isolation valves. This would allow individual pipelines to be removed or brought into service if required.

The valves would be located below ground in concrete chambers with removable and trafficable covers. To minimise the impact on users of the parking area below the John Whitton Bridge, this chamber would be located in Memorial Park beyond the parking area kerb and gutter.

After connection of the marine pipes to the common manifold, the section of the pipelines that pass below the existing sandstone sea wall would be concrete encased. The sandstone sea wall would then be reconstructed and the land-side area back filled and reinstated. Finally, the temporary sandbag and cofferdam wall would be removed.

6.1.2 Surface water and geomorphologic impacts

Construction work will occur within waterfront land and within the water column of Parramatta River.

During open trenching, sediment and acid sulfate soils will be managed in accordance with the project CEMP. This will include temporary shoring works to ensure that the adjoining areas of park are stable during construction. Stockpiled materials from construction will be managed with sediment control fencing and dust from stockpiles will be suppressed by irrigation. Any acid sulfate soils to be stockpiled will be treated and stored to prevent leaching to surface water. Stockpiles will be located away from overland flow paths and areas subject to frequent inundation. Refer to the Groundwater Impact Assessment for open trench dewatering impacts and management.

The cofferdam will extend into the channel upstream of the John Whitton Bridge. The effect will cause a slight narrowing of the channel. The resulting channel width would be similar to the section of river immediately downstream of the channel.

The narrowing of the channel will result in locally elevated velocities during the rising and falling tides. The elevated velocities may result in localised increases in sediment transport, however, it is not expected that the velocities would cause long term channel banks or channel bed material erosion.

Construction of the cofferdam, replacement of the seawall and the placement of concrete mattresses will have the potential to stir up sediment in the channel bed and result in release of sediment which will be minimised by the presence of the cofferdam itself and floating booms with silt curtains.

Using cranes to place geotextile mattress across the riverbed will allow for slow, careful and precise placement of sections of concrete mattress while minimising disturbance to the underlying sediment. The geotextile mattress will form a protective layer that will cap the underlaying sediment while facilitating the construction of the pipelines on top of the mattresses, minimising the risk of disturbing the sediments during pipe and diffuser installation.

Placement of concrete aprons in sections will minimise the extent of works on the riverbed at any one time. Any displaced or disturbed sediments will be contained as much as possible using floating booms and sediment curtains. Coordination of this work will be completed in consultation with Transdev (Sydney Ferries) and the Harbour Master. Construction timing may need to consider tidal and flow conditions to avoid working during high flow events that would interfere with silt curtains functioning as intended.

Any residual sediment disturbance during placement of the geotextile mattress would represent a relatively localised and instantaneous increase in sediment bed load which may be transported either upstream or downstream a short distance. The impact of disturbed sediment would be greatest during fine weather and an absence of rain and stormwater flows from the upstream catchment. During these conditions, tidal factors would dominate the transport process.

Considering the Hjulström curve, which is commonly used by hydrologists and geologists to determine whether a river will either erode, transport, or deposit sediment based on particle size and water velocity. Over a 6 hour period between slack tide, and in the absence of any storm flow, the majority of sediment disturbed during construction could be expected to travel up to 430 m downstream or upstream based on sediment transport threshold. This extent is limited to the area immediately downstream between the John Whitton Bridge and Ryde Bridge. It should be noted that modelling undertaken as part of the Sydney Harbour Estuary Process Study shows this zone to be a secondary deposition area where contaminated sediments would collect over time. Therefore, any residual increase in sediment load caused by the placement of the concrete mattresses would be comparable to sediment loads generated during bed shear events caused by existing waterway processes such as high winds and tides.

During stormflow events, sediment disturbed during the placement of mattresses may be transported further downstream than 430 m, however there is expected to be significantly more sediment mobilised into the water column as a result of typical stormwater runoff discharges to the river within proximity to the construction site. This would increase the level of sediment disturbance and transport across the entire river which may worsen the background water quality. As such, temporary disturbance during placement of the mattresses during or shortly after storm events is likely to be insignificant.

Impacts to the Parramatta River and Harbour that are not already impacted by contaminated sediments and dioxins are therefore expected to be minor during placement of the river release structure.

During pipe installation, the geotextile mattress will prevent any disturbance of underlying sediment and will permanently cap those materials in place, allowing for installation of the pipelines and release structures with a minimal risk of adding to sediment bed load and background sediment transport processes.

6.1.3 Construction water supply and demand

Commissioning and testing activities would occur throughout construction, as sections of pipelines and components are installed. Drinking water from the nearby drinking water network would be used for certain aspects of wet commissioning

Surface water extraction and groundwater extraction is not required for water supply purposes.

6.1.4 Influence on the NSW Water Quality Objectives

The NSW Water Quality Objectives are described in the Hydrodynamics and Water Quality Impact Assessment, which relate to the following environmental values for the Duck River and Parramatta River:

- Aquatic ecosystems
- Visual amenity
- Secondary contact recreation
- Primary contact recreation
- Aquatic foods.

An assessment of the significance and risk of construction water quality impacts is provided in Section 6.5. With the proposed management measures implemented, the impacts to water quality during construction are expected to be negligible to minor, short term and localised resulting in a low risk to the receiving environments of Duck River and the Parramatta River.

Any minor, temporary, localised water quality impacts during construction are not expected affect the long-term protection of the NSW Water Quality Objectives where they are met or their achievement over time where they are not met.

Similarly, any temporary minor, localised impacts are not expected to affect the objective to make the Parramatta River swimmable.

6.2 WRRF

Construction activities at the WRRF site would follow on from early environmental management works including importing capping material to partially raise and shape the site to direct stormwater to a single sediment basin and existing stormwater drains onsite. These erosion and sediment controls will be developed and implemented during construction. These early establishment works at the WRRF will have left the site in a construction ready state, with existing drainage and erosion and sediment controls in place.

Subsequent construction activities at the WRRF would include the following, which will be part of the assessment:

- Targeted dewatering of surficial local aquifer systems to required depths (refer to impacts assessed in the Groundwater Impact Assessment report)
- Excavation for construction of below surface infrastructure

- Installation of subfloor drainage, foundations and underground infrastructure
- Installation of aboveground civil, mechanical and electrical plant and equipment
- Installation of stormwater drainage pits, pipelines, filtration cartridges
- General landscaping
- Commissioning and testing.

6.2.1 Surface water impacts

During construction, disturbed soil will be exposed and runoff generated from this area will be captured within sediment controls established during early environmental management works.

These erosion and sediment controls will be developed during construction planning and will remain for the construction of the WRRF works to accommodate the staging and area of disturbed soils. Other erosion control measures would be implemented to manage potential erosion impacts documented in a specific Soil and Water Management Plan (SWMP).

Impacts associated with residual sediment loads that exceed the site management controls are possible but will be short term in nature and these events will be associated with storms that cause background poor water quality in the Duck River.

Changes in runoff patterns from the site will be small in the context of the entire upstream catchment area. Temporary construction stormwater discharges will therefore have a negligible impact on channel stability.

6.2.2 Construction water supply and demand

Water would be used during construction for a range of purposes including excavation, dust suppression, drilling, hydrostatic testing, materials preparation and use, and amenities for the construction workforce.

Construction areas and access tracks would be watered to suppress dust, with the frequency of watering dependent on wind and rainfall conditions. During construction, water would likely be sourced offsite from suitable mains reticulation so multiple tankers would be required.

Based on evaporation and rainfall differentials, the annual volume of water required for dust suppression and stockpile wetting is up to 79.3 ML/year. Of this volume, up to 86% of the water demand (68 ML/yr) may be sourced from runoff captured in sediment management basins.

During construction, water supply will be satisfied by a combination of captured stormwater and mains water supply. Surface water extraction and groundwater extraction is not required for water supply purposes.

6.3 Pipelines

All pipelines would be constructed using a combination of open trench and trenchless construction methods (HDD or micro-tunnelling). No open trenching is proposed near the waterways for construction of the pipelines (except at the river release structure). Trenchless construction is proposed at the waterway crossings, including:

- construction of the river release pipeline:
  - crossing Duck River between the WRRF and Carnarvon Street in Silverwater
  - crossing the Narawang Wetlands
  - between Sydney Olympic Park and Meadowbank Park under Hill Road and crossing Parramatta River.

Where pipelines would cross the minor waterways of Charity Creek and unnamed creek in Meadowbank Park, aerial (i.e. above ground) pipeline crossings would be constructed in line with existing gas pipeline infrastructure. The above ground pipeline would be fully concrete encased, with any valves located in a secured cage to prevent unauthorised access. The design would be developed further during detailed design in consultation with the City of Ryde Council.

The section of the brine pipeline between Camellia pumping station and the NSOOS at Dundas would involve repurposing the existing rising main.

6.3.1 Surface water impacts

Construction work will occur within waterfront land at Charity Creek, Narawang Wetlands, Haslams Creek, andDuck River but will be undertaken below ground via trnachless construction methods. Works within waterfront land along the Parramatta River will be conducted in accordance with the controlled activity guidelines. Erosion control measures and acid sulfate soil management will be implemented to manage potential surface water quality impacts during construction which will be documented in a project CEMP.

In accordance with the NSW Government’s Guidelines for laying pipes and cables in watercourses on waterfront land, pipeline construction will not involve trenching or open excavations across waterways. With the proposed management measures, direct or indirect impacts on surface water processes are unlikely to occur during construction.

Fluid loss during any horizontal directional drilling (HDD) required for trenchless construction of the pipelines may result in uncontrolled release of drilling fluid escaping from the borehole through fissures or weakness in the substrate resulting in increased sedimentation and turbidity in watercourses. Discharge of contaminated hydrostatic test water leading to toxicity affects. Any significant volumes of these chemicals entering the local water environment may lead to local ecological degradation, albeit temporary.

A Drilling Fluid Management Protocol will be developed. This will include:

- containing and monitoring drilling fluids at launch and receival pits
- identifying, managing and cleaning up frac-outs to prevent environmental harm.
- re-using and/or disposing of drilling fluids appropriately.

6.3.2 Construction water supply and demand

Water is required for wetting stockpiles and dust suppression and would be supplied from water carts given the distributed nature of works. Construction and backfilling will occur over relatively short lengths to minimise disruptions along the pipeline route.

During pipeline testing, water supply will be satisfied by mains water supply. Surface water extraction and groundwater extraction is not required for water supply purposes.

6.4 Camellia pumping station

Upgrades to the existing pumping station at Camellia include installation of new pumps and connections to the transfer pipeline to deliver wastewater to the new WRRF. Construction activities at the WRRF site include:

- Targeted dewatering of surficial local aquifer systems to required depths (refer to impacts assessed in the Groundwater Impact Assessment report)
- Excavation for construction of pump well and stockpiling
- Installation of foundations and underground infrastructure
- Installation of aboveground civil, mechanical and electrical plant and equipment
- General landscaping
- Commissioning and testing.

These works will occur outside of waterfront lands and will not increase impervious area at the site. Construction works will be located underground and will discharge to existing drainage systems rather than natural waterways. These works will not have the potential to impact on surface water hydrology.

6.5 Construction impact summary

Surface water impacts associated with the proposed project are identified and an assessment undertaken in accordance with the relevant general and project specific SEARs.

Table 6-1 responds to the SEARs while providing an overview of construction potential and residual (with management) impacts for the WRRF site, pipelines and release to the Parramatta River.

The potential impacts have been assessed with consideration to the relevant components of reference design. The potential impact significance and risk has been undertaken in accordance with the method outlined in Section 4.3.

Table 6-1 Construction impact assessment summary

Project location/Activity	Potential Impact	Potential Impact Significance and Risk (unmitigated)	Mitigation / Management measures	Residual Impact Significance and Risk
WRRF, Pipelines ***Earthworks, cutting and stockpiling & trenching***	Discharge or release of sediment-laden stormwater from cleared areas and stockpiled sites to receiving waterways resulting in sedimentation within adjoining watercourses and habitat degradation.	Magnitude: Moderate Sensitivity of environmental values: Moderate Significance of impact: Moderate (temporary) Likelihood: Likely Risk: High	Refer to MM1 in Table 8-1.	Magnitude: Low Sensitivity of environmental values: Moderate Significance of impact: Minor (temporary) Likelihood: Possible Risk: Low
WRRF, pipelines and river release structure: ***Disturbance and/or demolition of existing infrastructure***	Waste materials such as concrete, plasterboard, timber, asbestos and contaminated soil spreading via surface run-off to near site drainage pathways. The contamination assessment indicates the presence of waste materials currently on the WRRF site. If these materials were to find their way to the local watercourses, this could negatively affect the water quality in the area and downstream.	Magnitude: Moderate Sensitivity of environmental values: Moderate Significance of impact: Moderate (temporary) Likelihood: Possible Risk: Medium	Refer to MM2 in in Table 8-1.	Magnitude: Low Sensitivity of environmental values: Moderate Significance of impact: Minor (temporary) Likelihood: Unlikely Risk: Low
River release structure: Placement of concrete mattresses, pipes and nozzles on riverbed of Parramatta River	Disruption of the river-bed sediments and mobilisation of contaminated sediments (dioxin, furan and metal contaminants) into the water column of the river which impacts water quality within the Parramatta River.	Magnitude: High Sensitivity of environmental values: Moderate Significance of impact: Major (temporary) Likelihood: Possible Risk: High	Refer to MM3 in Table 8-1.	Magnitude: Low Sensitivity of environmental values: Moderate Significance of impact: Minor (temporary) Likelihood: Unlikely Risk: Low
WRRF, pipelines and river release structure: Excavation, dewatering and installation of underground infrastructures	Runoff or unintended dewatering or release of contaminated water from excavations or stockpiles which include contaminated or acid sulfate soils. This could lead to water quality impacts within receiving environments.	Magnitude: Moderate Sensitivity of environmental values: Moderate Significance of impact: Moderate (temporary) Likelihood: Possible Risk: Medium	Refer to MM4 in Table 8-1.	Magnitude: Low Sensitivity of environmental values: Moderate Significance of impact: Minor (temporary) Likelihood: Possible Risk: Low
WRRF and pipelines: Storage, transport, use and handling of chemicals used during	Leaks/spills of liquids / chemicals containing heavy metals, oils or petroleum hydrocarbons during the use and operation of machinery which may: ▪ introduce contaminants to surface water runoff and impact the quality of surrounding surface waters through stormwater discharge and plant wash down routines	Magnitude: Moderate Sensitivity of environmental values: Moderate Significance of impact: Moderate (temporary) Likelihood: Possible Risk: Medium	Refer to MM5 in Table 8-1.	Magnitude: Low Sensitivity of environmental values: Moderate Significance of impact: Minor (temporary) Likelihood: Unlikely

Project location/Activity	Potential Impact	Potential Impact Significance and Risk (unmitigated)	Mitigation / Management measures	Residual Impact Significance and Risk
construction and in the treatment process will likely be handled and stored on site in significant volumes	▪ lead to acute toxicity effects on ecosystems receiving surface water run-off.			Risk: Low
WRRF, pipelines and river release structure: Water demand and sourcing	Extraction of surface waters impacting on flows in local water ways	No extraction of surface waters is required.	None required	No residual impact
Pipelines: HDD and micro tunnelling	Fluid loss during any HDD required for installation of the pipelines which may result in uncontrolled release of drilling fluid escaping from the borehole through fissures or weakness in the substrate resulting in increased sedimentation and turbidity in watercourses Discharge of contaminated hydrostatic test water leading to toxicity affects Any significant volumes of these chemicals entering the local water environment may lead to local ecological degradation, albeit temporary	Magnitude: Moderate Sensitivity of environmental values: Moderate Significance of impact: Moderate (temporary) Likelihood: Possible Risk: Medium	Refer to MM7 in Table 8-1.	Magnitude: Low Sensitivity of environmental values: Moderate Significance of impact: Minor (temporary) Likelihood: Unlikely Risk: Low

7 Operational impact assessment

The operational impact assessment is structured in terms of the potential impacts to surface water (hydrology and geomorphology) associated with the following:

- Ongoing operation of pipelines and nozzles that will increase discharges to surface water
- Ongoing stormwater discharge from the WRRF site to the Sydney Harbour via Duck River and Parramatta River and contribution towards water quality objectives in the Parramatta River
- The major water infrastructure across river and creek channels in the floodplain.

7.1 River release structure

The river release structure will discharge treated water to the Parramatta River and will operate 24 hours a day and 7 days a week.

The WRRF is expected to operate at a constant rate and produce a constant stream of advanced treated water. The types of releases, their flow and release volume are summarised in Table 7-1.

Table 7-1 Summary of types of releases

Release type	Flow (ML/d)	Flow (m^3/s)	Release volume (ML/yr)	Scenario
Reverse osmosis (RO)	63	0.73	~ 22,743 (99% of annual volume)	Continuous river release, 24 hours per day, except when RO plant is offline.
Membrane bioreactor (MBR)	70	0.81	~280 (1% of annual volume)	Constant discharge occurring during RO-offline events. Notionally has been represented as two 48-hour offline events per year, conservatively assumed to occur during consecutive dry months.

Sydney Water undertook testing and optimisation of the river release structure including the number of release pipelines and their arrangement. Near field and far field modelling is described further in Sections 7.1.2 and 7.1.3 respectively.

Through the numerical modelling and testing process, the reference design was adjusted to include the following arrangements:

- The release structure is proposed on a narrow section of the Parramatta River where the natural constriction in the channel creates a deeper zone that also experiences elevated velocities. This location is less sensitive to increased discharge from the river releases.
- Angle of release structure nozzles (30 degrees to horizontal) reduces scour velocity induced at the riverbed surface. Resultant velocities closely match ambient conditions for the range of expected flow and tidal conditions
- Underlaying nozzles and pipelines with geotextile mattress will cap contaminated sediment and resist the potential for sediment to be remobilised immediately surrounding the release structure

- Limited discharge rates and velocities in each nozzle ensures that changes in velocity and scour potential at the riverbed is limited and confined to the extent of the concrete matrasses
- Flexible concrete mattresses will ensure that any unintended sediment migration will not result in failure of the structure.

A cross section and profile section of the reference design is shown in Figure 7-1, including the proposed release structure, concrete mattress and geotextile mattress.

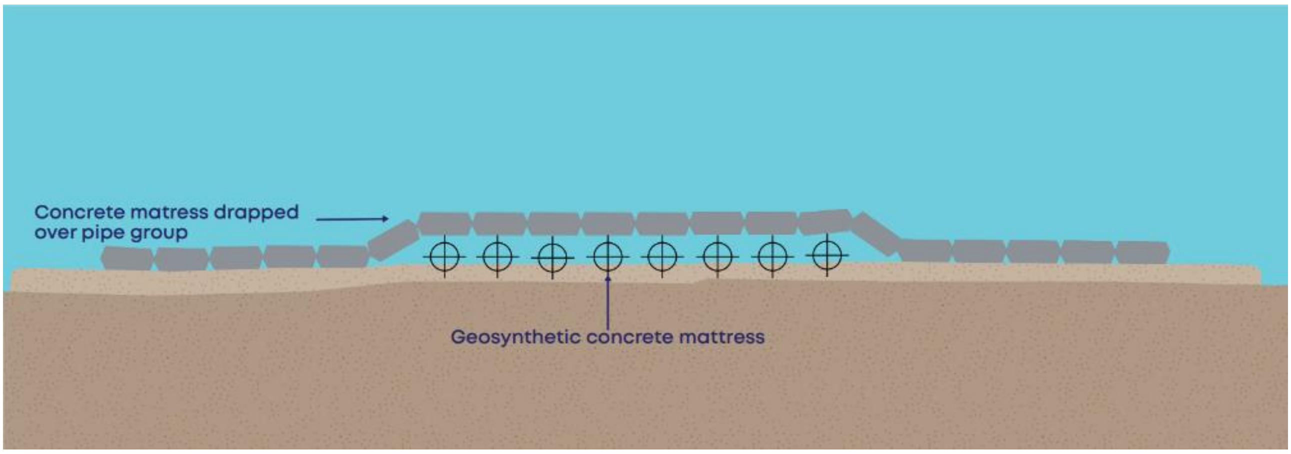

Figure 7-1 River release cross section and profile

7.1.1 Treated water quality

The reader is referred to the Hydrodynamics and Water Quality Impact Assessment ((Sydney Water, 2025)) report for a comprehensive account of the expected water quality concentrations released to the Parramatta River.

Median concentrations of sediment and salinity released under different treatment levels are presented in

Table 7-2. These analytes are the dominant species in surface water and sediment transport concerns. These discharges have a very low concentration of total suspended solids (TSS) and will not add to the sediment load in the Parramatta River or the density of water in the river, that could in turn affect the sediment transport potential of river flows. An analysis of other water quality analytes has been assessed using a WQRM and is presented in Hydrodynamics and Water Quality Impact Assessment (Sydney Water, 2025).

Table 7-2 Median concentrations of water quality

Parameter	Units	Advanced treated water (RO)	Tertiary treated water (MBR)
TSS	mg/L	4	1
Salinity	g/L	0.08	0.75

7.1.2 Farfield hydrodynamic modelling

The Hydrodynamics and Water Quality Impact Assessment (Sydney Water, 2025) for the river release provides a scientifically robust assessment of the hydrodynamic and water quality impacts from the operation of the WRRF on the Parramatta River and Sydney Harbor estuary.

Background ambient conditions

The ambient surface water flows for the Parramatta River were simulated in the WQRM using bathymetric survey data in the vicinity of the proposed release points collected specifically for this study in 2024 using Multibeam Echo Sounders.

Water levels, flows and velocities were extracted from WQRM model results in the vicinity of the proposed river to define the waterway conditions and sediment transport potential associated with peak, median and slack water tidal conditions. The modelled period selected for this analysis is June 2016 to June 2017 which represents an average wet year with approximately 1100 mm of annual rainfall.

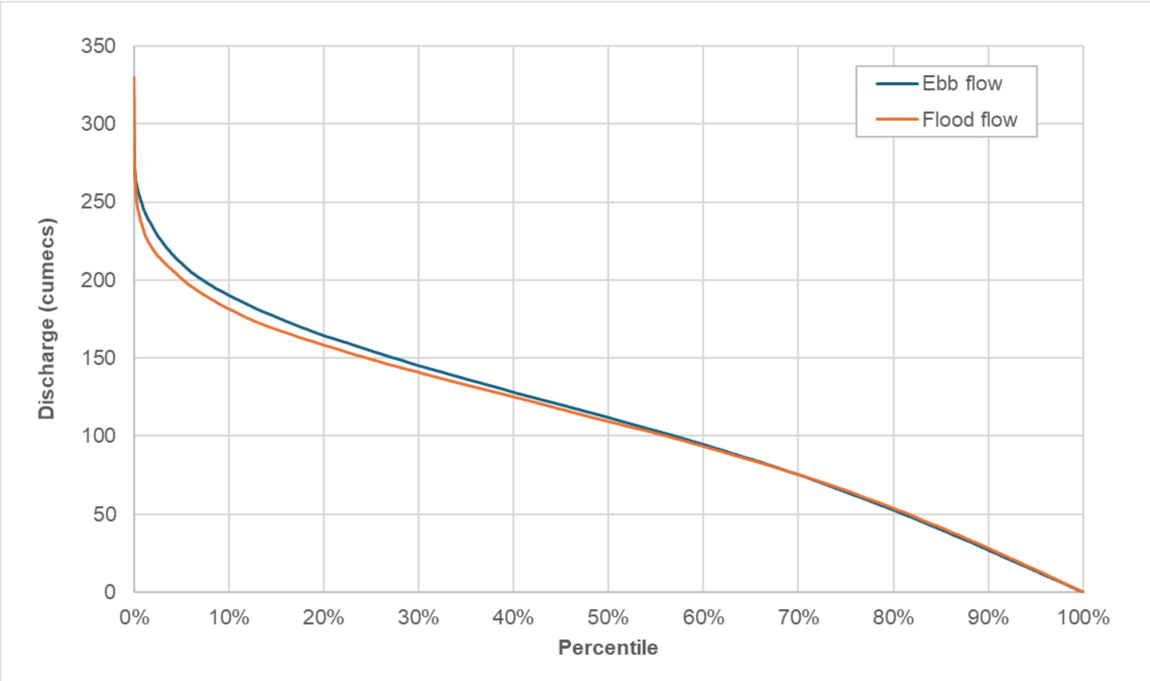

Figure 7-2 Predicted flow duration curves of the lower water column taken from the WQ response model under ambient, background conditions during the modelled dry year (*File ref: HD_JWB_data_extract.xlsx*)

Modelled bottom-channel velocities in ebb and flood tides have been extracted and ranked in Figure 7-3 below. The model predicts more frequent higher flows and velocities occurring in the ebb tide direction due to the contribution of stream river discharges flowing towards the sea. Correspondingly, sediment transport rates are predominately downstream into the lower parts of the estuary.

The sediment transport potential at the river release site has been assessed by considering the Hjulström curve. This curve is a graph used by hydrologists and geologists to determine whether a river will either erode, transport, or deposit sediment based on particle size and water velocity.

The modelled velocities are shown to exceed the Hjulström curve (Hjulström, 1935) sediment transport threshold (0.2 m/s) less than 2% of the time during the modelled period. It should be noted that this model is not expressly established to predict sediment transport, but the results are presented to provide an overall indication of the order of magnitude velocities that may occur in the reach of the Parramatta River.

The modelled velocities indicate that erosive flows are expected to form at the riverbed very infrequently. Erosive forces are predominantly in a downstream direction that would cause the transport of sediment towards the lower sections of the Parramatta River approximately 2% of the time.

The modelled velocities that would cause sediments to be eroded to upstream reaches will occur less than 1% of the time.

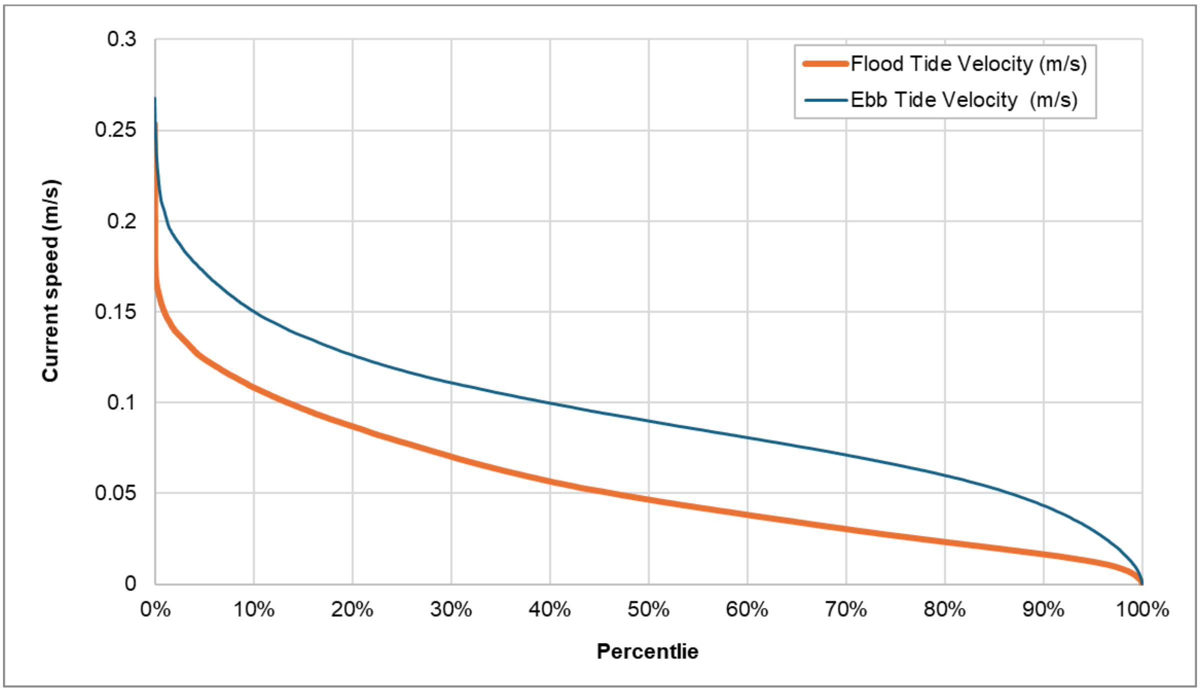

Figure 7-3 Bottom-channel predicted velocity duration curves taken from the WQRM results for ambient, background conditions (*File ref: HD_JWB_data_extract.xlsx*)

Mid-channel velocities are less critical for the resuspension of material but affect the transport of material that has become mobile. Mid channel velocities from the WQRM were adopted as boundary conditions for the detailed Computation Fluid Dynamic model. Mid-channel velocities for flood and ebb tide are presented in Figure 7-4.

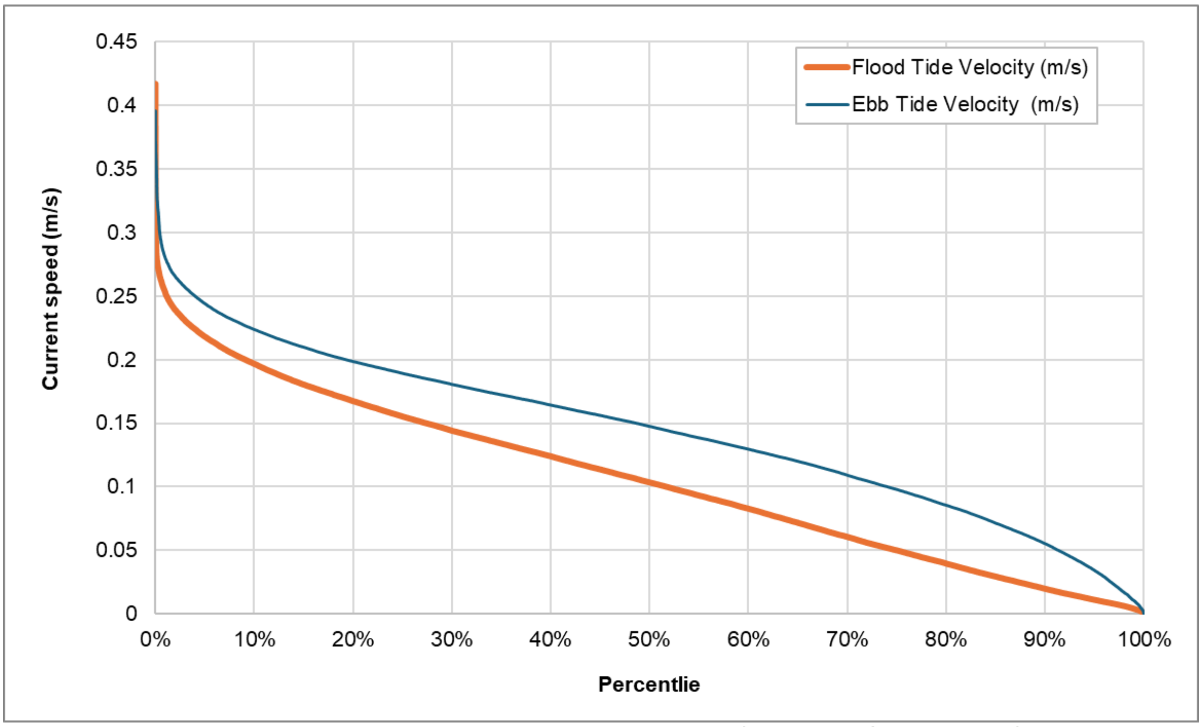

Figure 7-4 Mid-channel predicted velocity duration curves taken from the WQRM results for ambient, background conditions (*File ref: HD_JWB_data_extract.xlsx*)

A summary of the range of velocities are provided below Table 7-3.

Table 7-3 Summary of the range of velocities

Percentile	Mid-channel velocity (m/s)	Bed-velocity (m/s)	Comment
95%	0.23	0.152	Elevated velocities associated with mid tide
50%	0.126	0.070	Median velocities
5%	0.024	0.015	Typical low flow conditions during slack tide

Hydrologic analysis and interpretation

Timeseries plots showing the background and impact scenarios were prepared at selected analysis sites in the receiving waterways and hydrologic characteristics summarised at transects 100 m and 200 m upstream and downstream of the diffuser nozzles.

The assessment of impacts involved a comparison of hydrologic characteristics from the WQRM for a selection of the model results from 2017 for following scenarios:

- a background scenario representing the catchment conditions in 2056 without the operation of the WRRF
- an impact scenario representing the catchment conditions in 2056 with the inclusion of releases from the WRRF.

A time series plot of Parramatta River flows has been extracted from June to October 2017 to illustrate the relative change in river flows with the diffuser nozzles operating (63 ML/d, 0.73 m^3/s). See Figure 7-5 and Figure 7-6.

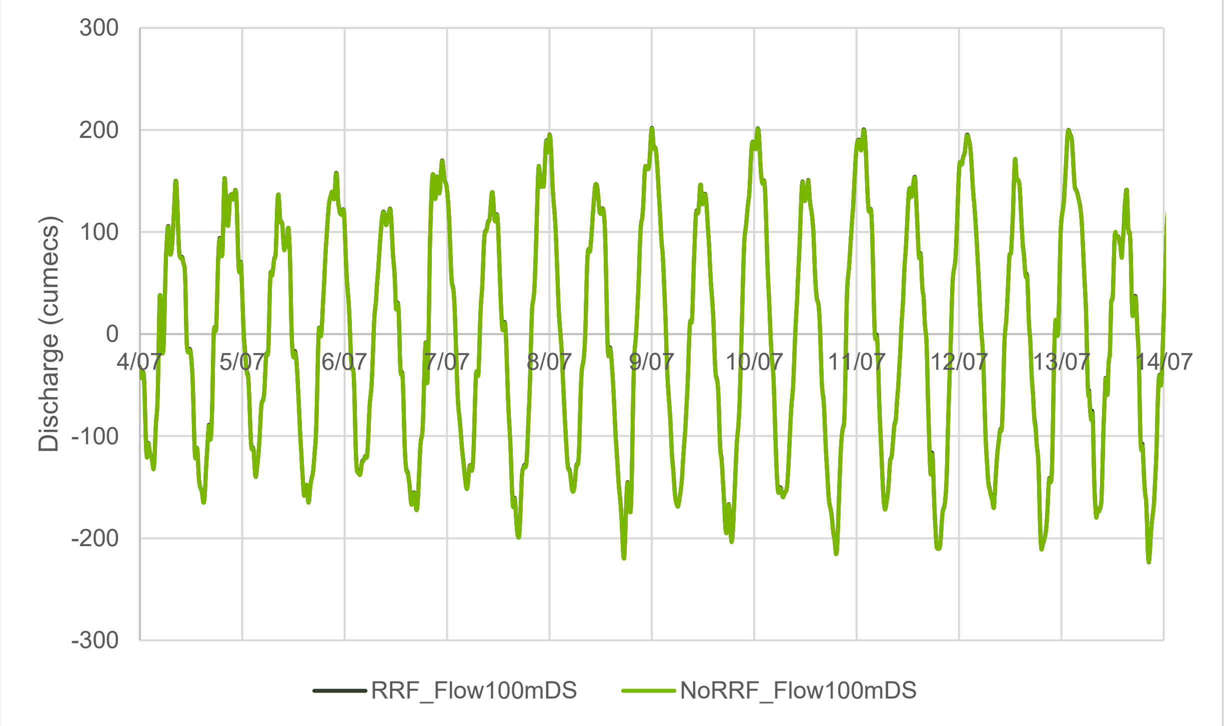

Figure 7-5 Predicted River flow rates from June to October 2017 with and without proposed release. Flows taken 100m downstream of release.

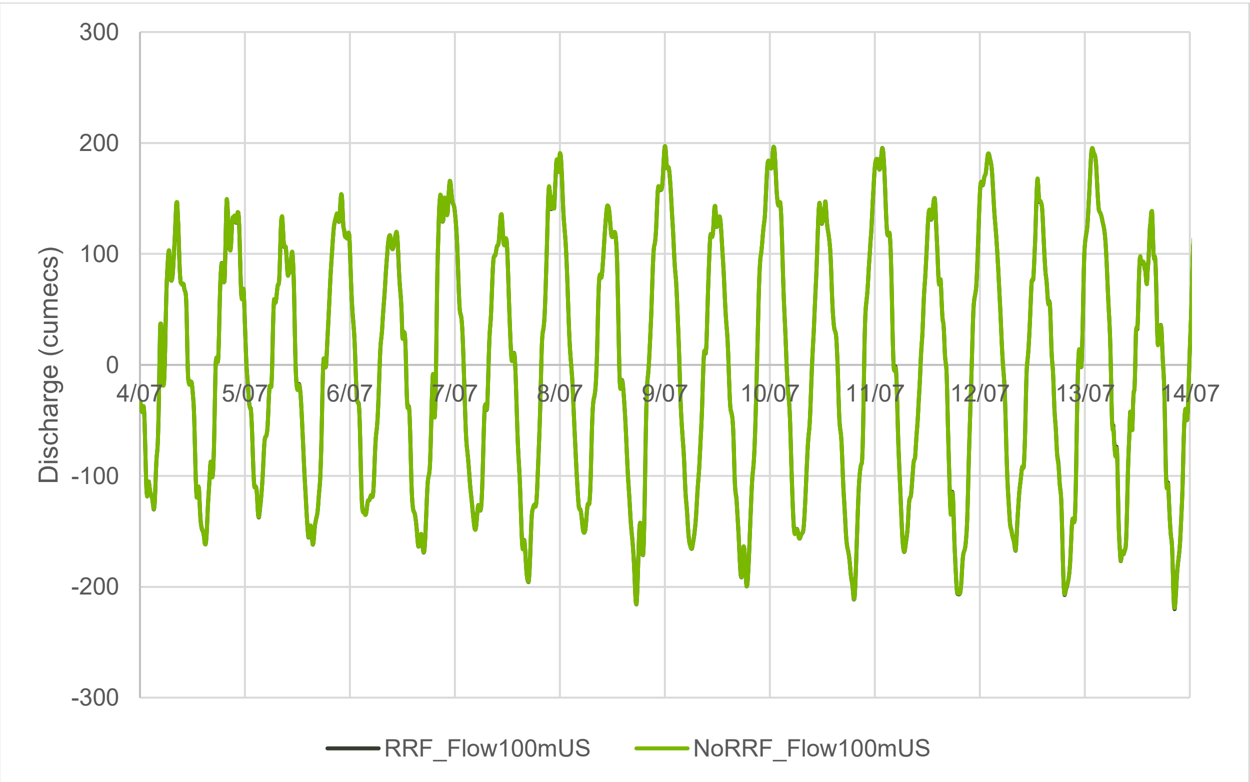

Figure 7-6 Predicted River flow rates from June to October 2017 with and without proposed release. Flows taken 100m upstream of release

The relative change in river flows caused by releasing an additional 0.73 m^3/s into the river is difficult to detect in these figures due to the scale of ambient river flows compared to the relatively small release rate. For ease of comparison, flow percentiles have been extracted and summarised in Table 7-4. Negative flow values refer to flood tide conditions when flows are predominantly moving upstream, east to west. Low flow conditions reflect slack tide and positive flows reflect ebb tide towards the sea. Please note that these are ambient flow conditions and do not reflect flood conditions in the Parramatta River when background river flows would be significantly higher.

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Table 7-4. Predicted River flow rates (m^3/s) from June to October 2017 for background conditions and with releases

Flow (m^3/s)	100m Downstream		100m Upstream		200m Downstream		200m Upstream	
Percentile	Background	With Release	Background	With Release	Background	With Release	Background	With Release
1%	-247.9	-247.4	-242.5	-242.9	-250.5	-250.1	-238.2	-238.5
10%	-167.8	-167.1	-164.2	-164.4	-169.5	-168.9	-161.0	-161.2
20%	-129.0	-128.1	-126.3	-126.1	-130.4	-129.5	-123.9	-123.7
30%	-92.1	-90.8	-90.1	-89.5	-93.1	-91.9	-88.5	-87.9
40%	-46.1	-44.9	-45.2	-44.6	-46.6	-45.4	-44.3	-43.6
50%	7.1	7.7	6.9	6.8	7.0	7.8	6.9	6.9
60%	58.6	58.9	57.3	56.9	59.2	59.5	56.3	55.8
70%	96.4	96.9	94.3	94.1	97.4	97.9	92.5	92.4
80%	124.8	125.3	122.1	121.8	126.2	126.5	119.8	119.6
90%	157.6	158.1	154.2	154.0	159.3	159.8	151.2	151.0
99%	216.3	216.9	211.6	211.5	218.7	219.2	207.5	207.4

The table shows that the relative change in ambient flow conditions is relatively small for the full range of flow percentiles. The most pronounced change in flow is predicted during slack tide (50%ile) flow conditions when an additional 1 m^3/s of flow downstream of the release site. This additional flow represents in the order of 10% change in total river flow. Relative to the magnitude of flows that are generated across the tidal cycle and in frequent rain events, this is a small and near negligible change in surface water flow conditions.

This change in flow will be distributed across the 75 m wide nozzle field at the release zone and this mixing zone will continue to expand downstream. Higher velocities are expected within the 50 m of the diffuser which is intended to aid mixing and dilution of the treated water with Parramatta River.

Outside of the mixing zone (discussed further in the section below), the relative change in velocity in the river is predicted to be small. The WQRM predicts that the dominant mid-channel velocities upstream of the river release will reduce by up to 5%, while velocities downstream are predicted to increase by a similar percentage.

Based on WQRM modelling results, this represents a change in upstream velocities from approximately 0.125 m/s to 0.12 m/s which is not sufficiently large to cause additional reductions in sediment transport or increases in deposition according to Hjulström curves (Hjulström, 1935). Similarly, the predicted increase in downstream mid-channel median velocity from 0.125 m/s to 0.13 m/s is insufficient to promote additional sediment transport in the downstream section.

Hjulström curves (Hjulström, 1935) show this change in velocity would not alter the erosion or deposition. This relative change will not change the depositional or transport potential of the Parramatta River under its ambient and regular tidal cycle. Given that there is little change shown for a range of different flow conditions, it is unlikely that there will be an incremental increase in erosion velocities in larger flow events in the Parramatta River.

In the context of the dynamic river system, this change in local river flow dynamics predicted to have an undetectable change in the sediment transport and deposition regime of the Parramatta River.

On this basis, it is highly unlikely that the river release of 63 ML/d or 70 ML/d will contribute to any detectable change in the sediment transport regime of the Parramatta River outside of the near field mixing zone immediately up and downstream of the nozzles.

7.1.3 CFD hydrodynamic modelling

Detailed hydraulic modelling of the nearfield mixing zone was undertaken using computational fluid dynamics (CFD) analysis to determine the sediment transport potential immediately in the vicinity of the river release site. This modelling can detect localised velocities and eddies formed at fine scales and provides a higher level of detail of the complex hydraulics than far field modelling described in Section 7.1.2. The models represent the nearfield mixing zone extending 135 m upstream and 185 m downstream of the diffuser nozzles. The nearfield model incorporates a computational mesh of the diffuser nozzles, pipelines infrastructure, concrete mattress, surrounding bathymetry and bridge piers beneath the John Whitton Bridge at Meadowbank.

The model was used to design and test the number of nozzles, their configuration and the extent of concrete mattress to be placed beneath the release structures. The proposed diffuser nozzle arrangement and concrete mattress will extend to the third pier. The angle of the nozzles and the inclusion of a concrete mattress are proposed to reduce the near bed shear velocities and minimise the chance of contaminated sediments being mobilised as a result of the river release operating.

It should be noted that the CFD modelling does not quantify the ongoing movement of sediments in the Parramatta River and the Sydney Harbour, but indicates the risk that the proposed river release would contribute to or increased the sediment transport potential of the background ambient flow conditions in the Parramatta River.

Modelling includes twelve scenarios that represent a combination of the ambient tidal conditions and river flow conditions with the diffuser nozzles operational and turned off. No model scenarios are provided for the existing channel bed without the release infrastructure. The model results show the velocity and shear stresses on the channel bed from the first layer of model cells at the sediment boundary.

The model results were mapped and processed to allow a comparison of the resulting velocities and shear stresses to demonstrate the location, the change in shear stress and the potential for sediment transport under operational conditions.

Hydraulic analysis and interpretation

The following criteria were selected to represent the sediment transport potential of the riverbed sediments identified in the bed material analysis presented in Section 5.4.4. These criteria indicate the potential for altered sediment transport as a result of the river releases and these criteria are applied to each scenario in Table 7-5 below:

- **Change in shear stress** – sediment transport would be accelerated where sediments are exposed to a bed shear stress exceeding 0.05 N/m^2
- **Change in the onset of erosion and formation of bed load** – bottom water speeds are just below the erosion velocity threshold and there is an increased risk of bed sediments becoming resuspended where modelled velocities are in the range of 0.1 to 0.2 m/s.
- **Erosion of bed material and formation of bed load** – bed sediments would become resuspended where bed speeds exceed the erosion velocity threshold of 0.2 m/s.

Table 7-5 Near field CFD model results and outcomes on sediment transport potential

Model ID	Tidal flow direction	Boundary velocity condition	Surrounding bed velocity (m/s)	Tide Height (mAHD)	Hydraulic Shear Stress Impacts	Risk of increased sediment transport
B1	Mid Ebb	High (95%ile)	0.152	0.5	B1 - Change in shear stress limited to extent of mattress	Mitigated
B2	Mid Ebb	High (95%ile)	0.152	0.5	B2 - No differential in bed velocity range between 0.1-0.2 m/s	No increase
B3	Mid Ebb	High (95%ile)	0.152	0. 5	B3 - No differential in bed velocity range between 0.2-0.6 m/s	No increase
B4	Mid Flood	High (95%ile)	0.152	0.25	B4 - Increase in shear stress limited to extent of mattress	Mitigated

Model ID	Tidal flow direction	Boundary velocity condition	Surrounding bed velocity (m/s)	Tide Height (mAHD)	Hydraulic Shear Stress Impacts	Risk of increased sediment transport
B5	Mid Flood	High (95%ile)	0.152	0.25	Increase in bed velocity range between 0.1-0.2 m/s limited to extent of mattress	Mitigated
B6	Mid Flood	High (95%ile)	0.152	0.25	No differential in bed velocity range between 0.2-0.6 m/s	No increase
B7	Mid Ebb	Medium (50%ile)	0.07	-0.22	No change in shear stress	No increase
B8	Mid Ebb	Medium (50%ile)	0.07	-0.22	No differential in bed velocity range between 0.1-0.2 m/	No increase
B9	Mid Ebb	Medium (50%ile)	0.07	-0.22	No differential in bed velocity range between 0.2-0.6 m/s	No increase
B10	Low Flood	Medium (50%ile)	0.07	-0.70	Change in shear stress limited to extent of mattress	Mitigated
B11	Low Flood	Medium (50%ile)	0.07	-0.70	Increase in bed velocity range between 0.1-0.2 m/s limited to extent of mattress	Mitigated
B12	Low Flood	Medium (50%ile)	0.07	-0.70	No differential in bed velocity range between 0.2-0.6 m/s	No increase
B13	High Ebb	Low (5%ile)	0.015	1.20	No change in shear stress	No increase
B14	High Ebb	Low (5%ile)	0.015	1.20	No differential in bed velocity range between 0.1-0.2 m/s	No increase
B15	High Ebb	Low (5%ile)	0.015	1.20	No differential in bed velocity range between 0.2-0.6 m/s	No increase
B16	Low Flood	Low (5%ile)	0.015	-0.80	Change in shear stress limited to extent of mattress	Mitigated
B17	Low Flood	Low (5%ile)	0.015	-0.80	Increase in bed velocity range between 0.1-0.2 m/s limited to extent of mattress	Mitigated
B18	Low Flood	Low (5%ile)	0.015	-0.80	No differential in bed velocity range between 0.2-0.6 m/s	No increase

The modelled scenarios show that the proposed diffuser river release structure arrangement and concrete mattress, reduces the near bed shear velocities that would be experienced on the riverbed sediments and therefore minimises the chance of sediment transportation.

The results of the modelling show that modelled river release structure design has the greatest impact on velocities at the channel bed during flood tides and during periods of slower bed velocities, less than the 50%ile channel speed.

Model results also indicate that the modelled release and diffuser design does not have an impact on bed velocity and shear stress for higher channel flows. It follows that there would be a similar outcome for all flows exceeding this including higher flows associated with frequent storm flows and flood events.

Velocities induced by the river release structure at the riverbed do not increase the risk or potential sediment transport rates beyond the proposed concrete mattress.

Shear stress of the riverbed downstream of the river release structure and outside of the concrete mattress extent remains below the critical shear stress considered in this analysis (i.e. < 0.05 N/m^2)

The risk of contaminated sediment remobilisation is therefore low due to mitigation afforded by placement of geotextile mattress beneath the pipelines and river release structure.

7.1.4 Changes in sediment transport potential

The river release structure, pipes and mattress will form a physical barrier to the movement of sediment under ambient conditions.

Hjulström curves predict that mobilisation of bed load is likely to occur when velocities at the bed level exceed 0.2 m/s. which is the notional sediment transport threshold for bed materials identified during sediment sampling for this project (see Section 5.4.4).

Sediment may be transported both upstream and downstream under ebb and flood tides but deposition is only likely to occur either side of slack water.

Sediment may temporarily collect or build up behind concrete mattresses and river release structure locally raising the bed of Parramatta River by an equivalent amount. Sediment is then likely to be moved away again during the reversal of the ambient flow conditions when velocities exceed 0.2 m/s again. Given the dominance of downstream transport motion, there is likely to be more sediment accumulation on the western side where sediment loads in stormwater may collect.

Overall, the proposed concrete mattress will cause localised changes to the bathymetry of the channel bed but will not form a permanent barrier causing significant sediment accumulation.

7.2 WRRF

The proposed WRRF site on the northern shore of the Duck River was formerly an industrial liquid storage site and ‘tank farm’ that comprised extensive pavements, roads, bunding, buildings and above ground tanks.

The proposed WRRF will establish new roads, buildings and landscaped areas. The land use will be similar in that it is an industrial development incorporating chemical handling and processing. Site design includes measures to mitigate the risk of surface water impacts from chemicals and generic stormwater pollutants.

Chemical storage and handling undertaken within designated zones that incorporate spill containment within designated ‘first flush’ and foul water interception zones.

7.2.1 Potable water demands

Water use by staff and during operations are expected to be limited to potable use and general site washdown requirements.

The estimated full time equivalent of staff on site will be 10 equivalent persons. The general daily potable water demand is thus expected to be in the range of 20 L/d (or 200 L/d). The wastewater generated by staff on site is expected to be around 160 L/d (based on a return efficiency of 80%) and could be directed straight to the headworks. Supply for washdown water will be prioritised from the local rainwater harvesting tanks.

7.2.2 Stormwater management

Surface water management at the WRRF includes foul water and first flush capture to manage onsite stormwater pollutants. A first flush system has been provided to capture the first 10 mm of runoff generated by any rainfall event from the roads and hardstand areas around the WRRF site. This first 10 mm of runoff would typically convey the majority of the gross solids, oil and grease from these areas as well as any chemicals spilt, dropped or washed off during rain.

The purpose of the first flush system is to capture this impacted runoff and pump it to the head of the WRRF. The water will then undergo the same high quality treatment process as the wastewater entering the site.

Stormwater runoff from rainfall exceeding 10 mm will overflow to the downstream water sensitive urban design measures and then discharge filtered stormwater to the Duck River.

The State Environmental Planning Policy (Biodiversity and Conservation) sets out the requirements for water quality management within the Sydney Harbour catchment. This SEPP is planning legislation even though it is called a policy. Part 6.2 of the act requires that water quality is considered in new development proposal and whether the water quality management approach will have a neutral or beneficial effect on the quality of water of Sydney Harbour. This requires that the stormwater discharged to the Duck River contributes to improved water quality or poses no worsening of existing or pre-development pollutant loads running off the site. To comply with this requirement, it is proposed that the site design applies water sensitive urban design principles to filter stormwater and reduce the generic pollutants leaving the WRRF including nutrients, metals, sediments and associated oils.

The first flush and foul water management contributes to the stormwater management on site. The residual areas discharging to the Duck River will require additional filtration to demonstrate a net reduction in pollutants in stormwater reaching the Duck River. A notional treatment train has been sized using MUSIC modelling software adopting the land uses and imperviousness areas in the WRRF reference design. These land use types and areas are summarised in Table 7-6.

Table 7-6 WRRF land use data

Catchment	Roof Area (m^2)	Impervious Area (m^2)	Open Air Tanks (m^2)	Pervious Area (m^2)	Total Area (m^2)
Bypass first flush tank	6,252	7,506	16,525	0	30,283
First flush tank	1,160	19,361	12,527	0	33,048
Foul water pump station	0	12,013	0	0	12,013

Catchment	Roof Area (m^2)	Impervious Area (m^2)	Open Air Tanks (m^2)	Pervious Area (m^2)	Total Area (m^2)
Western catchment	1214	4410	2071	54678	62,373
Total Area					137,717

The average annual loads discharged to the waterways from the reference design presented in Table 7-7 for flow, TSS, TP, TN and gross pollutants. The results indicate that all the target reduction values specified in the Parramatta Council DCP (PCC, 2020) can be achieved. In this assessment, the stormwater basins. The modelling adopts a treatment train shown in Figure 7-7 which incorporates the following assets located within the road reserve, upstream of the discharge to local stormwater and Duck River:

- Gross pollutant trap with 0.084 m^3/s capacity
- Underground chamber with a total volume of 12.32 m^3
- 36 media filtration cartridges with capacity to filter 0.032 m^3/s.

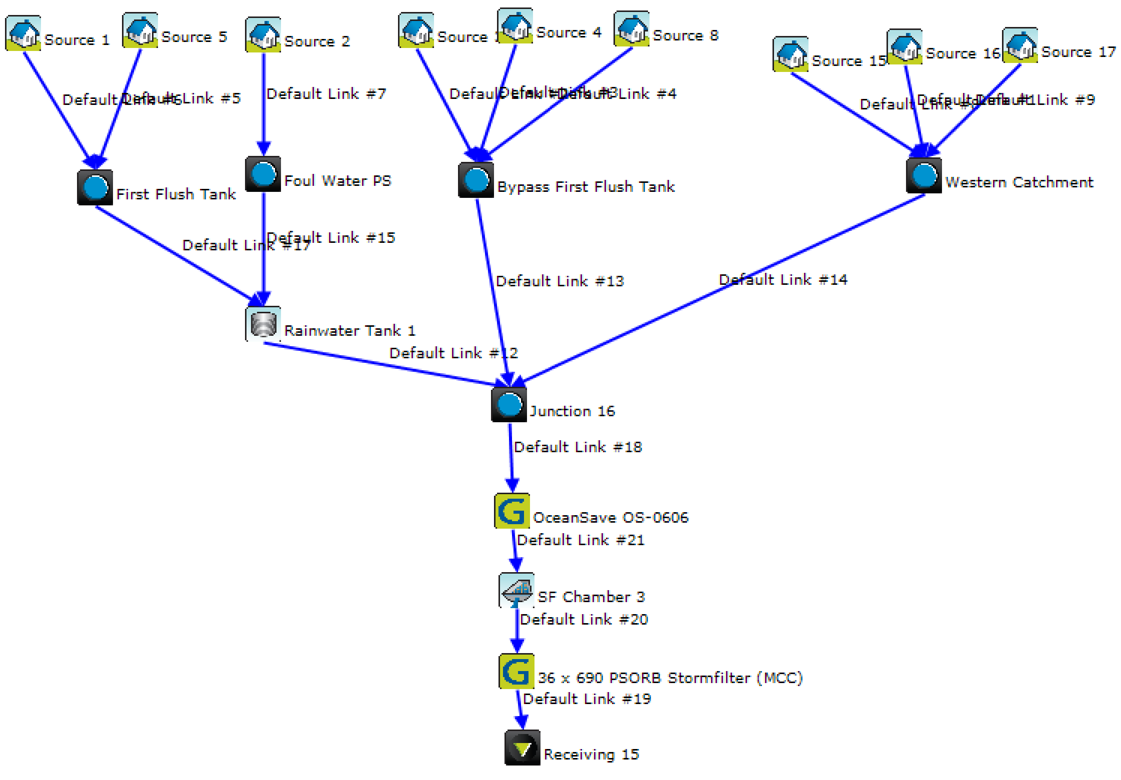

Figure 7-7 Treatment train in MUSIC software

These elements were simulated using industry standard software (*MUSIC X*) which is the widely adopted approach for quantifying generic pollutants from urban development and the performance of mitigation measures. Resulting pollution reductions were compared against the site in its pre-development state, with the WRRF established and with the water sensitive urban design mitigations in place. The summary of load reductions is presented in Table 7-7.

Table 7-7 Stormwater pollution loads and reduction summary (MUSIC X)

WRRF development	Historical tank storage use	WRRF without WSUD / mitigation	WRRF with WSUD / mitigation	Load reduction
TSS (kg/yr)	11,116.2	11,116.2	3,749.3	66%
TP (kg/yr)	20.6	20.6	7.7	63%
TN (kg/yr)	162.9	162.9	83.4	49%
Gross Pollutants (kg/yr)	1,286.0	1,286.0	0.0	100%

The modelling shows that the proposed stormwater treatment train will result in a reduction in pre-development stormwater pollution loads and will therefore contribute the Water Quality Objectives in the Parramatta River and an overall benefit in stormwater quality and resulting water quality in the Parramatta River and Sydney Harbour during rain events.

7.3 Pipelines

The pipeline infrastructure will primarily be below ground and thus potential impacts to the surface water resources associated with the pipelines are expected to be minimal and primarily associated with the construction phase. The potential operational phase impacts will be associated with maintenance activities and system malfunctions, such as leaks or bursts.

7.4 Water balance

A water balance has been developed to quantify the amount of water take and sources of water associated with the proposed WRRF operations including the daily and annual volumes.

The summary of the key components of the water balance and basis of the calculations are provided in Table 7-8.

Table 7-8 Annual water balance

Water balance component	Notional Rate	Annual Water Balance (ML/y)
Stormwater runoff to Duck River	149 ML/yr	149
Total water demand at WRRF for onsite workface and site maintenance	10 staff @ 20L/person	0.6
Wastewater generated at WRRF by onsite staff and site maintenance	10 staff @ 16L/person	0.4

7.5 Operational impact summary table

Surface water impacts associated with the proposed project are identified and an assessment undertaken in accordance with the relevant general and project specific SEARs.

The following sections respond to the SEARs while providing an overview of potential impacts for operation of the WRRF site, pipelines and release to the Parramatta River.

The potential impacts have been assessed with consideration to the relevant components of the reference design.

Table 7-9 Operation impact assessment summary table

Project location/Activity	Potential Impact	Impact (unmitigated) significance	Mitigation and management	Residual Impact significance following mitigation
River release structure Release of advanced treated water near surface of contaminated sediment	Increased rates of transport or migration of contaminated sediment including dioxins, furans and metals during normal operation Contaminants are of high concern. Recommendation for contaminants of this type is not to disturb.	Sensitivity of environmental values: Moderate (highly altered urban river but with significant regional value) Magnitude of Impact: Moderate (highly altered sediment chemistry upstream and downstream of release area) Significance of impact: Moderate (permanent) Likelihood: Unlikely Risk: Low	Refer to SW8 in Table 8-1	Magnitude: Low Sensitivity of environmental values: Moderate Significance of impact: Minor Likelihood: Unlikely Risk: Low
River release structure Ongoing presence of river release structure, pipelines and concrete mattress on river bed	River release structure, pipes and mattress will form physical barrier to the movement of sediment under ambient conditions including high and low flood and ebb tides. Sediment may collect or build up behind concrete mattresses and river release structure locally raising the bed of Parramatta River by an equivalent amount.	Sensitivity of environmental values: Moderate (existing scour holes and variations in bed level have naturally formed around the John Whitton Bridge) Magnitude of Impact: Low Significance of impact: Minor (permanent) Likelihood: Possible Risk: Low	Refer to SW9 in Table 8-1	Sensitivity of environmental values: Moderate (existing scour holes and variations in bed level have naturally formed around the John Whitton Bridge) Magnitude of Impact: Low Significance of impact: Minor (permanent) Likelihood: Possible Risk: Low
River release structure Injection of water into the water column and additional flows in waterway downstream of discharge	Disruption to natural, ambient flow processes within rivers, estuary, marine waters and floodplains Modified discharge volumes, durations and velocities in receiving environment and aquatic connectivity and access to habitat for spawning and refuge. Increased discharge into the Parramatta River resulting in direct or indirect increases in erosion, siltation, or a reduction in the stability of riverbanks or watercourses	Sensitivity of environmental values: Moderate (highly altered urban river but with significant regional value) Magnitude of Impact: Low Significance of impact: Minor Likelihood: Possible Risk: Low	Refer to SW10 in Table 8-1.	Sensitivity of environmental values: Moderate Magnitude of Impact: Low Significance of impact: Minor Likelihood: Possible Risk: Low
WRRF site New urban development and impervious surfaces	Ongoing impacts of urban pollutants in runoff entering of Duck and Parramatta River	Sensitivity of environmental values: Moderate (highly altered urban river but with significant regional value) Magnitude of Impact: Low Significance of impact: Minor Likelihood: Possible Risk: Low	Refer to SW11 in Table 8-1.	Sensitivity of environmental values: Moderate (highly altered urban river but with significant regional value) Magnitude of Impact: Low Significance of impact: Minor Likelihood: Possible Risk: Low
WRRF site	Leaks/spills: Spills of chemicals, heavy metals, oils, and petroleum hydrocarbons during the operation of WRRF	Sensitivity of environmental values: Moderate (highly altered urban river but with significant regional value)	Refer to SW12 in Table 8-1.	Sensitivity of environmental values: Moderate (highly altered urban river but with significant regional value)

Project location/Activity	Potential Impact	Impact (unmitigated) significance	Mitigation and management	Residual Impact significance following mitigation
Storage, transport, use and handling of chemicals used during operation and in the treatment process will likely be handled and stored on site in significant volumes	Potential to introduce surface contaminants to surface water runoff and impact the quality of surrounding surface waters through stormwater discharge and plant wash down routines Acute impacts to ecosystems receiving surface water run-off; in particular, the discharge location	Magnitude of Impact: Moderate Significance of impact: Moderate Likelihood: Possible Risk: Medium		Magnitude of Impact: Moderate Significance of impact: Moderate Likelihood: Unlikely Risk: Low
Pipelines Pipe leaks or bursts at overhead crossings	May lead to volumes of water discharging into creeks which in turn could increase turbidity, lead to local scouring, impact the local and downstream geomorphology In addition to the physical impacts associated with treated effluent leaks or bursts, such an incident on the pipelines could lead to water quality impacts in downstream systems	Sensitivity of environmental values: Moderate (highly altered urban waterways but with significant regional value) Magnitude of Impact: Low Significance of impact: Low Likelihood: Possible Risk: Low	Refer to SW13 in Table 8-1.	Sensitivity of environmental values: Moderate (highly altered urban waterways but with significant regional value) Magnitude of Impact: Low Significance of impact: Low Likelihood: Possible Risk: Low

8 Mitigation Measures and Management of impacts

8.1 Design considerations

8.1.1 River release structure

The following mitigation measures have been incorporated into the river release structure design as part of the reference design development to avoid, minimise or mitigate potential surface water (hydrologic and geomorphic) impacts associated with the river release structure:

- Angle of river release structure nozzles (30 degrees to horizontal) reduces scour velocity induced at the riverbed surface. Resultant velocities closely match ambient conditions for the range of expected flow and tidal conditions
- Flows released across wider extent of the river to facilitate mixing and distribute changes in flow across a larger area
- Limited discharge rates and velocities in each nozzle ensures that changes in velocity and scour potential at the riverbed is limited and confined to the extent of the concrete matrasses
- River release structure and pipelines are proposed to be underlain with geotextile mattress, which will cap contaminated sediment and resist the potential for sediment to be remobilised
- Flexible concrete mattresses will ensure that any unintended sediment migration will not result in failure of the structure
- Low profile concrete mattresses will minimise the layer of sediment build up and the resulting level of change in the river bathymetry
- Locating concrete mattress and river release structure away from downstream bridges will allow any accreted bed levels to dissipate and transition back to normal levels around existing bridges and hydraulic structures
- The river release structure has been located across part of the river only, and not entirely across the river. This will limit any minor unexpected impacts to a more localised area.
- Locating concrete mattresses, pipelines and river release structure in deeper zones, as much as possible will minimise and localise any impacts

With the proposed river release structure design mitigations in place, residual impacts to the natural rates of erosion and sediment transport will be negligible at the riverbed in the vicinity of the release structure and along the Parramatta River.

8.1.2 WRRF

Mitigation measures have been incorporated into the WRRF design as part of the reference design development to avoid, minimise or mitigate potential surface water impacts associated with operations at the WRRF site.

Spill control measures are incorporated into the site design including a first flush capture system that will collect any chemicals spilt within the designated chemical storage and handling area.

Generic stormwater pollutants will be filtered from residual stormwater runoff discharged to the Duck River. The combined impact of first flush capture and stormwater filtration will improve the water quality discharged from the site to the Parramatta River and Sydney Harbour and contribute to the water quality objectives being met over time.

8.2 Mitigation measures summary

A summary of the mitigation measures for the construction and operation of the project is summarised in Table 8-1.

Table 8-1. Mitigation measures summary

Ref.	Potential Impact	Mitigation / Management measures	Timing	Relevant Location
SW1	Discharge or release of sediment-laden stormwater from cleared areas and stockpiled sites to receiving waterways resulting in sedimentation within adjoining watercourses and habitat degradation.	Develop a Construction Environmental Management Plan (CEMP), Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP). The documents should consider: ▪ The size and operation of sedimentation basins. ▪ Reseal or revegetating surfaces as soon as applicable ▪ Location of stockpiles, sediment basins, bunds and vehicle wash-downs away from drainage lines ▪ Use geofabric on stockpiles throughout the course of construction ▪ Establish dirty water drains to direct site runoff to a sediment basin ▪ Eliminate ponding and erosion by restoring natural landforms to the pre-works condition where possible ▪ Stop work during heavy rainfall or in waterlogged conditions when there is a risk of sediment loss off site. ▪ Store contaminated material and waste materials away from site drainage, gutters and flow paths. ▪ Schedule construction works to avoid wet seasons and heavy rainfall, where possible ▪ All works within 40m of a watercourse or water body with defined bed or banks (or as otherwise agreed with DCCEEW) will be undertaken in accordance with the relevant Guidelines for Controlled Activity Approvals. Whilst the project is exempt from needing to obtain controlled activity approvals, the guidelines provide good practice measures for working within waterfront land. ▪ Groundwater quality samples from the piezometers should be collected during the recommended field investigations to determine the required engineering controls. ▪ Incorporate the proposed first flush system, which would capture runoff from areas prone to higher rates of chemicals spilled during handling and will discharge those chemicals back into the treatment plant for processing, filtration and treatment. ▪ Contractors must complete pre-mobilisation and post-demobilisation soil sampling on compound sites to confirm no residual impacts.	Construction	**WRRF, Pipelines** Waterways and surface water features

Ref.	Potential Impact	Mitigation / Management measures	Timing	Relevant Location
SW2	Waste materials such as concrete, plasterboard, timber, asbestos and contaminated soil spreading via surface run-off to near site drainage pathways.	Develop a Soil and Water Management Plan (SWMP), as above.	Construction	**WRRF, pipelines and river release structure:** Waterways and surface water features near infrastructure
SW3	Disruption of the river-bed sediments and mobilisation of contaminated sediments (dioxin, furan and metal contaminants) into the water column of the river which impacts water quality within the Parramatta River.	Develop a River Release Structure Construction Environmental Work Method Statement (RRSC EWMS). This document will establish the locations and nature of key environmental controls for mitigating environmental risks during construction of the river release structure. This should be prepared in consultation with relevant stakeholders, including local Councils, NSW Maritime and DPI Fisheries. The RRSC EWMS would include: ▪ construction methods for the temporary works (assessed as the cofferdam) and river release structure equipment used to place concrete mattresses (or similar performing structure), pipes and nozzles slowly, carefully and minimising the need for repositioning ▪ barge and watercraft traffic management (if required) ▪ documentation, standard practices and emergency protocols ▪ reference to the SWMP (for contamination and acid sulfate soil management) and the dewatering protocol ▪ measures for: – avoiding aquatic biodiversity impacts – measures to avoid sediment disturbance, including sediment curtains (or similar device) – night works – water quality monitoring during instream works including upstream and downstream locations, focusing on changes in turbidity and total suspended solids to act as an early warning system for construction impacts – restoration. The following measures are recommended to be incorporated into the RRSC EWMS to minimise the potential for sediment disturbance during works:	Construction	Waterways and surface **River release structure:** Parramatta River water features

Ref.	Potential Impact	Mitigation / Management measures	Timing	Relevant Location
		▪ Installation of sediment curtains to reduce turbidity/sediment disturbance when construction the coffer dam, where possible ▪ Schedule construction works to avoid times when flow velocity will interfere with sediment curtains. ▪ Minimise potential for sediment disturbance by placing filter layers (e.g. geotextile material) beneath concrete mattresses ▪ Use equipment to place concrete mattresses, pipes and nozzles slowly, carefully and minimising the need for repositioning ▪ Monitor works during construction and stop work during heavy rainfall or if there is evidence of sediment loss outside of the construction area		
SW4	Runoff or unintended dewatering or release of contaminated water from excavations or stockpiles which include contaminated or acid sulfate soils.	Develop a River Release Structure Construction Environmental Work Method Statement (RRSC EWMS) as SW3. An Acid Sulfate Soil Management Plan (ASSMP) will be developed specific to the construction works in close proximity to Parramatta River and areas of known high potential for occurrence of ASS Document and standard practices and emergency protocols. The ASSMP will be prepared and implemented in accordance with the Acid Sulfate Soils Management Advisory Committee: Acid Sulfate Soils Assessment Guidelines (ASSMAC, 1998). A dewatering procedure will be developed and implemented to manage dewatering during the works. This would include: ▪ A process for testing whether water meets discharge criteria ▪ Water treatment methods including flocculation and pH adjustment ▪ Discharge process and location/s including avoiding erosion or scour ▪ Water quality monitoring requirements ▪ Permits and records required ▪ Any water which cannot be treated to meet discharge criteria would be removed by sucker truck and transported for offsite disposal at a licenced facility.	Construction	**WRRF, pipelines and river release structure:** Waterways and surface water features
SW6	Extraction of surface waters impacting on flows in local water ways	None required	Construction	**WRRF, pipelines and river release structure:** Waterways and surface water features

Ref.	Potential Impact	Mitigation / Management measures	Timing	Relevant Location
SW5	Leaks/spills of liquids / chemicals containing heavy metals, oils or petroleum hydrocarbons during the use and operation of machinery which may: ▪ introduce contaminants to surface water runoff and impact the quality of surrounding surface waters through stormwater discharge and plant wash down routines ▪ lead to acute toxicity effects on ecosystems receiving surface water run-off.	Develop a Soil and Water Management Plan (SWMP), as above which ensures: ▪ All vehicles, plant and equipment to be checked regularly for fuel tank and line leaks or failures ▪ Vehicle wash-water to be contained and disposed of appropriately. ▪ The proper storage, containment, and usage of all fuels and chemicals ▪ A spill response procedure/s ▪ Spill kits to be maintained in appropriate locations in accordance with Australian Standards, including where required inside machinery and vehicles. ▪ If field refuelling is necessary, designate an area away from waterways and drainage lines with functioning spill kits close by. ▪ Bunds and sumps be regularly inspected, and capacity maintained by regular draining and disposal	Construction	**WRRF and pipelines:** Waterways and surface water features
SW7	Fluid loss during any HDD required for installation of the pipelines which may result in uncontrolled release of drilling fluid escaping from the borehole through fissures or weakness in the substrate resulting in increased sedimentation and turbidity in watercourses Discharge of contaminated hydrostatic test water leading to toxicity affects Any significant volumes of these chemicals entering the local water environment may lead to local ecological degradation, albeit temporary	Develop a Drilling Fluid Management Protocol to minimise the potential for impacts, including: ▪ contain and monitor drilling fluids at launch and receival pits ▪ identify, manage and clean up frac-outs to prevent environmental harm. re-use and/or disposal of drilling fluids appropriately.	Construction	**Pipelines** Whole project

Ref.	Potential Impact	Mitigation / Management measures	Timing	Relevant Location
SW8	Increased rates of transport or migration of contaminated sediment including dioxins, furans and metals during normal operation	Inspect and take photographs of the zone around the pipeline installation within the river post-construction to check for any scour and major changes in local bathymetry in conjunction with asset structure checks. This will be done periodically (every 6 months for 2 years) by diver or remove operated vehicle.	Operation	**River release structure** Whole project
SW9	River release structure, pipes and mattress will form physical barrier to the movement of sediment under ambient conditions including high and low flood and ebb tides. Sediment may collect or build up behind concrete mattresses and river release structure locally raising the bed of Parramatta River by an equivalent amount.	As per SW8.	Operation	**River release structure** Waterways and surface water features near structure
SW10	Disruption to natural, ambient flow processes within rivers, estuary, marine waters and floodplains Modified discharge volumes, durations and velocities in receiving environment and aquatic connectivity and access to habitat for spawning and refuge. Increased discharge into the Parramatta River resulting in direct or indirect increases in erosion, siltation, or a reduction in the stability of riverbanks or watercourses	As per SW8.	Operation	**River release structure** Waterways and surface water features near structure

Ref.	Potential Impact	Mitigation / Management measures	Timing	Relevant Location
SW11	Ongoing impacts of urban pollutants in runoff entering of Duck and Parramatta River	Implement additional water sensitive urban design measures, such as filtration cartridges and gross pollutant traps, on assets connecting to the existing stormwater system to demonstrate a net reduction in pollutants entering Duck River from the WRRF. Where a gross pollutant trap (GPT) and stormwater filtration cartridges are utilised for treatment, these systems will be maintained in accordance with manufacturer requirements to maintain treatment performance A Construction Water Quality Monitoring Plan is recommended which outline water quality monitoring during instream works in the Parramatta River including the coffer dam construction and operation and installation of the mattress and pipeline. Monitoring to include upstream and downstream monitoring focussing on changes in turbidity and total suspended solids to act as an early warning system for construction impacts	Operation	**WRRF site** Waterways and surface water features (Duck River and Parramatta River)
SW12	Spills of chemicals, heavy metals, oils, and petroleum hydrocarbons during the operation of WRRF Potential to introduce surface contaminants to surface water runoff and impact the quality of surrounding surface waters through stormwater discharge and plant wash down routines Acute impacts to ecosystems receiving surface water run-off; in particular, the discharge location	▪ Use of first flush capture zones and foul water pumps will capture the majority of rainfall within high-risk areas and divert this runoff away from Parramatta River ▪ Prepare and implement site specific Operation Environmental Management Plans. ▪ Incorporate the proposed first flush system, which would incorporate trickle release back into the treatment plant ▪ Develop a spill response procedure ▪ Spill kits to be maintained in appropriate locations in accordance with Australian Standards, including where required inside machinery and vehicles. ▪ Conduct refuelling, fuel decanting and vehicle maintenance in compounds where possible. If field refuelling is necessary, designate an area away from waterways and drainage lines with functioning spill kits close by. ▪ All vehicles, plant and equipment to be checked regularly for fuel tank and line leaks or failures ▪ Bunds and sumps should be regularly inspected, and capacity maintained by regular draining and disposal ▪ Contractors must complete pre-mobilisation and post-demobilisation soil sampling on compound sites to confirm no residual impacts.	Operation	**WRRF site** Whole project

Ref.	Potential Impact	Mitigation / Management measures	Timing	Relevant Location
SW13	May lead to volumes of water discharging into creeks which in turn could increase turbidity, lead to local scouring, impact the local and downstream geomorphology In addition to the physical impacts associated with treated effluent leaks or bursts, such an incident on the pipelines could lead to water quality impacts in downstream systems	Operate the project in accordance with Sydney Water's existing management systems (or equivalent contractor management systems), including: ▪ Asset Management System (ISO 55001) ▪ Quality Management System (ISO 9001) ▪ Health and Safety Management System (AS/NZ 4801) ▪ Environmental Management System (ISO 14001).	Operation	**Pipelines** Whole project

9 Conclusion

A surface water and geomorphology impact assessment has been undertaken for the construction and operation of the GPOP WCM project.

The proposed construction and operation of GPOP WCM project will occur around and within the highly modified but regionally significant waterways of the Parramatta River and Sydney Harbour. The legacy of poor industrial practices has resulted in highly contaminated sediments and ongoing poor water quality in the vicinity of the project that must be carefully considered as part of the reference design development.

A significant concern is the potential for the project to increase sediment transport rates at the river release site and accelerate or contribute to the dispersal of historical contamination within riverbed sediments. The river release reference design has been developed using detailed hydraulic modelling to minimise the hydraulic impacts of the release structure on bed shear stress and flow velocities along the riverbed sediments.

A concrete mattress is proposed to underlay the river release structure and extend upstream and downstream to provide scour protection and prevent the structure from failing. Computational fluid dynamic modelling of the river release structure demonstrates that changes in the shear stresses at the riverbed, and changes in erosive velocities, are contained within the extent of the concrete mattress.

The river release structure is proposed to extent part way across the river within a narrow and deeper reach of the river. The velocities associated with this zone are naturally higher during flood and ebb tide conditions. The additional release of water to this reach of the river represents a very small incremental increase in flow when compared to the tidal prism and runoff from the upstream catchment. The operation of the release will therefore have a low risk of contributing to increased rates of erosion of sediment material at the riverbed. The operation of the release structure will not increase the distribution of existing contamination in the surrounding sediments. Overall, the concrete mattress is intended to cap a section of contaminated sediment and prevent its distribution to other parts of the estuary.

Careful construction of the river release structure using cranes and barges is proposed to ensure that the placement and installation of the concrete mattress, pipeline and release nozzle structures results in minimal sediment disruption.

Open trenching within the northern section of the river is proposed to facilitate the construction of the pipelines through the northern riverbank. The trenching will require construction of a temporary cofferdam and installation of silt curtains to contain sediment.

The assessment found that including the project mitigations results in a:

- Low risk of impacts to surface water during construction and operation of the WRRF
- Low risk of impacts to surface water from construction of the river release structure. This work will be short term but will require careful construction management to avoid more moderate impacts of disturbing existing affected sediments.
- Low risk of impacts from operation of the river release structure
- Low risk of impacts from the construction and operation of pipelines.

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