Review of Environmental Factors

Quakers Hill Water Resource Recovery Facility Advanced Treatment Upgrade

September 2025

Sydney WATER

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Approval

This Review of Environmental Factors (REF) assesses potential environmental impacts of the Quakers Hill Water Resource Recovery Facility (WRRF) Advanced Treatment Upgrade proposal. The REF was prepared under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), with Sydney Water both the proponent and determining authority.

The main potential construction environmental impacts are removal of native vegetation and amenity impacts (e.g. noise, dust, additional traffic movements and access restrictions in public open spaces).

During operation, environmental impacts are expected to be minimal. New infrastructure at Quakers Hill WRRF will be of similar scale to existing assets with potential impacts such as noise and odour being similar to current conditions. The brine pipeline will be underground, with the main above ground structure being a barometric loop at Billy Goat Hill Reserve in Blacktown.

The proposal will not be carried out in a declared area of outstanding biodiversity value and is not likely to significantly affect threatened species, populations or ecological communities, or their habitats. Therefore, a Species Impact Statement (SIS) and/or Biodiversity Development Assessment Report (BDAR) is not required.

Given the nature, scale and extent of impacts and implementation of the mitigation measures outlined in this REF, the proposal is unlikely to have a significant impact on the environment. Therefore, we do not require an Environmental Impact Statement (EIS).

The Sydney Water Project Manager is accountable for ensuring the proposal is carried out as described in this REF. Additional environmental impact assessment may be required if the scope of work or work methods described in this REF change significantly following determination. The proposal will be determined under Division 5.1 of the EP&A Act in a Decision Report after public display of the REF.

Sydney Water respectfully acknowledges the Traditional Custodians of the land and waters on which we work, live and learn. We pay respect to Elders past and present.

Sydney Water recognises the physical and cultural connection of local Aboriginal communities to waters and the land.

I certify that I have reviewed and endorsed this REF and, to the best of my knowledge, it is in accordance with the EP&A Act and the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation). The proposal has been considered against matters listed in section 171 and 171A (Appendix A and Appendix B) and the guidelines approved under section 170 of the EP&A Regulation. The information it contains is neither false nor misleading.

Prepared by:	Reviewed by:	Endorsed by:	Endorsed by:
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Blair Davies Environmental Scientist Sydney Water Date: 28/08/2025	Elissa Howie Environmental Assessment Team Manager Sydney Water Date: 28/08/2025	James Harrington Senior Project Manager Sydney Water Date: 28/08/2025	Murray Johnson Senior Manager Environment and Heritage Services Sydney Water Date: 29/08/2025

Approved by:	
	[redacted] Louise Beer A/Executive General Manager, Water and Environment Services Sydney Water Date: September 17, 2025

1. Executive summary

Sydney Water proposes to upgrade our Quakers Hill Water Resource Recovery Facility (WRRF) in the Blacktown local government area. We propose to modify and expand wastewater treatment processes and build a new brine pipeline between the WRRF and our existing wastewater network in Seven Hills.

These works are part of a proposal called the 'Quakers Hill WRRF Advanced Treatment Upgrade'. The proposal will increase the amount of wastewater that can be treated, to accommodate forecast growth in the Quakers Hill WRRF catchment and support the NSW Government's housing strategy. It will improve the quality of the treated wastewater produced by the WRRF to meet the more stringent water quality requirements in its environment protection licence (EPL). This will be achieved with a new advanced water treatment plant (AWTP) that will include reverse osmosis.

Construction of the proposal is expected to start in early 2027 and take about 2 years to build. Some early civil works are proposed to start in 2026. The main construction locations are:

- Quakers Hill WRRF, where construction activities will be contained on Sydney Water's existing site. This will involve constructing buildings and other structures for the new and upgraded treatment processes
- the brine pipeline, which will be built mainly along roads and public open spaces between Quakers Hill and Seven Hills. The pipeline will be laid below ground by open trenching, with about 2.2 km installed by tunnelling methods. Up to 20 construction compounds are proposed over the construction period.

Sydney Water has considered a range of options and refined the proposal to minimise environmental impacts. The proposal aligns with the principles of ecologically sustainable development.

Most environmental impacts are expected in the construction phase and are temporary. The main construction impacts include removal of native vegetation and amenity impacts (e.g. noise, dust, additional traffic movements and access restrictions in public open spaces). We will implement a range of mitigation measures to manage these impacts, as part of a Construction Environmental Management Plan.

Once the project is operating, it will have an environmental benefit by improving the quality of treated water released to Breakfast Creek. New infrastructure at Quakers Hill WRRF will be in keeping with existing assets with potential impacts such as noise and odour being similar to current conditions. The brine pipeline will be underground, with the main above ground structure being a barometric loop at Billy Goat Hill Reserve in Blacktown.

This review of environmental factors (REF) assesses the proposal's environmental impacts and will be determined by Sydney Water under Division 5.1 of the *Environmental Planning and Assessment Act 1979*. Sydney Water has been consulting with the community and other stakeholders throughout proposal planning, and will continue this as design and construction progress.

Part of this consultation includes inviting public and stakeholder comment on the REF and the suite of supporting technical studies. Details about the display period and how to make a submission are available on the proposal's website. We will consider all submissions and prepare a Decision Report.

2. Introduction

2.1 Context

Sydney Water provides water, wastewater, recycled water and some stormwater services to over 5 million people. We operate under the *Sydney Water Act 1994* and have 3 equal objectives to protect public health, protect the environment and be a successful business.

We are a statutory State-owned corporation and are classified as a public authority. We are also a determining authority for the Quakers Hill Water Resource Recovery Facility (WRRF) Advanced Treatment Upgrade ('the proposal') under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This review of environmental factors (REF) assesses the potential environmental impacts associated with the proposal and identifies mitigation measures that avoid or minimise potential impacts.

2.2 Proposal background and need

Sydney Water proposes to upgrade the wastewater treatment process at Quakers Hill WRRF by increasing treatment capacity and improving treatment performance.

The works will involve:

- modification and addition of wastewater treatment processes at Quakers Hill WRRF
- a new brine pipeline about 8 km long between the WRRF and our existing wastewater network in Seven Hills.

The proposal will increase the amount of wastewater that can be treated, to accommodate forecast growth in the catchment and support the NSW Government's housing strategy. It will improve the quality of the treated wastewater produced by the WRRF to meet the more stringent water quality requirements in its environment protection licence (EPL). This will be achieved with new advanced treatment processes that will include reverse osmosis.

Treated water will be released to Breakfast Creek, in the same location as existing releases from Quakers Hill WRRF. A new pipeline will be built to transport brine to the Northern Suburbs Ocean Outfall Sewer (NSOOS) at Seven Hills. Brine is produced as a by-product of advanced treatment.

Figure 2-1 provides an overview of the proposal. The proposal, including its construction and operation, is described in more detail in Chapter 3.

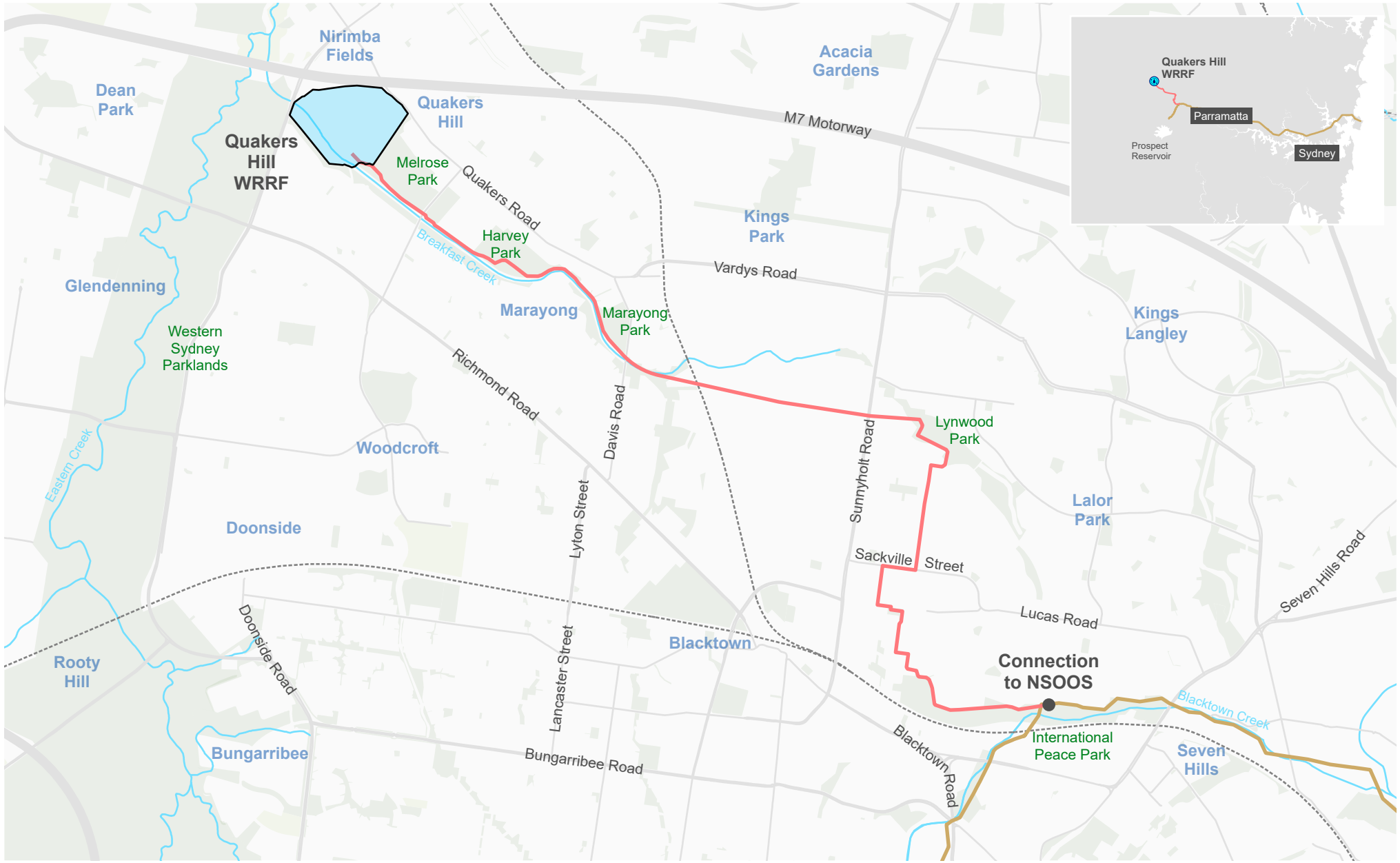

Figure 2-1 Proposal location

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Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:35,000 @ A4
GDA2020 MGA Zone 56

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2.2.1 Proposal background and need

The 2 key drivers for the proposal are:

- accommodating growth in wastewater service demand
- ensuring EPL compliance.

Each of these is outlined in more detail below.

2.2.1.1 Growth in service demand

The current average dry weather flow capacity of Quakers Hill WRRF is 28 megalitres per day (ML/d). Current and projected growth in the area means the wastewater treatment capacity of the WRRF needs to increase. An average dry weather capacity of 48 ML/d is anticipated to be required by 2056. To cater for this growth, an additional 20 ML/d of treatment capacity is required.

Quakers Hill WRRF currently transfers 12.5 ML/d of effluent and solids to St Marys WRRF, which services a neighbouring wastewater catchment. Growth in the St Marys catchment means that WRRF will become capacity constrained within the next 3 years if such transfers continue. Transfers of effluent and solids from Quakers Hill WRRF to St Marys WRRF will need to be reduced by treating more wastewater at Quakers Hill WRRF. During operation, solids will be concentrated and transferred to St Marys WRRF for biogas production. The liquid portion will be lower than current transfers, to reduce capacity constraints.

The proposal directly addresses both the capacity constraints of Quakers Hill WRRF from increasing wastewater servicing demand, and future capacity constraints anticipated at St Marys WRRF.

2.2.1.2 Licence compliance

Quakers Hill, Riverstone, and St Marys WRRFs, along with the Upper South Creek Advanced Water Recycling Centre (USC AWRC), share a common 'bubble' licence nutrient load limit in the Sackville 2 subzone. This subzone is defined in *Regulating nutrients from sewage treatment plants in the Lower Hawkesbury Nepean River catchment* (EPA 2019).

The NSW Environment Protection Authority (EPA) issued new nitrogen and phosphorus annual load limits for treated water releases to the Sackville 2 subzone, which took effect in July 2025. The proposed secondary wastewater treatment upgrade and the addition of advanced wastewater treatment technology at Quakers Hill WRRF will contribute to meeting these licence requirements.

In addition to the shared nutrient load limit with Riverstone and St Marys WRRFs, the EPL includes nutrient concentration limits for treated water releases from Quakers Hill WRRF.

2.2.2 Proposal objectives

The proposal objectives are to:

- service growth and support the NSW Government's housing strategy
- protect waterway health through continued environment protection licence compliance within Breakfast Creek and Sackville 2 subzone of the Hawkesbury Nepean River catchment.

2.2.3 Consideration of alternatives/options

This section discusses the strategic and proposal options Sydney Water considered to identify the preferred option assessed in this REF.

2.2.3.1 Strategic options

Do nothing option

Wastewater treatment capacity constraints would worsen under a do-nothing scenario. This could lead to untreated wastewater discharges or overflows to the environment, or equipment failure at Quakers Hill and St Marys WRRFs. Under a worst-case scenario, wastewater may back-up and overflow the local wastewater reticulation network.

Under the do-nothing option, the more stringent nutrient concentration and load limits outlined in section 2.2.1.2 would be exceeded due to limits of existing treatment capacity and quality at Quakers Hill WRRF, leading to non-compliance with the EPL. This would likely lead to higher nutrient concentrations in the Hawkesbury-Nepean catchment. Higher nutrient levels would increase the risk of algal blooms with potential ecological and waterway health impacts.

The do-nothing option would not meet proposal objectives and Sydney Water is therefore assessing an option in this REF that addresses proposal objectives.

Achieving EPL compliance

As outlined in section 2.2.1.2 and discussed in section 5.3 and 6.3, Quakers Hill WRRF is part of a licence 'bubble' and the more stringent nutrient load limits apply across this bubble, rather than to individual WRRFs. This means there are multiple investment pathways to achieve compliance with the EPL. For example, these could include treatment upgrades at Quakers Hill WRRF, Riverstone WRRF and/or St Marys WRRF.

Sydney Water's analysis of investment pathways concluded that all options to achieve EPL compliance would require an advanced treatment upgrade at Quakers Hill WRRF. The proposal has been developed to address that need and is being prioritised over investment at other WRRFs for reasons including:

- There are projected exceedances of capacity at Quakers Hill WRRF given growth in the catchment.
- The sludge transfer pipeline to St Marys WRRF is not large enough to accommodate future growth.
- Quakers Hill WRRF has ample available land and existing infrastructure (such as brine ponds) that can be used in the upgrade.

Any future investments needed at other WRRFs would be subject to separate environmental impact assessment and approvals.

Potential future recycled water opportunities

The proposal also presents an opportunity to support the NSW Government and Sydney Water's strategies for a sustainable, resilient and reliable water supply (RRWS). It will produce high-quality feedwater suitable for potential future recycled water uses at Quakers Hill WRRF, including potentially for new data centres proposed in the region.

2.2.3.2 Proposal options

This section describes the various options considered for the proposal, including at Quakers Hill WRRF and for the associated brine pipeline.

Secondary and advanced wastewater treatment upgrade processes

The 2 secondary treatment process options that were considered were Aerobic Granular Sludge (AGS) and Membrane Bioreactor (MBR). Options were limited based on site footprint constraints, operational experience and treatment capability. Analysis found that both treatment processes would achieve compliance to the new nitrogen concentration limits across a broad range of rainfall conditions. However, AGS may not achieve compliance to the new phosphorus limits. Advanced treatment is still required after secondary treatment to meet the nutrient load limits required by the bubble licence.

MBR was the selected upgrade option, as modelling suggests that this treatment process targets nutrient compliance more effectively than AGS, in terms of both nitrogen and phosphorus. This is partly driven by wet weather considerations and the higher total phosphorus of tertiary bypass discharge with an AGS. MBR was also identified as the more reliable option to treat water to the quality required for the downstream advanced water treatment process in the AWTP.

Advanced water treatment options considered included denitrifying filters, ultrafiltration and reverse osmosis. These processes have all been adopted at other operational treatment plants. Data on the treatment performance of other operational treatment plants was reviewed during the options assessment. These options did not reliably meet the nutrient load limits.

To achieve further reduction of nitrogen and phosphorus concentrations and meet load limits, the preferred method is to use a combination of ultrafiltration (for flows from the existing plant) and reverse osmosis in the AWTP. This is also the method that best achieves the required feedwater quality for potential future recycled water uses. The key benefits of this approach include:

- Ultrafiltration was identified as a critical pathogen removal and pre-treatment step before water undergoes reverse osmosis. The membrane pore size of ultrafiltration cartridges will filter residual solids, bacteria, cryptosporidium and certain viruses from the wastewater.
- The MBR product water would not require ultrafiltration as the membrane treatment is similar in pathogen removal to the ultrafiltration step.
- Reverse osmosis forces water through even finer-grained membrane pores under pressure, providing a higher removal rate for many pathogens and pollutants.

Collectively these processes have a high level of nutrient removal which reduces the potential for the treated water to contribute to algal blooms in waterways.

Sizing of treatment processes

Sydney Water is currently undertaking value engineering to consider whether we could achieve EPL requirements with smaller capacity secondary treatment and/or advanced water treatment than what is assessed in this REF. This could help provide better value for money for our customers by reducing capital and operating costs and support sustainable operations by reducing chemical and energy use. If Sydney Water decided to proceed with this option we would prepare an addendum to this REF. The main changes

would relate to a smaller scale of infrastructure required at Quakers Hill WRRF and a change in the water quality assessment.

Infrastructure locations at Quakers Hill WRRF

Key considerations that informed the location of new assets within Quakers Hill WRRF included:

- avoiding key constraints, such as sensitive vegetation set aside as biodiversity offsets for previous projects, and a grave site
- locating infrastructure in vacant areas or areas occupied by disused assets
- siting the assets associated with each component of the proposal (i.e. secondary treatment upgrade and AWTP) in a discrete area to provide a logical water treatment process sequence.

Further optioneering for specific locations of new assets considered hydraulics, locations of buried services, and distance to other assets.

Two areas were considered for locating the secondary treatment upgrade infrastructure:

- Option 1: in the centre of Quakers Hill WRRF, south-east of the existing AGS process unit.
- Option 2: a smaller area north-west of the existing AGS process unit, close to the proposed AWTP site.

Option 2 was discounted for not having sufficient space required given the location of existing assets. Option 1 was selected because it provides the space required for the proposed infrastructure, has good accessibility and allows efficient hydraulic flows within the WRRF.

Two areas were considered for locating the AWTP:

- Option 1: the north-western section of the site, in an area occupied by existing structures (Intermittently Decanted Aerated Lagoons (IDALs)) that have been decommissioned and will be demolished as part of the proposal.
- Option 2: the eastern section of the site, in an area occupied by an existing spoil stockpile from previous projects.

Option 2 was discounted for not having sufficient space required for the AWTP, being close to established biodiversity offset areas and encroaching on land management zones. In addition to avoiding those constraints, Option 1 also has good accessibility and allows efficient hydraulic flows within the WRRF site.

Brine pipeline

Brine is produced as a by-product of reverse osmosis, which is part of the advanced water treatment process. Sydney Water's standard approach to managing brine is to transfer to it to our existing wastewater network. An existing brine pipeline runs from Quakers Hill WRRF to the NSOOS and transfers brine received from the St Marys WRRF. The potential for this existing brine pipeline to accept future combined brine flows from Quakers Hill and St Marys WRRF was reviewed. It was determined that this existing pipeline does not have enough capacity to accommodate combined flows, and that a second brine pipeline is required.

The new brine pipeline is also proposed to connect into the NSOOS, as it is the closest wastewater network with capacity. The proposed connection point into the NSOOS is in a different location to the existing brine pipeline connection point in Dundas. A closer suitable connection point was identified for the new brine

pipeline in International Peace Park in Seven Hills. Connecting brine into the NSOOS closer to Quakers Hill WRRF reduces cost. It also reduces the areas impacted by construction and the associated environmental and community impacts.

Three brine pipeline alignments were identified during the options development phase, between Quakers Hill WRRF and the NSOOS connection point in Seven Hills. These alignments are shown on Figure 2-2 and summarised below:

- Option 1 is a pipeline alignment about 7 km long that follows the route of the existing brine pipeline, except that it connects to the NSOOS at Seven Hills, not Dundas. It would mostly be constructed by open trenching.
- Option 2 is a pipeline alignment about 8 km long involving a tunnelled section of about 2 km to install pipework under an existing railway, State road (Sunnyholt Road), residential and industrial areas. The alignment of option 2 is described in more detail in section 3.2.4.
- Option 3 is a pipeline alignment about 7 km long that is closely aligned with option 1, with deviations in the central section (between Marayong Park and Kings Park industrial estate) and eastern sections (from about Sunnyholt Road to Blacktown Aquatic Centre). It would mostly be constructed by open trenching.

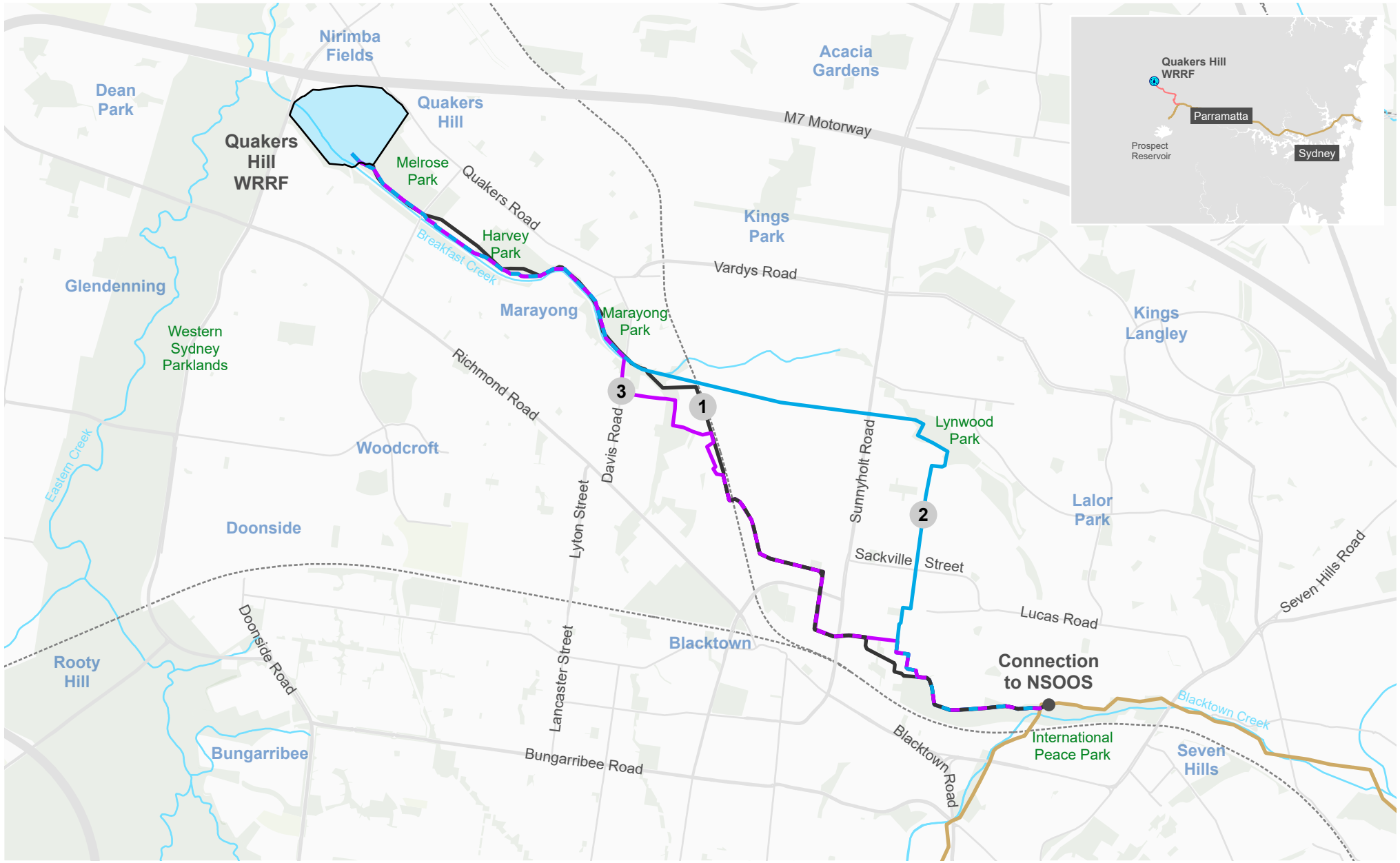


Figure 2-2 Brine pipeline alignment options

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:35,000 @ A4
GDA2020 MGA Zone 56

Options development considered factors such as constructability, environmental and community impact, cost, interaction with existing infrastructure and services, and stakeholder feedback. A multi-criteria analysis (MCA) using these criteria was undertaken to compare the options. Key issues identified with option 1 included:

- interacting with sensitive receptors including an aged care facility, and residential properties on Ironwood Crescent and Boyd Street
- crossing through Harvey Park sports fields, under Breakfast Creek, and through mapped threatened vegetation
- impacting State roads, including Third Avenue and Sunnyholt Road. This would require road closures and night works
- space constraints around the railway line. The alignment of the existing brine pipeline runs beneath the railway line near Springfield Avenue.

Options 2 and 3 were developed to address these community, environmental, and other technical concerns.

Table 2-1 shows that option 2 was identified as the highest scoring option across most criteria. Reasons for selecting this option include, but are not limited to:

- It minimises traffic-related impacts compared to other options from work within public roads and avoids impacts to the State road Sunnyholt Road by using horizontal directional drilling (HDD).
- It avoids the need for open trenching in Breakfast Creek and impacts to threatened vegetation.
- It decreases disruption from construction noise, dust and visual impacts compared to other options.

Table 2-1 Brine pipeline options multi-criteria analysis

Criteria	Brine pipeline options		
	Option 1	Option 2	Option 3
Asset condition and performance	Good	Good	Good
Asset life	Good	Good	Good
Soil contamination	Good	Good	Good
Heritage	Fair	Good	Fair
Environmental constraints	Poor	Good	Fair
CO_2 emissions	Good	Good	Good
Delay risk	Fair	Good	Fair
Community	Fair	Fair	Fair

Criteria	Brine pipeline options		
	Option 1	Option 2	Option 3
Health and safety	Poor	Good	Fair
Level of road impact	Poor	Good	Poor
Property impact	Good	Fair	Fair
Total	24	31	25

Note: good = 3, fair = 2, poor = 1

Four alignments for the HDD section of option 2 were identified. Two options involved an HDD section, open trenching through industrial streets, and then another HDD section. These 2 options were discounted due to increased community and road user disruption compared with other options. Technical challenges associated with a > 2 km HDD (such as spatial constraints at the launch and retrieval pits) ruled out a singular drill from Marayong Park to Lynwood Park. Therefore, the preferred HDD option is to complete the drill in 2 sections: the western drill from Marayong Park to Gate Road within Kings Park industrial estate, and the eastern drill from Lynwood Park to Gate Road.

Where open trenching cannot be avoided within public roads, the preferred pipeline alignment has been micro-sited to be located on one side of the road to reduce traffic impacts associated with road closures.

Barometric loop

Barometric loops ensure consistent water flow by regulating pressure changes in pipes caused by changes in gradient. A barometric loop is needed at the high point of the brine pipeline. Not installing a barometric loop would be inconsistent with Sydney Water's specifications and would mean that sections of the pipe could drain inconsistently due to elevation-induced changes in pressure, causing brine to leak to the environment.

The highest point in the landscape around the brine pipeline is on private property. A barometric loop in this location was ruled out, to avoid building the brine pipeline and a barometric loop on private property.

Billy Goat Hill Reserve was identified as the nearest public land to the highest point of the brine pipeline with the space to accommodate a barometric loop.

Several options for micro-siting the barometric loop within Billy Goat Hill Reserve were considered. At the first location, the barometric loop would be close to a private property fence line and at the highest elevation along the perimeter of Billy Goat Hill Reserve. The pipeline within Billy Goat Hill Reserve would closely follow the fence lines along the western and southern edges of the park. At the second location, the barometric loop would be located close to several trees, situated slightly downhill from the western perimeter of the reserve. The pipeline would be further away from the fence line but closer to the playground.

The first location was discounted due to its proximity to private property west of the reserve and the need to remove mature vegetation along the southern boundary of the reserve. Despite needing to be a slightly higher structure, the second location was selected as the preferred option considering the construction

impacts to private properties, better access during construction and potential long-term visual and ecological impacts.

2.2.4 Avoid or minimise impacts in design

Sydney Water considered environmental constraints and potential impacts during the design process. The proposal's design has been modified to avoid or minimise anticipated environmental impacts as far as possible. Table 2-2 identifies embedded mitigation through design, and the reasons for these design choices.

Table 2-2 Mitigation embedded through design

Design aspect	Reason
Quakers Hill WRRF	
Siting new infrastructure on previously developed land	Minimises potential environmental impacts, particularly to native vegetation on the site by locating the proposal's components within previously disturbed land.
Reuse existing stockpiles on the site as fill material, reducing the volume of imported material	Reduces construction-related vehicle movements on the local road network and associated greenhouse gas emissions. Also represents a sustainable use of disused material already available within the site.
Use existing discharge point to Breakfast Creek	Using the existing Breakfast Creek discharge pipe reduces the need for new infrastructure within the waterway and avoids ecological impacts associated with vegetation removal.
Brine pipeline	
Horizontal directional drill (HDD) between Marayong Park and Lynwood Park in Blacktown	Avoids interaction with existing surface infrastructure, including a railway, the Kings Park industrial estate, Sunnyholt Road and multiple private and commercial properties. The vertical alignment of the HDD has been designed to be at least 9 m below ground under all privately-owned lots. During construction, this will reduce potential noise and vibration related impacts. The depth of the HDD also means an easement over private property is not required for the pipeline.
Aligned in one half, or along edge, of public roads	Installing the pipeline in one side of the public road minimises the need for full road closures, so decreases the likelihood of potential traffic and transport impacts during construction and maintenance activities.
Pipeline alignment through Harvey Park, Blacktown	The final pipeline alignment avoids sensitive areas of vegetation along the shared path south of Harvey Park. The route has considered existing services and the amenity value of the playing fields.
Barometric loop micro-siting and pipeline re-alignment	As the only large piece of above-ground infrastructure associated with the brine pipeline, siting the barometric loop within public land was necessary for effective pipeline operation. Different pipeline alignments were assessed to balance community, environmental and technical needs.
Routing the pipeline within road reserves, shared paths, and co-locating with existing pipelines where practicable	Minimises potential environmental impacts through siting the pipeline in previously disturbed areas.

Design aspect	Reason
No surface crossings of waterways	Minimises construction-related impacts to waterways, such as sedimentation and / or spills or hydrocarbons.
Alignment of pipeline between Quakers Hill WRRF to Falmouth Road (Blacktown) to avoid vegetation where possible	Minimises impacts to vegetation either side of the shared path, particularly the stand of vegetation to the north-east. Should pruning or vegetation removal be required, it will be limited to the stand of vegetation south-east of the shared path at this location.
Construction near the Blacktown Aquatic Centre	The existing brine pipeline travels through an easement on a private property driveway before entering the aquatic centre carpark. The preferred option was re-routed through local streets and enters the carpark through a vacant lot on Winifred Crescent (Blacktown) to avoid constructing through a driveway.

Further to the design decisions presented in Table 2-2, minimising potential environmental impacts has also been considered in construction planning. For example:

- The location and size of construction compounds has been refined throughout the proposal's planning phase to avoid vegetation and reduce the amount of land required, while retaining a reasonable degree of flexibility for the delivery contractor.
- Decisions regarding the construction compounds and methodology have considered community feedback. For example, tenants along Gate Road have been consulted on the potential disruption of HDD retrieval pits. Comments received were used to understand ongoing access requirements.
- Where the temporary lay-out of pipe to be 'pulled' through the HDD tunnel (known as 'pipe stringing') is required, stringing the pipe under Breakfast Road and Venn Avenue to minimise impacts on road/traffic flows.

2.3 Consideration of Ecologically Sustainable Development

Table 2-3 considers how the proposal aligns with the principles of ecologically sustainable development (ESD).

Table 2-3 Consideration of principles of ecologically sustainable development (ESD)

Principle	Proposal alignment
Precautionary principle – if there are threats of serious or irreversible environmental damage, lack of scientific uncertainty should not be a reason for postponing measures to prevent environmental degradation. Public and private decisions should be guided by careful evaluation to avoid serious or irreversible damage to the environment where practicable, and an assessment of the risk-weighted consequences of various options.	The proposal will not result in serious or irreversible environmental damage and mitigation measures have been designed to reduce scientific uncertainty relating to the proposal. The proposal has been informed by a range of specialist environmental investigations including desktop investigations, field investigations and modelling. This means there is a high level of certainty about the proposal's potential impacts. A key objective of the proposal is to minimise potential environmental impacts by improving the quality of water released to Breakfast Creek from Quakers Hill WRRF.

Principle	Proposal alignment
	Opportunities to avoid potential environmental impacts through design have been explored and identified. Where avoidance of a potential environmental impact is not possible, mitigation measures have been identified and proposed within Chapter 6 to minimise the severity of any adverse effects.
Inter-generational equity – the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.	The proposal will help to meet the needs of future generations by providing a reliable wastewater service and improving the quality of water released to Breakfast Creek. It will also produce high-quality water that could be used as feedwater for potential future recycled water uses. A sustainability opportunities register has been prepared for the proposal and used to inform mitigation requirements with respect to climate change. Further consideration of climate change is provided in section 6.17.
Conservation of biological diversity and ecological integrity – conservation of the biological diversity and ecological integrity should be a fundamental consideration in environmental planning and decision-making processes.	The proposal will not significantly impact biological diversity or ecological integrity. The proposal is expected to improve waterway health and ecology through upgrading treatment processes at Quakers Hill WRRF. Proposal design has considered biodiversity constraints and been refined to avoid and minimise impacts on threatened ecological communities. Where avoidance of high value ecological features is not possible, exclusion zones and / or mitigation measures have been identified in section 6.9.
Improved valuation, pricing and incentive mechanisms - environmental factors should be included in the valuation of assets and services, such as 'polluter pays', the users of goods and services should pay prices based on the full life cycle costs (including use of natural resources and ultimate disposal of waste) and environmental goals	The proposal will provide cost efficient use of resources and provide optimum outcomes for the community and environment. Options assessment for the proposal considered cost and community impacts. For example, the MCA process undertaken for the brine pipeline found the proposal scored the highest across all criteria, including a good cost rating and a fair community rating.

3. Proposal description

3.1 Proposal overview

The proposal scope includes:

- modifying existing assets and installing ancillary infrastructure at Quakers Hill WRRF to enable the proposal (section 3.2.1)
- secondary wastewater treatment process upgrade to increase treatment capacity of the WRRF from 28 ML/d up to 48 ML/d and provide suitable feedwater for the new AWTP (section 3.2.2)
- AWTP to treat wastewater to a high quality before release to Breakfast Creek (section 3.2.3)
- brine pipeline with associated valves, chambers, barometric loop and maintenance access points to transport brine to the existing wastewater network (section 3.2.4).

Assets could be installed incrementally in a staged approach.

All components will be located within the existing Quakers Hill WRRF site except for the brine pipeline, as shown in Figure 2-1. All infrastructure is in the Blacktown Local Government Area (LGA). The WRRF site at 240 Quakers Road (Lot 1, DP 1029672) is owned by Sydney Water. The brine pipeline will be built primarily on public land, with some sections tunnelled beneath private properties.

3.2 Proposal design

The details in this section are based on a concept design and therefore represent the likely scale and location of infrastructure. Details may be modified as detailed design progresses. Section 3.2.5 provides more detail about how this REF accommodates the need for some flexibility in the design.

3.2.1 Existing asset modifications and ancillary infrastructure

Existing assets within the WRRF need to be modified to support construction and operation of the proposal. This includes changes to various treatment plant components, tanks, pumps, chemical storage, site services, electrical and automation components. The type of modification required depends on the asset but can include retrofitting connections, cut-ins, reuse, demolition, or the addition of structures.

Two Intermittently Decanted Aerated Lagoons (IDALs) will be demolished and infilled. These are currently unused and occupy the proposed location of the AWTP. Section 3.6.2 provides more details about this.

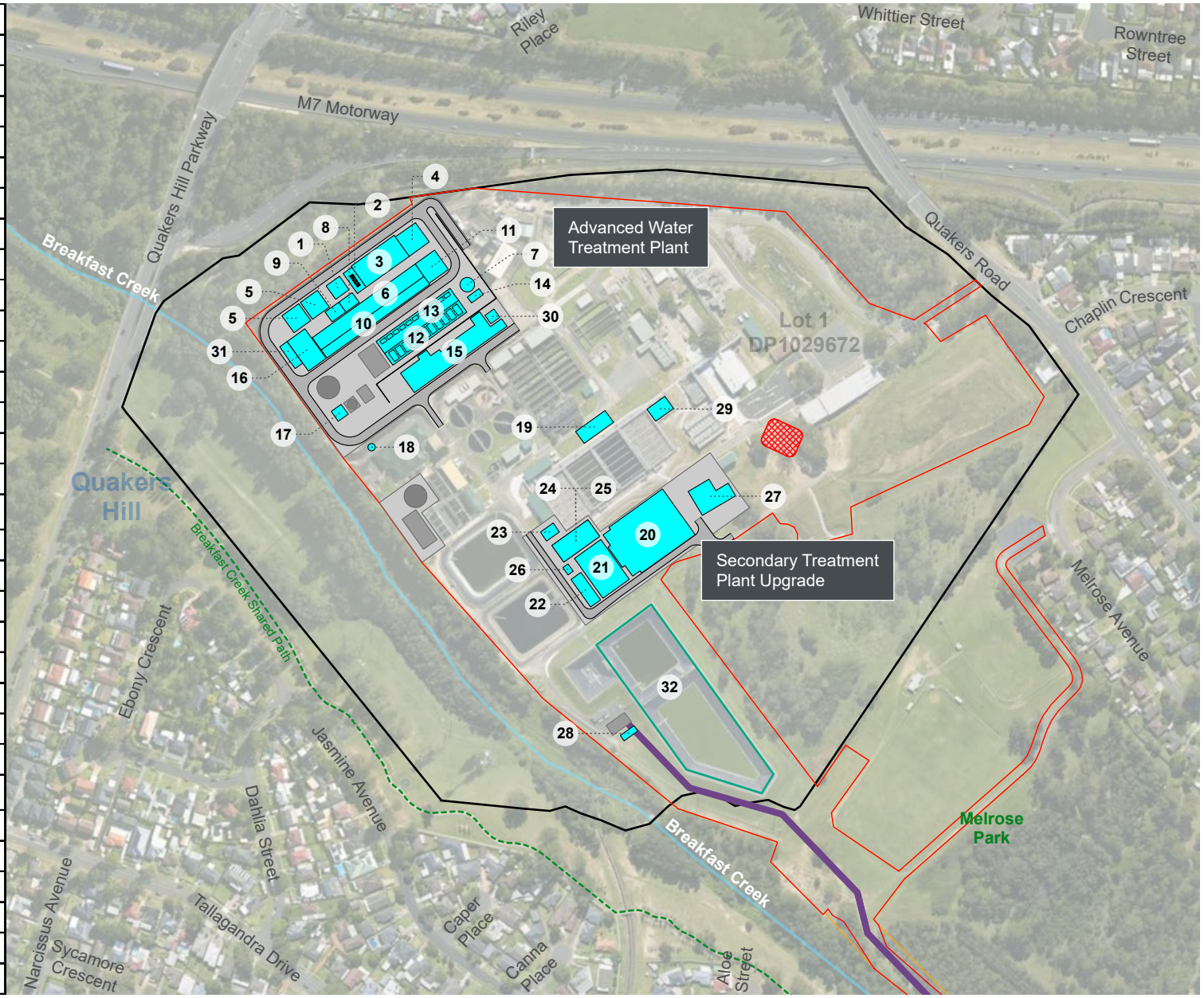
Ancillary infrastructure such as connecting pipelines, valves and isolation points, safety equipment, electricity cables, utility conduits, site lighting and internal roads will also be built to support the secondary wastewater treatment upgrade and AWTP.

3.2.2 Secondary wastewater treatment

The secondary wastewater treatment plant will be located near the middle of the existing Quakers Hill WRRF site on vacant land adjacent to existing infrastructure. Figure 3-1 shows the indicative location of the secondary wastewater treatment plant and supporting assets. Section 3.3.2 describes the new secondary wastewater treatment process.

The new secondary treatment plant includes a range of new infrastructure including bioreactors, pumps, screens, odour control, and buildings including for a switch room and blower room. Most of the infrastructure is process units such as large tanks that will be located outside. The largest outside structures will be the bioreactor (about 58 m long, 70 m wide and 6 m high) and the odour control discharge stack at about 14 m high. The main building required is a 2-storey building up to 12 m high to house the switch room and blower room.

1	Ultrafiltration (UF) Feed Tank	AWTP Area
2	UF Feed Pumps	AWTP Area
3	UF Building	AWTP Area
4	UF Clean in place (CIP)	AWTP Area
5	Reverse osmosis (RO) Feed Tank	AWTP Area
6	RO Building	AWTP Area
7	RO Permeate Building	AWTP Area
8	Low pressure RO Pumps	AWTP Area
9	Cartridge Filters	AWTP Area
10	High pressure RO Pumps	AWTP Area
11	RO CIP	AWTP Area
12	Enhanced Treatment	AWTP Area
13	Enhanced Treatment Feed Pumps	AWTP Area
14	Service Water & RO Flush Pumps	AWTP Area
15	Chemical Dosing Area	AWTP Area
16	AWTP and PRW Switchrooms	AWTP Area
17	AWTP pH Correction & Stabilisation Standpipe	AWTP Area
18	AWTP Flow Splitter Tank	AWTP Area
19	Odour Control Facility	AWTP Area
20	Bioreactor	Secondary Treatment Area
21	Membrane bioreactor (MBR)	Secondary Treatment Area
22	MBR Permeate Pumps	Secondary Treatment Area
23	MBR & Bioreactor Switchroom	Secondary Treatment Area
24	MBR & Bioreactor Switchroom	Secondary Treatment Area
25	Blower Room	Secondary Treatment Area
26	Waste activated sludge / Scum Pumping Station	Secondary Treatment Area
27	MBR Pre-screen	Secondary Treatment Area
28	Brine Pump Station	Secondary Treatment Area
29	Cover existing sludge tank	AWTP Area
30	Clean Water Lab	AWTP Area
31	AWTP/PRW Transformers	AWTP Area
32	Existing Brine Storage Tanks	Secondary Treatment Area



Quakers Hill WRRF
Advanced treatment upgrade infrastructure
Plant access
Plant hardstand
Existing Brine Storage Tanks

Impact area
Impact assessment area
Exclusion area

Brine pipeline construction method
Open trench

Figure 3-1 Indicative arrangement and impact area of secondary wastewater treatment upgrade and AWTP

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

3.2.3 Advanced water treatment

The proposed AWTP will be in the west of the existing Quakers Hill WRRF site, in an area currently occupied by 2 disused IDALs. Figure 3-1 shows an indicative layout of the AWTP. Section 3.3.2 describes the new advanced water treatment process.

The new AWTP includes a range of new infrastructure, including buildings for ultrafiltration, reverse osmosis, enhanced treatment, chemical dosing, a switch room, a workshop and a laboratory. It also includes a range of outside structures such as tanks and pumps. The largest building for the AWTP will be the reverse osmosis building at about 118 m long, 22 m wide and 12 m high. The tallest outside structure will be the flow splitter tank at about 14 m high.

The existing brine storage tanks in the southern section of the WRRF have capacity to store 28 ML of brine transferred from St Marys WRRF before releasing to the NSOOS via the existing brine pipeline. No changes to the existing brine storage tanks are proposed. However, they will also store brine generated during AWTP operation and will need to be connected to the AWTP.

3.2.4 Brine pipeline

The new brine pipeline is about 8 km long and will be located underground between Quakers Hill WRRF in the west and International Peace Park (Seven Hills) in the east, where it will connect into the NSOOS. The proposed pipeline will be about 500 mm diameter, providing up to 38 ML/d flow capacity. Brine will be managed at the Quakers Hill WRRF during wet weather and stored to avoid impacting wet weather overflow frequency or volume in the NSOOS.

Figure 3-2 shows the route of the brine pipeline. The brine pipeline will be constructed using a combination of tunnelling and open trenching methods. Ancillary infrastructure is required along the brine pipeline including:

- air valves (about 19 required at high points along the pipeline to expel air when the pipeline fills with water)
- scour valves and scour chambers (about 17 required at low points along the alignment to drain or flush sections of the pipeline)
- isolation valves (about 3 isolation valves required in trenched sections to stop or control flow in the pipe)
- maintenance hole (about 8 maintenance holes required to allow access for inspection and maintenance).

These are either located in the pipe or with a low profile on the ground surface. The exact locations of these structures will be determined during detailed design.

An above ground barometric loop is required at the high point of the pipeline. Barometric loops are required where the high point of the pipeline is higher than the outlet, to manage the pressure change. The barometric loop will be about 12 m high and 2.5 m diameter, with a chain link fence installed around it. Figure 3-3 provides an illustration of how a barometric loop works, with an artist's impression in section 6.14.

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

Figure 3-2a Construction methodology and impact area of the brine pipeline

Impact area
Impact assessment area
Construction compounds

Watercourse
Shared path

Brine pipeline construction method
Open trench
HDD pipe string

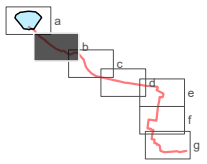


Figure 3-2b Construction methodology and impact area of the brine pipeline

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

Impact area
Impact assessment area
Construction compounds

Watercourse

Brine pipeline construction method
Open trench

HDD
HDD pipe string

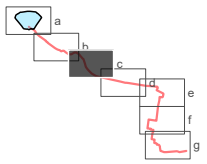


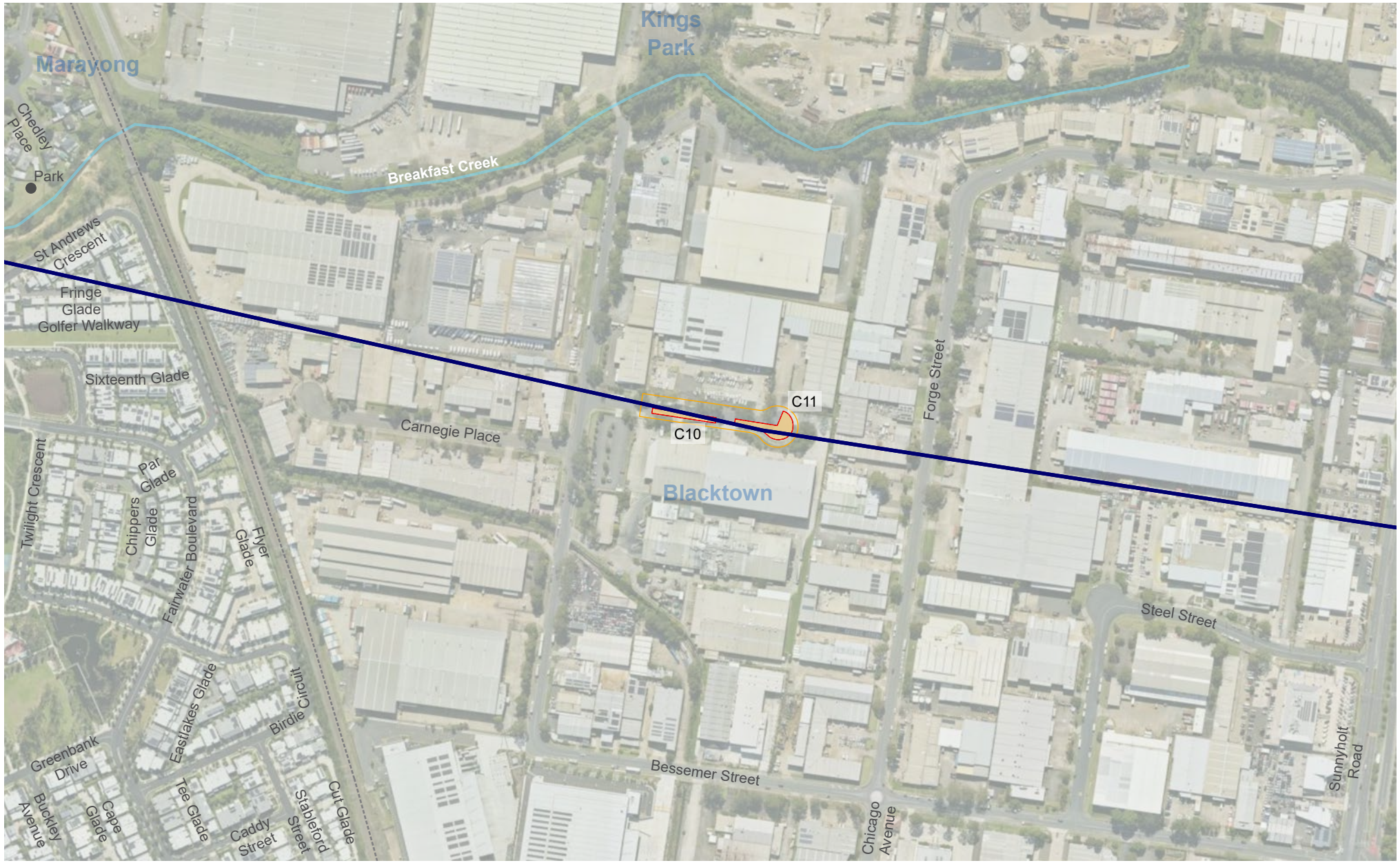
Figure 3-2c Construction methodology and impact area of the brine pipeline

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025

Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N



Impact area
Impact assessment area
Construction compounds

Watercourse

Brine pipeline construction method

HDD

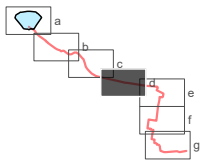


Figure 3-2d Construction methodology and impact area of the brine pipeline

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025

Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

Impact area
Impact assessment area
Construction compounds

Brine pipeline construction method
Open trench
HDD
HDD pipe string

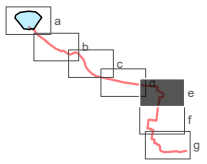


Figure 3-2e Construction methodology and impact area of the brine pipeline

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

Impact area
Impact assessment area
Construction compounds
Barometric loop

Brine pipeline construction method
Open trench
HDD pipe string

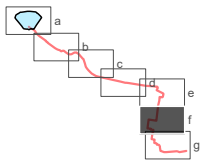


Figure 3-2f Construction methodology and impact area of the brine pipeline

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

Impact area
Impact assessment area
Construction compounds
NSOOS pipeline

Watercourse

Brine pipeline construction method

Open trench

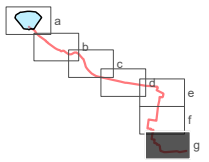


Figure 3-2g Construction methodology and impact area of the brine pipeline

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025

Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

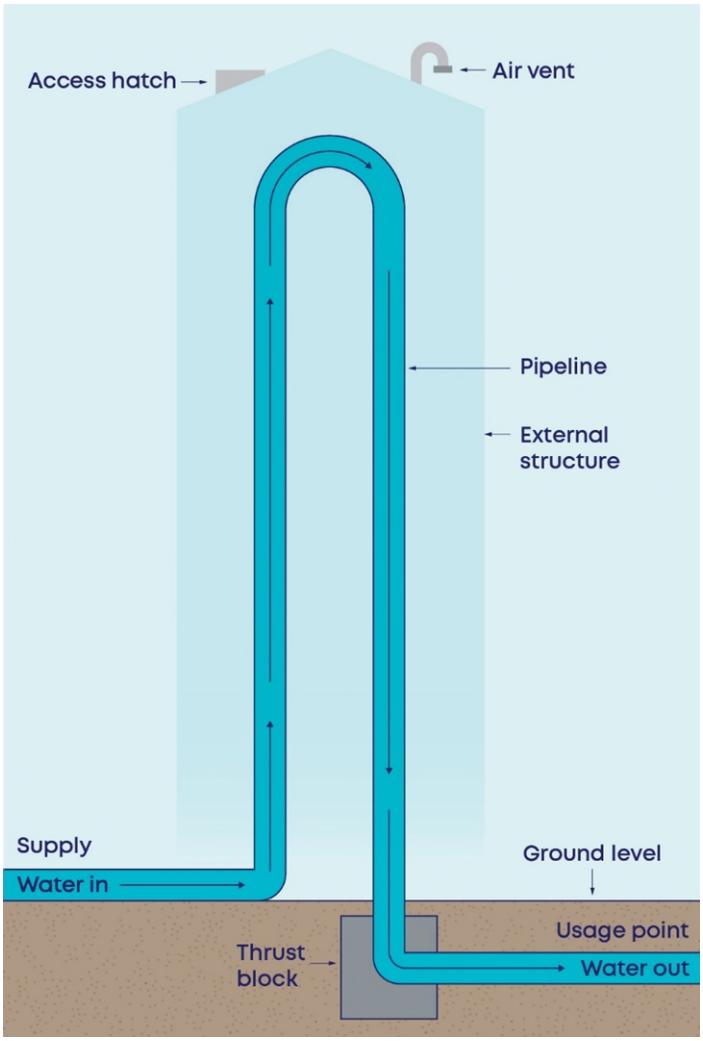


Figure 3-3 Illustration of barometric loop

3.2.5 Design flexibility

The infrastructure described in this REF is indicative and based on the concept design at the time of writing. Impacts have been assessed based on an impact area, shown on Figure 3-1 and Figure 3-2.

The proposal defines an impact assessment area in some locations to give some flexibility in locating infrastructure without needing further environmental impact assessment (for example, locating the brine pipeline along the opposite side of a road; or the exact location and size of equipment at Quakers Hill WRRF). The final proposal may change based on detailed design and construction planning. The general mitigation measures in Table 6-56 outline when changes to the proposal trigger supplementary environmental impact assessment.

Sydney Water may locate the proposal anywhere in the impact assessment area, provided changing the location has no additional net environmental impact.

This REF seeks approval to build and operate the proposal, to treat an average of 48 ML/d on any given day within a year. On any given day, the treated volume could be lower or higher than 48 ML. The exact volume will depend on how much wastewater is generated and the amount of rainfall. Section 3.3.3 provides details regarding the flow capacity of the proposal.

3.3 Operation – wastewater treatment

The secondary wastewater treatment upgrades and AWTP at Quakers Hill WRRF will be constructed, operated and maintained to meet Sydney Water's obligations under EPL 1724. As required by the EPL, the proposal has been designed to avoid dry weather overflows. The proposal will be operated according to standard Sydney Water procedures and policies.

The sections below provide more detail on existing and proposed future operation of Quakers Hill WRRF, including wastewater treatment processes, future flow volumes and water quality.

3.3.1 Current WRRF treatment

Sydney Water owns and operates Quakers Hill WRRF, which services Quakers Hill wastewater catchment shown in Figure 3-4. The existing WRRF receives wastewater from businesses, industry and domestic properties and treats an average of 28 ML/d through a series of preliminary, primary, secondary and tertiary treatment processes. Each stage of the process has a higher quality of treatment to remove more inorganic and organic impurities. About 12.5 ML/d of treatment byproduct (2.5 ML/d sludge and 10 ML/d effluent) is transferred to St Marys WRRF. Brine produced at St Marys WRRF is stored at Quakers Hill WRRF before transfer to the NSOOS.

Sydney Water designs treatment processes based on average dry weather flow (ADWF). This is the average volume of incoming wastewater that Quakers Hill WRRF is expected to receive from the servicing area each day. Actual incoming wastewater volume may be lower or higher than the average, depending on how much wastewater is generated and how much rainfall there has been. Volumes increase substantially during wet weather for reasons including illegal stormwater connections to the wastewater system and stormwater entering the system through damaged wastewater pipes.

Treated wastewater is released to Breakfast Creek, in accordance with EPL 1724. An update to the EPL requiring compliance with more stringent water quality parameters took effect from July 2025.

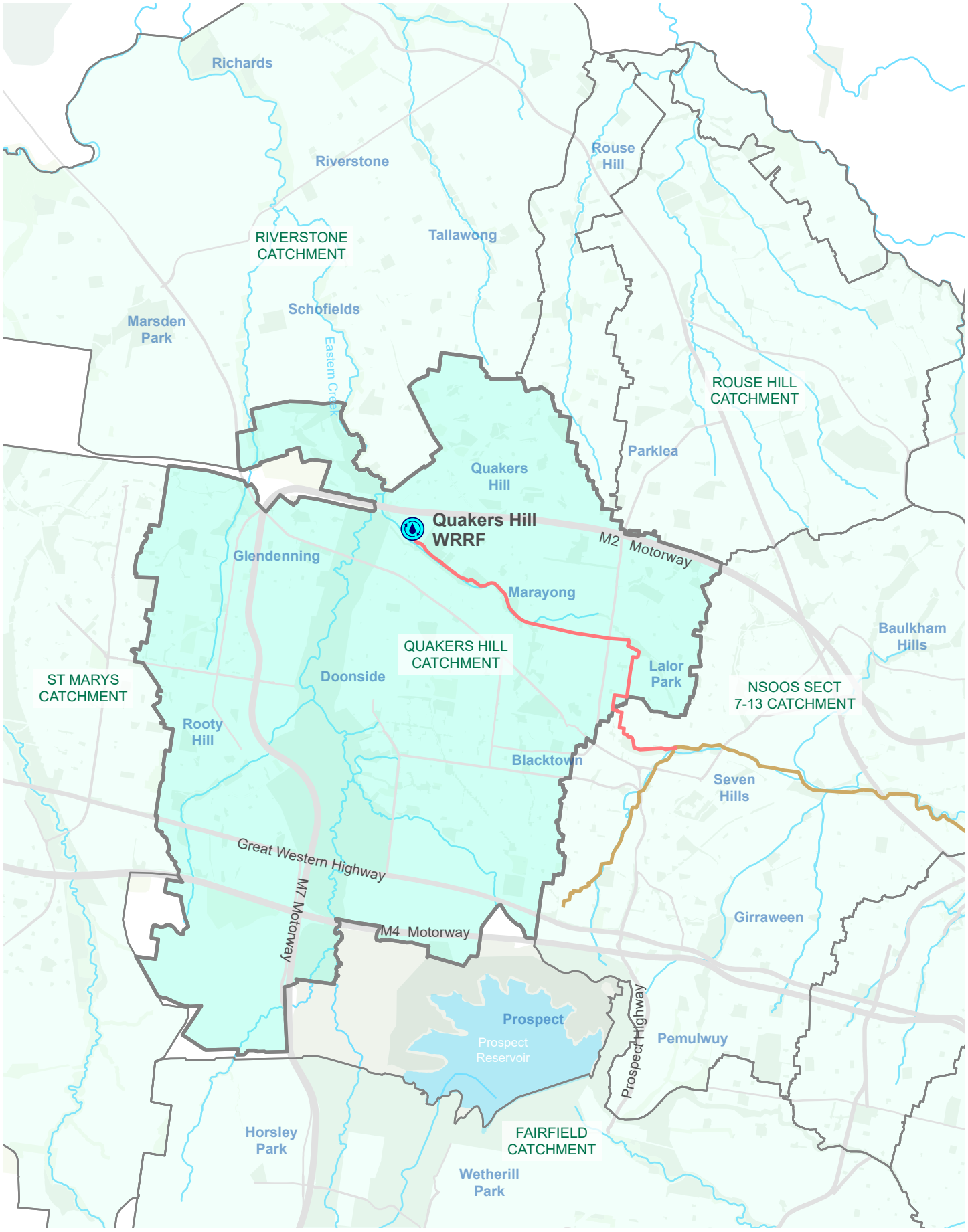


Figure 3-4 Quakers Hill WRRF wastewater treatment catchment

The existing steps of wastewater treatment at Quakers Hill WRRF comprise:

- Preliminary treatment uses physical processes and barriers to remove debris in the feedwater and is an important step to avoid damage to downstream wastewater treatment units and ensure they operate efficiently.
- Primary treatment uses mechanical methods to remove solids within the wastewater, aided by a few chemical agents.
- Secondary treatment uses biological processes to breakdown residual solids within primary treated wastewater and further remove organics.
- Tertiary treatment can use a mix of mechanical and chemical means of further removing solids and clarifying primary and / or secondary treated wastewater.
- Before release to Breakfast Creek, the wastewater undergoes a final stage of disinfection in a chlorine contact tank (CCT).

Figure 3-5 illustrates the existing wastewater treatment process at Quakers Hill WRRF, following preliminary treatment. All treatment steps are and will continue to be monitored to ensure the wastewater meets quality requirements before being further treated.

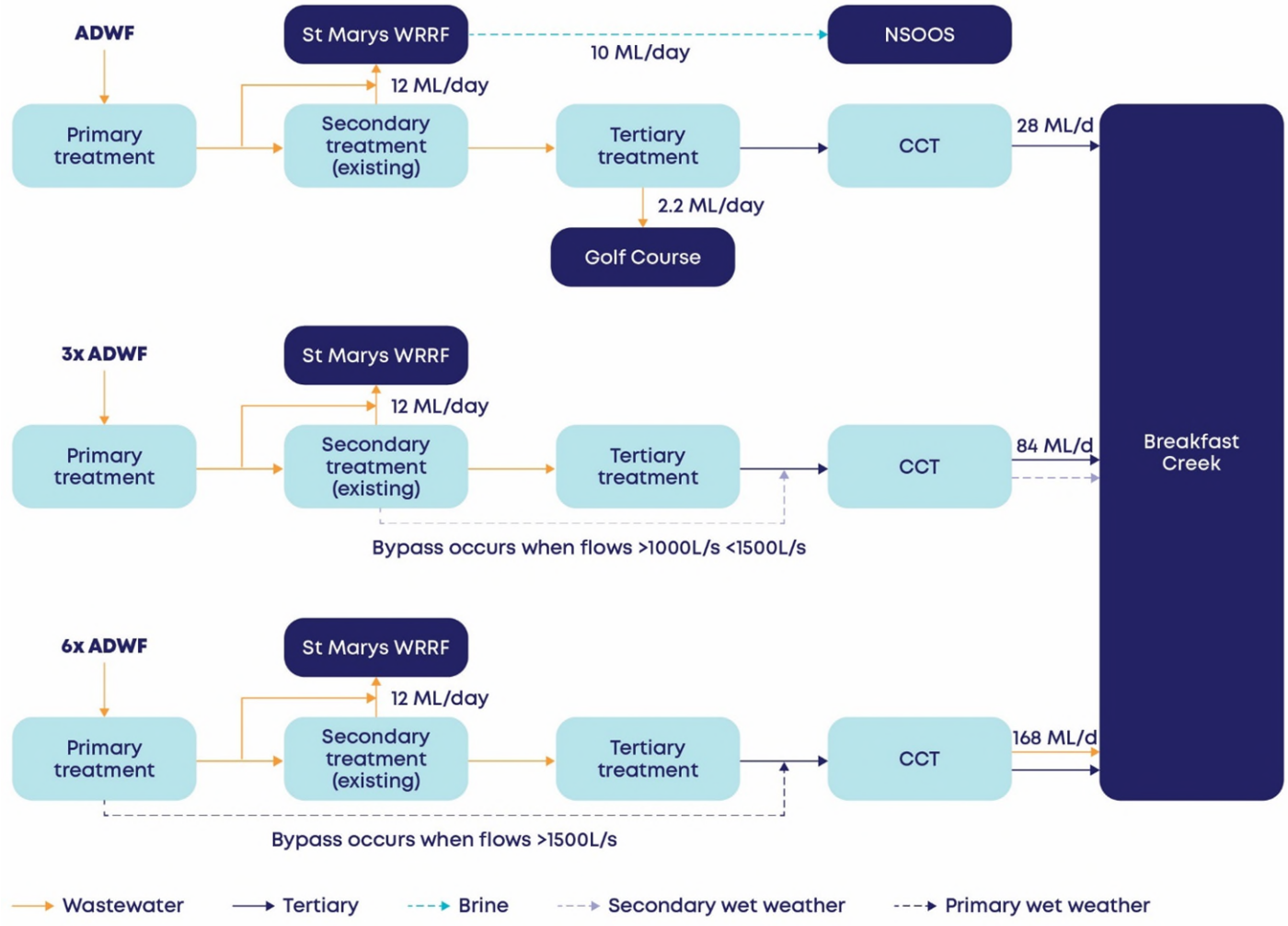


Figure 3-5 Quakers Hill WRRF existing treatment flow diagram for a range of wastewater inflow scenarios

As shown in Figure 3-5, transfers of tertiary treated water to Stonecutters Ridge Golf Course are peak flows. Flows will be up to 2.2 ML/d.

The wastewater treatment processes at Quakers Hill WRRF are supported by ancillary processes that enable primary and secondary wastewater treatment. These include pumping between treatment steps, effluent and solids transfer to St Marys WRRF, chemical dosing, odour control, power supply and brine storage.

3.3.2 Proposed wastewater treatment

Under the proposal, a new secondary treatment stream will be built, primarily comprising up to 2 bioreactor trains operating in parallel with integrated MBR treatment technology supported by ancillary assets (including additional pump stations and fine screens). The bioreactors provide a sequence of anaerobic, anoxic and aerobic conditions, each accommodating microbes that remove nitrates and phosphorus from wastewater. Wastewater will cycle between aerobic and anoxic zones within the bioreactor and be dosed with ferric chloride. It will flow to the MBR where filtrate progresses to advanced treatment, while sludge formed in the MBR is returned to the bioreactor for further nutrient removal.

MBR technology combines an activated sludge process with a membrane filtration process (either microfiltration or ultrafiltration). Feed water will flow into the MBR directly from the bioreactor. During normal operation, the MBR will increase the ADWF capacity of the secondary wastewater treatment process at Quakers Hill WRRF by 20 ML/d to a total of 48 ML/d. However, the peak hydraulic capacity of the MBR system will accommodate wet weather flows of up to 6x ADWF (288 ML/d). Flows of 48 ML/d are not expected when the proposal first starts operating. Flows are expected to gradually increase to that point over time, as wastewater inflows increase from growth in the catchment.

The MBR process unit consists of a series of treatment trains, operating with some trains on duty and some back-up trains on standby at any one time. Duty systems are the typical operating systems. Standby systems typically allow for some redundancy or backup so the plant can continue operating as normal, if there is a problem with the duty system or it needs to be taken offline for maintenance. An additional pump station will be installed with 3 backwash pumps for the purposes of washing the MBR system. An associated clean in place (CIP) system will be installed alongside the MBR for undertaking maintenance and recovery cleans.

The proposal also includes building and operating a new AWTP. Advanced treatment aims to further remove impurities remaining in the wastewater following the primary, secondary and tertiary treatment processes. This includes smaller-sized particles of biological, organic and inorganic material that may have passed through previous treatment stages.

At a high-level, the advanced water treatment process will comprise:

- ultrafiltration of existing plant flows with associated feed tank and pumps
- up to 6 reverse osmosis trains operating in a 5 duty and one standby arrangement and supported by a range of tanks, pumps and filters. The reverse osmosis process produces a brine stream which will be transferred to the NSOOS via a new brine pipeline (the operation of which is described in more detail in section 3.4)
- pH correction and stabilisation, comprising a chemical dosing building housing tanks and dosing pumps.

The number of assets could be installed incrementally in a staged approach.

Reverse osmosis achieves a high quality of treatment by forcing the wastewater through a membrane under high pressure. The quality of permeate produced by each reverse osmosis train will be monitored individually.

During the pH correction and stabilisation process, the reverse osmosis permeate will be dosed with lime and carbon dioxide (CO_2) to balance pH levels and remineralise the wastewater. This prevents concrete corrosion in pipelines and returns salinity and acidity to levels typical within receiving waterways. After correction and stabilisation in the standpipe, the treated wastewater is pumped to the existing chlorine contact tank. It will then mix with other feedwater and be de-chlorinated with sodium bisulphate before it is released to Breakfast Creek or pumped for use at Stonecutters Ridge Golf Course.

Other supporting processes requiring construction of new assets include:

- additional solids transfer to St Marys WRRF. The volume of sludge transferred is expected to remain about the same. Although the treatment capacity is increasing, we intend to further concentrate the sludge. The only changes to the existing solids transfer system are tying a new connection from the bioreactor waste activated sludge (WAS) pumps to the harvest well, and modifications to enable flushing of the pipeline. As a result, no additional impacts to St Marys WRRF are anticipated, beyond those assessed for previous projects
- odour control. Each odour-producing process will be covered during operation, with air extracted and sent to an odour control unit for treatment. Treated air will either be discharged via a new discharge stack or transferred to and released via the current odour control unit servicing the existing Quakers Hill WRRF. The final odour treatment technology will be confirmed during detailed design but is likely to use activated carbon
- chemical dosing. Water will be dosed with various chemicals at different steps of the treatment process. Chloramine (a mix of ammonium hydroxide and sodium hypochlorite) is dosed in the tertiary and advanced treatment stage to manage biological fouling of equipment used in ultrafiltration, MBR and reverse osmosis. Lime and carbon dioxide (CO_2) are added after advanced treatment to balance pH levels and chemically stabilise the water before final disinfection and release
- electricity supply. New pumps and equipment needed to operate and control the proposal require new switch rooms with associated substations and transformers. New cables will provide electricity to the new plant from a high voltage supply (to be assessed in a separate approval).

3.3.2.1 Other operating scenarios

On occasion, there may be a need to release wastewater to Breakfast Creek without full advanced water treatment. This could include situations such as:

- if there is an unforeseen power or equipment failure of the reverse osmosis process unit requiring all or some of the trains to be taken offline for emergency repairs, preventing treatment of all or some of the feedwater
- if the reverse osmosis process unit is required to be taken offline for planned maintenance

- if downstream capacity constraints within the NSOOS requires Quakers Hill WRRF to limit releases of brine
- if the AWTP needs to shut down to avoid damage during prolonged periods of wet weather or during other planned or unforeseen events
- if the quality of feedwater to, or permeate from, the reverse osmosis process unit does not meet the required quality specification.

The current supply of recycled water to Stonecutters Ridge Golf Course will be retained. In addition, some water may also be supplied directly to additional recycled water customers from Quakers Hill WRRF. However, this falls outside the scope of the proposal and would be subject to separate approvals.

3.3.3 Future flows

ADWF at Quakers Hill WRRF is forecast to increase due to the catchment's growing population. The design for the proposal is based on an ADWF of 48 ML/d, as described in section 3.3.1. Planning for the proposal has also considered the peak dry weather flow (PDWF) scenario and wet weather flows (WWFs):

- PDWF — Quakers Hill WRRF has a historic diurnal peak inflow rate (from 2018 to 2022) during dry weather equal to 1.6 times the ADWF. This multiplier has been adopted as the PDWF rate for the design of the proposal. Based on an ADWF of 48 ML/d, the PDWF is 77 ML/d.
- Peak wet weather flow (PWWF) — Quakers Hill WRRF inlet works pump station has a maximum capacity of 288 ML/d, or about 6 times the ADWF. This flow rate has been adopted as the PWWF for the proposal.
- Moderate wet weather flow — A wet weather flow of 3 times the design ADWF or 144 ML/d has also been considered.

The ADWF scenario is being used for the purposes of the assessment presented in this REF given it represents the operating scenario expected over 90% of the time. However, potential impacts on waterway health associated with wet weather flows has been considered with the assessment presented in section 6.3.

The frequency of each of these scenarios is presented in Table 3-1.

Table 3-1 Indicative frequency of flow scenarios

Flow scenario	ADWF	PDWF	Moderate WWF (3x ADWF)	PWWF (6x ADWF)
Frequency	91% (332 days)	3% (11 days)	5% (18 days)	1% (4 days)

The AWTP produces treated water and brine. Table 3-2 shows the treated water and brine release volumes relative to the inflow volumes under different flow scenarios.

Table 3-2 Quakers Hill AWTP flow scenarios (ML/d)

Flow scenario	Inflow	Releases to Breakfast Creek	Transfer of brine to NSOOS[1]	Transfer to St Marys (sludge & sewage)	Transfer to Stonecutters Golf Course[2]
Average dry weather flow (ADWF)	48	34	5 – 7	1 – 4	0 – 2.2
Peak dry weather flow (1.6x ADWF)	77	61	10	1 – 4	0 – 2.2
Moderate wet weather flow (3x ADWF)	144	140	0	1 – 4	NA
Peak wet weather flow (6x ADWF)	288	284	0	1 – 4	NA

Notes:

1 This does not include existing dry weather St Marys AWTP brine transfers to NSOOS from Quakers Hill WRRF, which are typically around 10 ML/d

2 During wet weather flows, treated water is not transferred to Stonecutters Golf Course due to water quality potentially being too high in nutrients

Table 3-2 presents a summary of typical operations during selected scenarios to provide an indication of volumes and release locations. Daily volumes of treated water released to Breakfast Creek will increase compared to existing flows:

- Under an ADWF scenario, the volume of treated water released to Breakfast Creek is predicted to increase by about 6 ML/d. This relatively small increase is due to some of the product being converted to brine and discharged to the NSOOS.
- Under a 3x ADWF scenario, the volume of treated water released to Breakfast Creek is predicted to increase by 56 ML/d. This increase is due to increased flows coming to Quakers Hill WRRF associated with storm water infiltration into the wastewater network.
- Under a 6x ADWF scenario, the volume of treated water released to Breakfast Creek is predicted to increase by 116 ML/d. This significant increase is due to the advanced treatment process unit shutting down during PWWF to preserve the integrity of equipment. In the absence of advanced treatment, no brine is produced and nearly all treated effluent will be released to Breakfast Creek.

The treated water release volume can vary depending on a range of factors:

- The flow entering the treatment plant each day can vary.
- While certain treatment processes have capacity limits, there is some ability to balance flows within the plant.

- Designs are based on assumed levels of reliability of various treatment processes.

While a range of contingencies will be in place to minimise this, there are times when the AWTP will not be operating, as outlined in section 3.3.2.1. Figure 3-6 illustrates the proposed treatment process at Quakers Hill WRRF (pale blue boxes) under a range of future flow input scenarios.

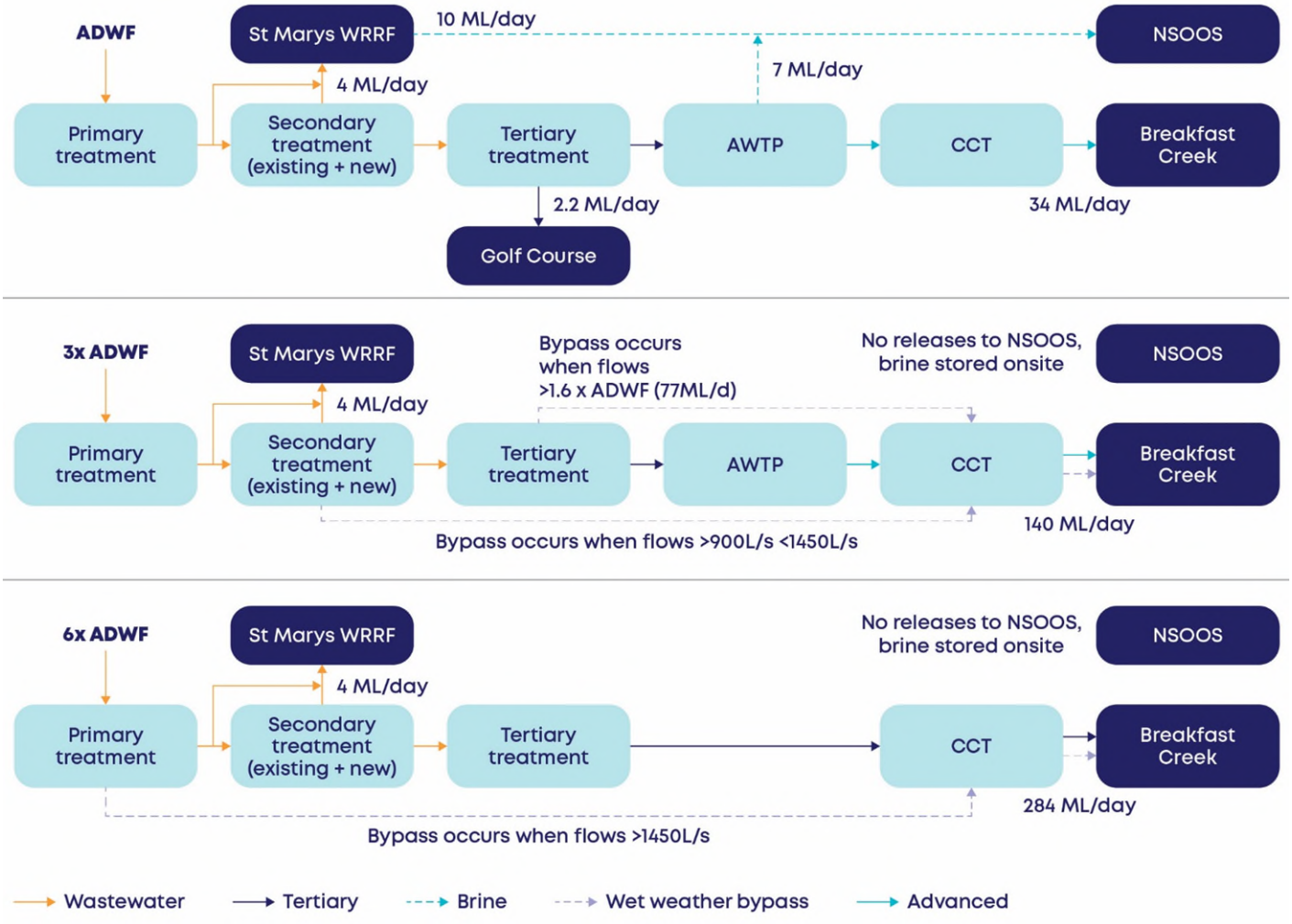


Figure 3-6 Treatment flow diagram under the proposal

3.3.4 Treated water quality

The proposal will primarily produce treated water at 2 tiers of quality:

- advanced (very high-quality) treated water
- tertiary (high quality) treated water.

During wet weather events, when the capacity of the tertiary and advanced treatment process units is exceeded, some flows will only receive primary or secondary treatment (as shown in Figure 3-6). This is to reduce the risk of damage to equipment (i.e. biofouling of the reverse osmosis system from nutrient carryover). W Table 3-3 compares existing treatment with proposed treatment for different flow scenarios.

Table 3-3 Existing and proposed treatment levels for flow scenarios

Flow scenario	Existing		Proposed	
	Treatment level	Volume (ML/d)	Treatment level	Volume (ML/d)
ADWF	Tertiary	28	Advanced	48
Peak dry weather flow (1.6x ADWF)	Tertiary	45	Advanced	77
Wet weather flow (3x ADWF)	Tertiary[1]	84	Advanced[3]	144
Peak wet weather flow (6x ADWF)	Tertiary[2]	168	Tertiary[4]	288

Notes:

1 Flows > 1,000 L/s and < 1,500 L/s receive secondary treatment only

2 Flows > 1,500 L/s receive primary treatment only

3 Flows > 900 L/s and < 1,450 L/s will receive secondary treatment only

4 Flows > 1,450 L/s will receive primary treatment only

Wastewater receiving higher levels of treatment will have lower concentration of total nitrogen, total phosphorus and ammonia. Table 3-4 shows indicative concentrations of different water quality parameters for the different flow scenarios.

Table 3-4 Indicative concentration of water quality released to Breakfast Creek for different treatment levels

Parameter	Units	Advanced treatment		Tertiary treatment	
		ADWF 50th percentile	ADWF 90th percentile	3x ADWF	6x ADWF
Physical parameters					
Temperature	°C	23.40	26.20	23.40	23.40
Total suspended solids (TSS)	mg/L	4.00	8.00	2.00	4.00
Total dissolved solids (TDS)	mg/L	54.00	54.00	207.87	189.73
pH	pH units	7.50	7.50	7.50	7.50
Dissolved Oxygen	mg/L	4.00	4.00	4.00	4.00
Nutrients and metals					
Total nitrogen (TN)	mg/L as N	0.35	0.75	8.40	4.10

Parameter	Units	Advanced treatment		Tertiary treatment	
		ADWF 50th percentile	ADWF 90th percentile	3x ADWF	6x ADWF
Nitrogen Oxides	mg/L as N	0.22	0.45	4.00	2.60
Nitrogen (Ammonia)	mg/L as N	0.03	0.10	1.40	1.40
Total phosphorus (TP)	mg/L as P	0.01	0.02	2.00	0.70
Soluble Reactive Phosphorus	mg/L as P	0.01	0.03	1.20	1.00
Aluminium (filtered)	mg/L	0.08	0.10	0.17	0.08
Cobalt	µg/L	0.13	0.14	0.15	0.10
Copper	µg/L	0.04	1.97	0.86	0.58
Nickel	µg/L	0.58	0.64	0.70	0.44
Zinc	µg/L	5.23	14.41	6.89	2.18

Notes

1. TSS is higher for advanced treatment due to the need for lime dosing of the reverse osmosis permeate.
2. Most parameters are generally more dilute at 6x ADWF, which means they have lower concentrations than 3x ADWF

3.4 Operation – brine

Given brine will be transferred to the NSOOS, it will be subject to conditions of the Northern Suburbs Sewage Treatment System EPL (EPL 378). The sections below provide more detail on existing and proposed future operation of Quakers Hill WRRF, specifically regarding brine transfer, future brine volumes and quality.

3.4.1 Current brine transfer

Quakers Hill WRRF does not produce brine as a byproduct of current operations. Brine produced by an AWTP at St Marys is transferred to Quakers Hill WRRF before being pumped to the NSOOS via an existing brine pipeline. During wet weather, brine transferred from St Marys AWTP is stored in tanks at Quakers Hill WRRF. Existing brine tanks at Quakers Hill WRRF have capacity to store 28 ML of brine before being pumped to the NSOOS. However, brine storage tanks are operated at low volumes to reduce the risk of algal growth and knock-on impacts on pumps.

If the capacity of the brine storage tanks is exceeded during prolonged WWF scenarios, the AWTP temporarily shuts down to avoid brine overflows.

3.4.2 Future brine production

Brine will be produced as a byproduct of the treatment process at the AWTP and will be transferred to the NSOOS via a new brine pipeline.

During ADWF, 7 ML/d of brine will be produced by the AWTP such that a total of 17 ML/d of brine will be discharged via the new brine pipeline and the existing brine pipeline to the NSOOS (this includes 10 ML/d from existing transfers of brine from St Marys AWTP to Quakers Hill WRRF).

During moderate wet weather events (3x ADWF) the AWTP will produce 10 ML/d of brine, which will be stored within the existing brine storage tanks (that provide 28 ML of storage). The advanced treatment process will be switched off if the brine storage tanks reach capacity. No brine will be released to the NSOOS via the brine pipeline during moderate wet weather events, as this would cause downstream overflows. Modelling of the wastewater system suggests such an event is likely to happen about 9 days per year, although the exact frequency will depend on the amount of rainfall.

During peak wet weather flows (6x ADWF) the AWTP will be switched off and no brine produced.

Table 3-5 presents the indicative concentrations of parameters within the AWTP brine stream.

Table 3-5 Indicative concentration and composition of the brine stream during ADWF

Parameter	Units	50th percentile	90th percentile
Physical Parameters			
Total suspended solids (TSS)	mg/L	0.67	0.67
Total dissolved solids	mg/L	3,886.83	5,278.48
pH	pH units	7.50	7.50
Dissolved oxygen	mg/L	4.00	4.00
Nutrients and metals			
Biochemical oxygen demand	mg/L	6.67	20
Nitrate	mg/L as N	10.77	31.60
Nitrogen (ammonia)	mg/L as N	2.00	2.00
Nitrogen (total)	mg/L as N	21.43	42.53
Phosphorus (total)	mg/L as P	0.69	3.50
Metals & other			
Aluminium (filtered)	mg/L	4.00	6.60

Parameter	Units	50th percentile	90th percentile
Cadmium	µg/L	1.33	1.33
Chromium	µg/L	4.00	13.33
Cobalt	µg/L	3.33	6.67
Copper	µg/L	20.00	33.33
Iron	mg/L	0.33	0.46
Lead	µg/L	< 1.00	< 2.00
Magnesium	mg/L	100.67	122.60
Mercury	µg/L	< 0.15	< 0.48
Selenium	µg/L	< 2.00	< 3.00
Zinc	µg/L	153.33	127.60
Chlorine	mg/L as Cl_2	0.00	0.11
Nitrogen Oxides	mg/L as N	10.77	31.60
Soluble Reactive Phosphorus	mg/L as P	0.69	3.50

3.4.3 Pipeline failure and maintenance

All pipes will be built to the relevant specifications to ensure that risks are effectively managed. However, there is a residual risk with all pipelines for failure. Sydney Water has processes and procedures in place to respond to the unlikely event of system failures, including leaks. This includes isolating damaged areas for repair and rehabilitating any impacted areas.

Scour valves are proposed to allow emptying of sections of the brine pipeline for maintenance. Scour valves will mostly be connected to the existing wastewater network. Where this is not possible, scour water will be pumped to a tanker and transported offsite to a suitable facility.

3.5 Operating details

3.5.1 Workforce and hours

The secondary wastewater treatment upgrade and AWTP will operate as an integrated component of Quakers Hill WRRF. About 4 operational jobs will be generated by the proposal.

The proposal will typically operate 24 hours a day, 7 days a week, like the existing Quakers Hill WRRF. There may be times when certain components are not operational (for example during maintenance or some wet weather conditions). Operational staff will likely only be present during standard hours unless

emergency work or maintenance is required. The secondary wastewater treatment upgrades and AWTP will be designed to operate autonomously and be linked to systems allowing for remote operation.

The brine pipeline will typically operate 24 hours a day, 7 days a week, consistent with Sydney Water's existing wastewater network. There may be times when brine is not flowing through the pipeline, such as when the AWTP is switched off or when brine is being stored in the storage tanks. No additional workforce is expected for operation of the brine pipeline.

3.5.2 Maintenance

Maintenance activities generally involve inspections, planned maintenance, refurbishment and minor improvements to the mechanical and electrical assets of the treatment plant and pumping stations. Maintenance work is usually carried out by a small number of staff using light vehicles, often by operational staff already working at Quakers Hill WRRF.

Ongoing maintenance activities are outside the scope of this REF. Sydney Water would seek separate environmental approvals if needed for maintenance activities.

3.5.3 Transport and access

Access to the new infrastructure at Quakers Hill WRRF will continue via the existing access on Quakers Road. Table 3-6 outlines expected operational vehicle type, purpose and frequency. The vehicle activity is similar to existing operations at Quakers Hill WRRF, but the number of movements is expected to increase.

Table 3-6 Expected vehicle activity at Quakers Hill WRRF during proposal operation

Vehicle type	Purpose	Frequency
B-double trucks	Chemical deliveries	Every 3-10 days
Articulated trucks	Equipment and lime/chemical deliveries	Monthly
Fixed chassis trucks	Removal of screenings	Weekly – monthly
Mobile crane (Franna)	General maintenance	1-3 months
Long reach mobile crane (with stabilising bars)	Specific maintenance tasks	Annually
Private vehicles / light commercial vehicles	Personnel transport and light maintenance	Daily

3.6 Construction – infrastructure at Quakers Hill WRRF

The below sub-sections discuss likely activities involved in construction of the new assets at Quakers Hill WRRF.

3.6.1 Site establishment and early works

The following activities are required to establish the site:

- site surveys to locate buried services and utilities – e.g. scanning
- set up of site access and traffic management controls – e.g. extension of internal road network
- setting out the site and construction compounds (including boundary marking) before civil works start
- installing safety barriers, fencing and chemical storage as well as erosion and sediment controls including sediment basins
- minor vegetation clearance, in pre-approved areas
- stripping and stockpiling of topsoil for reuse in restoration. Stockpiles to be stored separately and reused at construction completion to support reinstatement and landscaping
- minor earthworks associated with ground levelling.

Exact activities required will be site-specific and may differ between the secondary wastewater treatment upgrades and the AWTP. Site establishment and early works activities will be manual or involve the use of minimal plant and equipment to prepare the site for the main construction activities.

3.6.2 Preliminary civil works

Two IDALs occupy the current site of the proposed AWTP. Both IDALs are earthen-wall ponds 80 m wide and 117 m long. Recent upgrades to Quakers Hill WRRF as part of the Lower South Creek Treatment Program (LSCTP) mean the IDALs are no longer needed and will be decommissioned under a separate project.

As part of the proposal, the IDALs will be demolished and infilled using material stockpiled at Quakers Hill WRRF site from previous Sydney Water projects. While some of the available stockpiled material is known to contain asbestos, safeguards will be implemented to ensure it is safely handled, as outlined in Table 6-3 and Table 6-44.

Excavated material from the secondary wastewater treatment upgrades may be used as infill, in addition to the material described above, if suitable for reuse. Additional material may need to be imported, with volumes to be determined during detailed design. Demolishing and infilling the IDALs will involve:

- excavations to assess potential contamination of material underlying the pond lining
- pumping out water from the IDALs to the head of the WRRF for treatment
- demolishing the IDALs, including removal of internal structures, lining and buried piping within and up to 20 m from the ponds
- classifying waste and disposing it off site

- creating a platform for the AWTP by infilling with stockpiled material and clean fill
- constructing retaining walls and protective fencing for chemical storage areas
- installing below-ground pipework and connections
- stockpiling any remaining material elsewhere in the site.

3.6.3 Main civil works

The main civil works involve installing structures within or below ground. Construction activities include:

- breaking out and excavating for treatment process units
- ground levelling involving redistribution of excavated natural material (ENM) and / or virgin ENM (VENM)
- piling, foundation-laying and constructing the benching / platforms for above-ground structures
- installing below ground pipework and drainage systems
- laying the main access road base.

Both the secondary wastewater treatment upgrade and AWTP components of the proposal will require significant civil works.

3.6.4 Main structural works

The main structural works relate to activities involving the installation of above-ground structures, with more structural work required for the AWTP than the secondary treatment. Construction activities will include:

- installing foundations for buildings
- concrete pouring of base slabs for pumps, tanks and other structures
- creating formwork for concrete structures in the secondary wastewater treatment upgrade and AWTP
- building water-retaining structures
- constructing steel frame buildings to house the water treatment process units
- building brick and / or tilt slab buildings to house electronic equipment for the switch room and workshop
- roofing and cladding of buildings.

3.6.5 Main mechanical and electrical works

The main mechanical and electrical works relate to assets that require mechanical processes and a source of power for operation. Construction activities will include:

- installing wastewater and water treatment process units, such as reverse osmosis trains
- fitting out buildings with plumbing, wiring and electrical systems (i.e. lighting, communications), and heating, ventilation and air condition (HVAC) systems
- tying in interconnecting pipework and connecting process units
- connecting to electricity source and powering process units.

Works to install and upgrade the Quakers Hill WRRF power supply to a high voltage (HV) system are also required and these will be subject to a separate approval as outlined in section 3.9.

3.6.6 Post-construction

3.6.6.1 Commissioning

Following completion of each stage of works, testing and commissioning activities will be carried out to ensure the safe and effective operation of installed plant and equipment. The overarching testing and commissioning activities expected are:

- pipework – filling with water, pressure testing, flush test
- water retaining structures – filling with water to inspect for leaks
- treatment process units – mechanical and electrical testing, filling with water, pressure testing, flush test
- monitoring devices – electrical and signal testing
- buildings – structural testing, electrical and power testing.

Minor works may be required to remedy any faults identified with the wastewater treatment infrastructure installed until testing and commissioning confirms the assets are performing to the required standards.

3.6.6.2 Restoration

The working areas of the construction site will be returned to the pre-construction condition. Key activities include:

- dismantling the site, cleaning up and restoring areas
- removing waste materials, machinery and excess materials
- removing environmental controls, contractor site sheds, temporary fencing and safety barriers
- fixing any defects during the liability period.

3.6.6.3 Demobilisation

All construction plant, equipment, waste and personnel not required to operate the proposal will be removed from site.

3.7 Construction – brine pipeline

Brine pipeline construction will generally follow the same steps identified for the wastewater treatment infrastructure in section 3.6. However, the brine pipeline construction footprint will be dynamic, likely occurring in several locations at one time and moving progressively along the pipeline alignment. This means each location is likely to be in a different phase at any one time.

The delivery contractor(s) will install the brine pipeline using 2 construction methods. About 5.8 km of the overall brine pipeline will be constructed using an open trench method. About 2.2 km of pipeline between Marayong Park and Lynwood Park will be installed using a tunnelling technique, expected to be HDD.

To reduce the construction program and for procurement reasons, several work fronts may be established along the length of the brine pipeline. It is likely that one work front will construct the open-cut trench sections of pipeline, while the other will construct the tunnelled sections of pipeline.

3.7.1 Site establishment and early works

Site surveys, implementing safety and environmental controls, clearing vegetation and stockpiling material for site restoration as part of site establishment will be consistent with that described for the wastewater treatment infrastructure in section 3.6.1. Given the dynamic location of the work front, there will be differences in access and traffic management given work in roads will require lane closures.

In addition, construction compounds will be required along the pipeline alignment, mostly in public open space. Table 3-7 and Table 3-8 describe the indicative locations and types of compounds required. Figure 3-2 illustrates indicative compound locations.

Up to 20 locations for construction compounds have been identified at intervals along the brine pipeline alignment. Sydney Water may not need all compounds that are proposed, or alternative locations may be required. Taking a conservative approach, 20 construction compound locations have been included within the scope of this REF to provide optionality for the pipeline delivery contractor(s).

Table 3-7 Overview of construction compound types

Compound type	Key activities and description	Duration
Main	Large compounds that will be active for the entire construction of the proposal and will include: • Temporary buildings such as offices and meeting rooms, amenities and first aid facilities • Stockpiling and sorting of waste material before disposal or reuse • Storage of site equipment, including bunded storage for any chemicals such as fuel.	Entire 24-month construction period of the proposal
Satellite	Smaller compounds that will be active for the entire construction of the proposal. They will have similar activities to main compounds.	Entire 24-month construction period of the proposal
HDD/tunnelling	Only identified for HDD launch and receival pits where an increased construction presence will be required. Accommodate activities associated with drilling such as the drill rig, spoil management and pipe placement. Only required during HDD activities.	Duration of the tunnelling work they are supporting, typically 1 – 6 months
Laydown	Small, transient compounds located at brine pipeline trenching construction sites. These will only be required for short periods of time and will move along the pipeline alignment as trenching progresses.	About 4 – 8 weeks

Table 3-8 Numbering, location and type of indicative construction compounds

Number	Location	Access	Compound type
C1	Southern end of Melrose Park, along the northern side of Breakfast Creek	From car park off Melrose Avenue, Blacktown	Main Laydown
C2	Grassed area immediately west of Falmouth Road, along northern side of Breakfast Creek	Falmouth Road, Blacktown	Laydown
C3	Grassed area immediately east of Falmouth Road, along northern side of Breakfast Creek	Falmouth Road	Laydown
C4	Grassed area occupying the southern end of St Andrews College Junior Campus sports field, along northern side of Breakfast Creek	Benalla Crescent, Blacktown	Laydown
C5	Grassed area occurring a western part of Harvey Park, along northern side of Breakfast Creek	Benalla Crescent	Laydown
C6	Grassed area occupying a southern and eastern part of Harvey Park, north of the vegetation and shared path along the northern side of Breakfast Creek	Benalla Crescent	Laydown
C7	Grassed area immediately south of Benalla Crescent, along the northern side of Breakfast Creek	Benalla Crescent	Laydown
C8	Grassed area immediately east of Breakfast Road, along the northern side of Breakfast Creek	Breakfast Road / Aqua Place, Blacktown	Laydown
C9	Grassed area in the south of Marayong Park immediately west of Davis Road, along the northern side of Breakfast Creek	Davis Road, Blacktown	Laydown HDD/tunnelling
C10	Within Gate Road	Gate Road, Blacktown	HDD/tunnelling
C11	Within Gate Road	Gate Road	HDD/tunnelling
C12	Grassed area between Allen Road and Turner Street, along eastern side of Breakfast Creek	Allen Road, Blacktown	Laydown
C13	Car park and western adjacent grassed area west of Lynwood Park, along southern side of Breakfast Creek	Allen Road	Laydown HDD/tunnelling
C14	Car park in middle of Lynwood Park	Stephen Street, Lalor Park	Laydown

Number	Location	Access	Compound type
C15	Grassed area immediately east of Venn Avenue, along the southern side of Breakfast Creek	Venn Avenue, Lalor Park	Laydown
C16	Grassed area immediately east of Stephen Street within Lynwood Park	Stephen Street	Laydown
C17	Within Billy Goat Hill Reserve	Cardiff Street, Blacktown	Laydown
C18	Grassed area between Winifred Crescent and Blacktown Aquatic Centre car park	Winifred Crescent / Blacktown Aquatic Centre car park, Blacktown	Laydown
C19	Northern and eastern part of Blacktown Aquatic Centre car park	Boyd Street, Blacktown	Main Laydown
C20	Grassed area within International Peace Park	Jean Street, Seven Hills	Main Laydown

3.7.2 Main civil works

The main civil work activities associated with both brine pipeline construction methods are described in this section.

3.7.2.1 Open trench method

Prefabricated pipe will be laid in a trench about 1-1.5 m underground. The main construction steps include:

- strip the grass and topsoil from the site of the trench and store these separately for use in restoration in grassy areas. On hardstand, pneumatic drilling, concrete cutting or jackhammering may be required to break the solid surface
- excavate and temporarily stockpile excavated material within the construction corridor
- dig a trench up to 2.5 m depth. The width of the trench and the requirement for benching or shoring will depend on site-specific constraints, soil characteristics and the specific construction methodology. Figure 3-7 provides an illustration of an indicative construction working arrangement in public roads
- cap the bed of the trench with sand or fine-grained fill material to avoid damage to the pipe
- lay prefabricated sections of pipe on top of the fill material
- add extra fill material or backfill the excavated material in reverse order around the pipe, finishing with the topsoil and grass
- if excavated material is unsuitable for fill, we will separate and send this to a licensed waste facility. Trenches will be backfilled only using suitable fill material
- move any excess subsoil for use at other locations along the pipeline alignment (provided it is not contaminated), or otherwise transport offsite for disposal to a licenced waste management facility.

The pipeline will be installed at about 12-24 m per shift during open trenching. Restoration of the impacted area is expected to be completed following backfill of the trench.

Figure 3-8 and Figure 3-9 show examples of open trenching in roads and greenfield areas respectively.

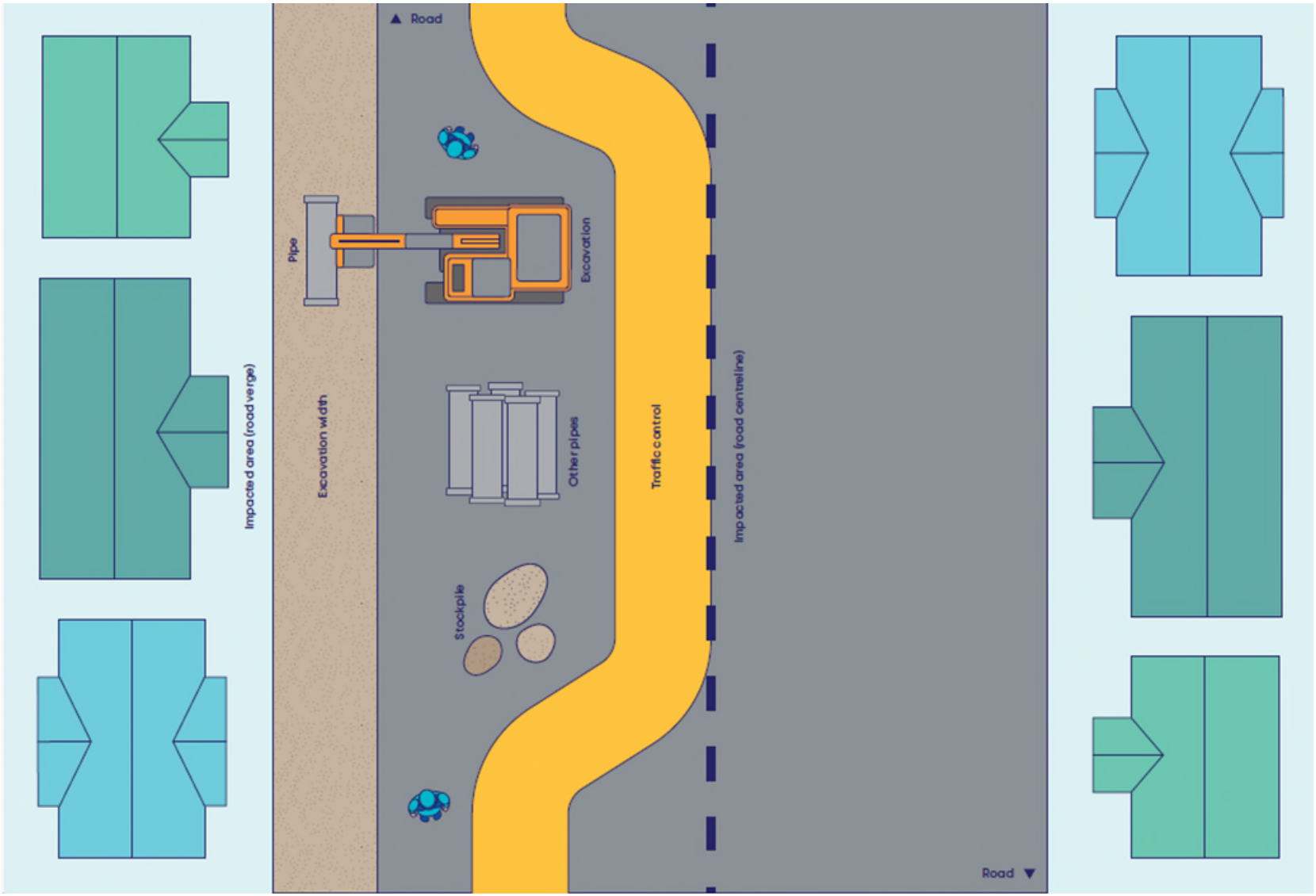


Figure 3-7 Pipeline construction corridor cross section

Figure 3-8 Trenched pipeline construction within road

Figure 3-9 Trenched pipeline construction with benching

3.7.2.2 Tunnelled (HDD) method

The following steps are expected:

- a launch and receival pit will be established at the start and end of the planned HDD route:
  - launch pits will be located at construction compounds C9 and C13 and will be about 12 m long by 4 m wide
  - retrieval pits will be located at compounds C10 and C11 and will be about 12 m long by 4 m wide
- lengths of pipe to be installed by an HDD construction method will be ‘strung’ out on the ground along the alignment of the brine pipeline and connected and pressure tested. The indicative length and arrangement of pipe-stringing is shown in Figure 3-2
- an HDD rig will be set up and calibrated at the launch pits. The contractor will ensure sufficient water supplies, cooling fluids and lubricants (e.g. bentonite) to the drilling rig. Drilling fluids will be recirculated, with any excess being treated and disposed

- the drill head will be activated and begin drilling along the pre-defined path. The drill will be operated continuously between the launch and retrieval pit. Drilling mud will be stockpiled within the construction compounds
- once drilling between launch and retrieval pits is complete, the pipe-string will be pulled through the hole that has been drilled
- stockpiled spoil will be managed depending on the type of material – reused on site or removed from site by a licensed waste carrier to a licensed waste management facility
- demobilise and remove the HDD rig, along with all other plant, equipment, materials and waste associated with HDD activities.

Figure 3-10 shows a simple illustration of a typical tunnelled methodology.

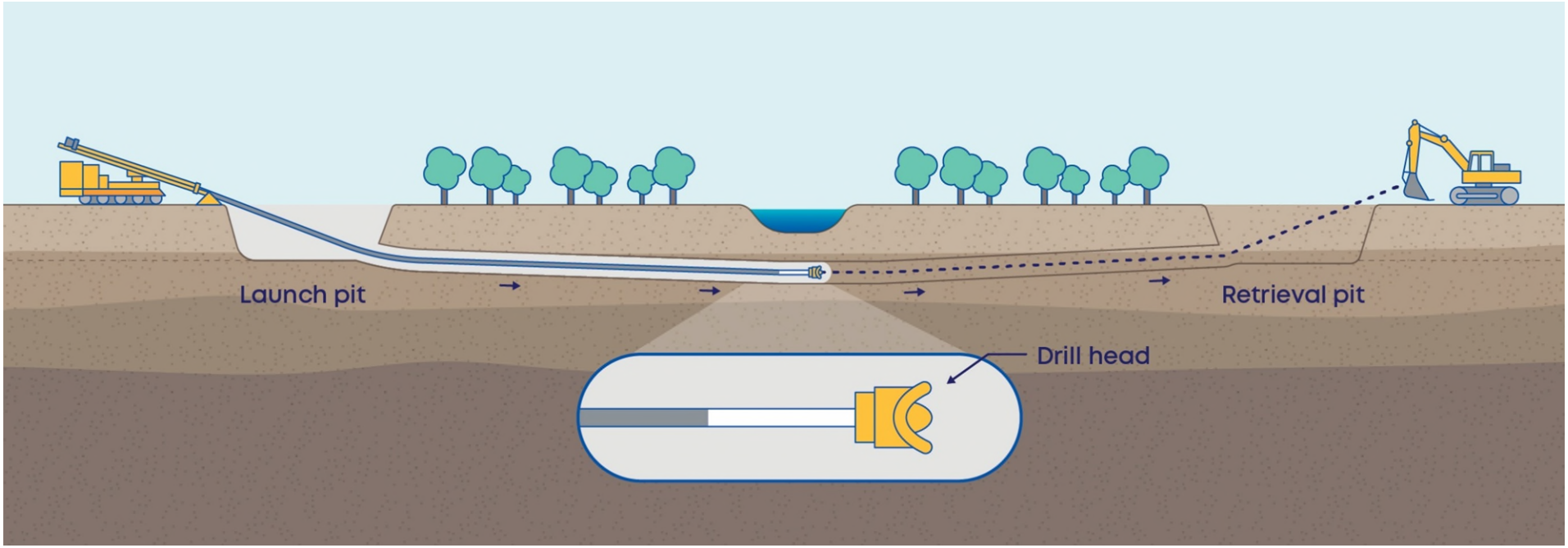


Figure 3-10 Illustration of HDD tunnelled construction technique

3.7.2.3 Connection to NSOOS

The brine pipeline will tie into the existing NSOOS at International Peace Park at Seven Hills, about 1.3 m below ground. Where the open trench excavated for constructing the brine pipeline encounters the existing maintenance hole, an opening of about 500 mm diameter will be drilled through the chamber wall within which an adaptor will be fitted and grouted in place. The brine pipeline will connect to this adaptor before being grouted and sealed in place. Figure 3-11 shows the indicative connection setup.

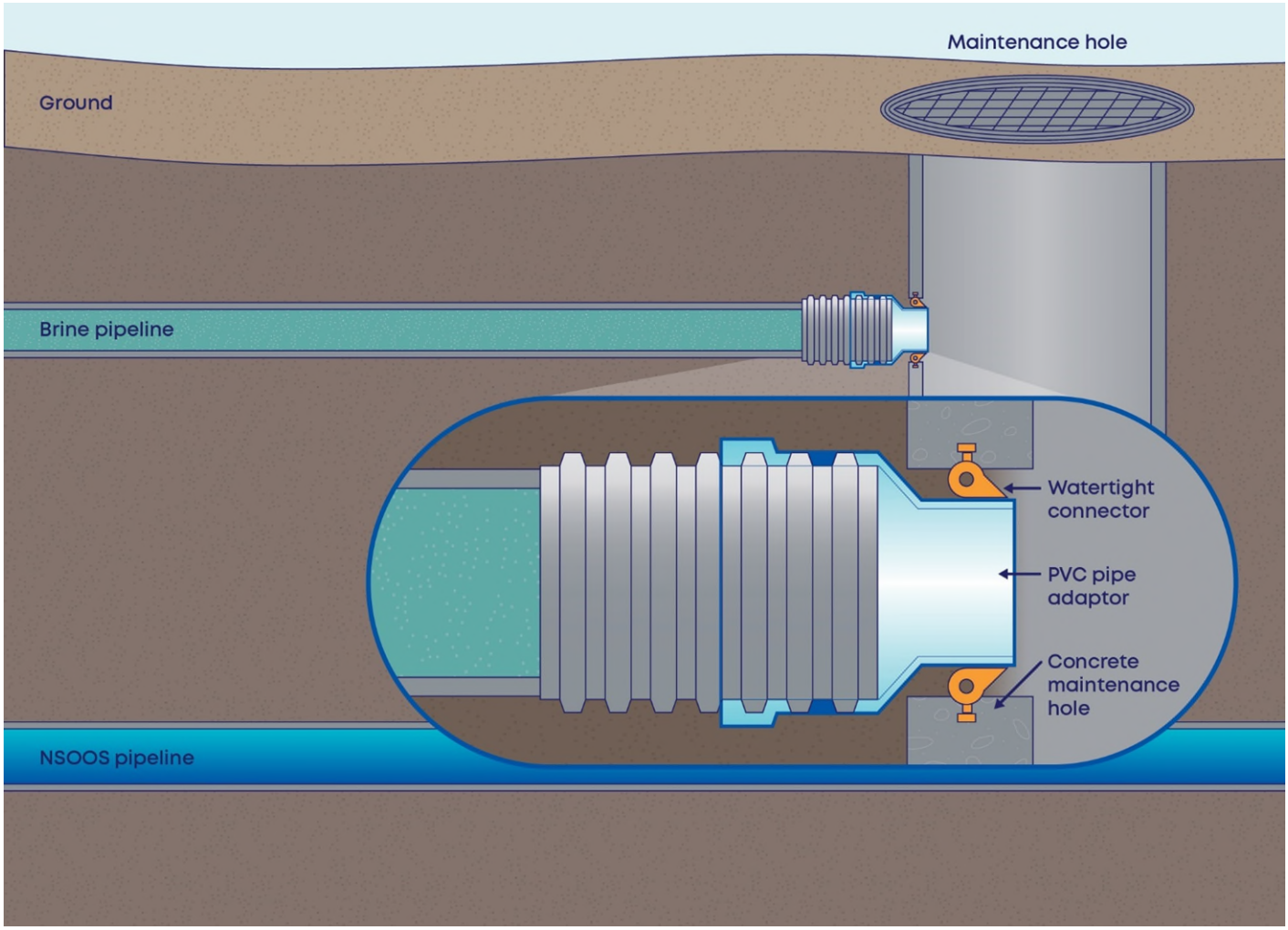


Figure 3-11 Indicative representation of the brine pipeline - NSOOS connection

3.7.3 Main structural works

Limited structural works are expected for construction of the brine pipeline. The extent of structural works activities will include:

- installing the barometric loop
- small structures to protect maintainable valves and scour pits if required.

At the location of the barometric loop in Billy Goat Hill Reserve in Blacktown, the western and eastern sections of brine pipeline will come above ground. Couplings will be connected to each end of the brine pipeline before a concrete base is poured in situ around the above-ground pipe sections for the barometric loop structure to stand on. The internal pipework and tank of the barometric loop will be prefabricated offsite and delivered to site as one unit. It will be craned into position, with the internal pipework connecting into the above-ground brine pipeline couplings. A standard 2.5 m-high chain link fence will be installed around the barometric (offset by about 1 metre) for security reasons. Figure 3-3 shows an indicative cross-section of the barometric loop.

3.7.4 Main mechanical and electrical works

Mechanical and electrical works will be limited for the brine pipeline. The extent of mechanical and electrical works activities will include valves and flow meters on the pipeline.

3.7.5 Post-construction

Testing and commissioning activities for the brine pipeline will include:

- flushing the pipeline with water
- pressurising the pipeline and testing valves and scour chambers
- flow testing of the barometric loop
- ensuring the correct and proper functioning of each maintenance access point.

Restoration and demobilisation activities will be the same as those for the wastewater treatment infrastructure described in section 3.6.

3.8 Construction details

3.8.1 Program

Sydney Water is targeting 2027 to start construction of the proposal. Early civil works for the demolition of the IDALs are likely to start in 2026. Table 3-9 shows the expected start and anticipated duration of works for each proposal component. Commissioning would take about an additional 6 months after the main construction activities are complete.

Table 3-9 Expected start and duration of construction for each component

Proposal component	Expected start	Duration
Early civil and enabling works	Mid-2026	About 9 – 12 months
Secondary wastewater treatment upgrades and advanced water treatment plant	Mid-2027	About 24 months
Brine pipeline	Mid-2027	About 18 months

3.8.2 Work hours

Work and deliveries will typically be scheduled and carried out during standard daytime hours of:

- 7am to 6pm, Monday to Friday
- 8am to 1pm, Saturdays.

At this stage, minimal night works are planned. However, some work outside standard daytime hours may be required for:

- truck deliveries
- tunnelled construction techniques, including HDD activities
- activities requiring continuous work, e.g. concrete pours, commissioning and performance testing
- excavations (trenching) and pipe installation in busy public roads
- connections within the operational WRRF to operating assets
- works requiring low flows in the wastewater network, e.g. connections and cut-ins.

Sydney Water's Project Manager can approve work outside of standard daytime hours. The approval process is described in the mitigation measures in Chapter 6.

3.8.3 Construction materials and equipment

The construction plant and equipment required for each component of the proposal is presented in Table 3-10.

Table 3-10 Expected construction plant and equipment

Work at WRRF	Brine pipeline construction	Both sites
10 – 15 tonne roller	Trencher	7 – 10 tonne excavator
30 tonne excavator	Excavator with hammer	Dumper truck
50 tonne crane	HDD rig	12 – 15 tonne franna crane
200 tonne crane	Pneumatic jackhammer	Air compressor
CAT 140 M grader	Stringing winches	Backhoe
Concrete agitator		Bob cat
Concrete pump		Flatbed Hi-Ab truck
D10 dozer		Generator
Elevated working platform		Semi trailer

Work at WRRF	Brine pipeline construction	Both sites
Piling rigs		
Rigid tippers		
Water cart		
Transport truck		

3.8.4 Construction workforce

A breakdown of the number of construction workers required per key construction activity for each of the proposal's components is set out in Table 3-11.

Table 3-11 Indicative number of construction workers for key construction activities

Activity	Task within activity	Indicative workforce numbers
Brine pipeline construction	Site establishment, early works, set out works	11
	Main civil construction work	33
	Commissioning	5
	Demobilisation	8
Quakers Hill WRRF secondary treatment upgrade and AWTP	Site establishment, early works, set out works	15
	Main civil construction work	30
	Main structural construction work	69
	Main mechanical/electrical construction work	100
	Commissioning	26
	Demobilisation	15

3.8.5 Vehicle movements

Construction traffic related to the proposal will be generated by activities including:

- worker crews – crews undertaking tunnelling and open trenching along the pipeline alignment
- light vehicles accessing site compounds, including at Quakers Hill WRRF

- heavy vehicles accessing site compounds, including Quakers Hill WRRF, to deliver construction materials and equipment to remove waste.

Table 3-12 provides the estimated peak traffic movements for light vehicles and heavy vehicles during construction.

Table 3-12 Indicative construction traffic generated by the proposal

Location	Likely route	Estimate peak daily vehicle movements
Quakers Hill WRRF	Quakers Road	100 light vehicles 78 heavy vehicles
Brine pipeline	Western section: M7 Motorway, Quakers Hill Parkway and Quakers Road Central section: M7 Motorway, Sunnyholt Road and Vardys Road Eastern section: M7 Motorway and Sunnyholt Road	50 light vehicles 8 heavy vehicles

3.8.6 Car parking

Car parking spaces are available within the existing Quakers Hill WRRF site for worker's vehicles during construction. However, at peak construction periods the number of personal vehicles associated with the workforce may exceed the number of onsite parking spaces. To address the potential shortage of parking spaces within Quakers Hill WRRF, an existing Blacktown City Council car park at Melrose Avenue (east of the WRRF) is proposed as temporary overflow parking. The existing car park at Melrose Avenue will provide about 27 additional parking spaces and Sydney Water will consult with council to investigate this option further.

3.9 Related development

An upgrade to the high voltage power supply to Quakers Hill WRRF will be required to meet the energy requirements of the proposal. Options analysis for these works is ongoing at the time of writing. Planning approval for these works is expected to be undertaken by Endeavour Energy so they are not included in this REF. A new high voltage power line is likely to be required either above ground or below ground through suburban areas in the Blacktown LGA between a nearby substation and Quakers Hill WRRF. This is expected to have similar environmental constraints and impacts to those outlined for the brine pipeline.

4. Consultation

4.1 Community and stakeholder consultation – overview

Our approach to community and stakeholder consultation is guided by Sydney Water's community and stakeholder engagement guidelines. This proposal also considers the objectives in *Undertaking Engagement Guidelines for State Significant Projects* (DPHI 2024):

- Plan early – identify stakeholders and consider appropriate and effective engagement activities.
- Engage as early as possible – to identify, avoid or manage issues without significant cost or delay.
- Ensure engagement is effective – provide the information and opportunities that allow stakeholders to engage in a meaningful way.
- Ensure engagement is proportionate to the scale and impact of development.
- Be innovative – use innovative means to enable participation from a broad spectrum of community members.
- Be open and transparent about what can be influenced.

Some engagement for this proposal, such as that with First Nations representatives, was undertaken in conjunction with engagement for other future programs of work at Quakers Hill WRRF. This chapter focuses on engagement specific to this proposal.

Engagement has been ongoing during proposal planning and will continue through later stages of design and construction. We will consult with affected groups throughout the proposal.

We will also provide Blacktown City Council with reasonable notice when we intend starting work. Ongoing and proposed future consultation with council is discussed in section 4.2.

4.1.1 Features of the local community

There are 592 properties adjacent to the proposal impact area and 17,336 properties within 750 m. Table 4-1 discusses the features of the community surrounding the proposal, potential impacts, and engagement measures used.

Table 4-1 Summary of local community and expected impacts

Local community	Potential impacts	Engagement measures
Mixed use: • Blacktown CBD • Industrial and residential • Sports facilities and public green space • Schools and care facilities	• Alignment largely avoids major roads and private properties • Working along council roads • Construction impacts including noise, dust and traffic • Progression of open trenching sections (12-24 m per shift) will	• Early and ongoing consultation with council including site walks and meetings • Project notifications with design updates and potential impacts • Briefings with impacted stakeholders

Local community	Potential impacts	Engagement measures
	mean these impacts are short-term • Future tunnelling (and constructed pipeline) under some private properties • Partial closures of sports fields and parking lots from compounds/HDD/tunnelling	• Providing a website and dedicated phone and email address

4.2 Community and stakeholder consultation outcomes

4.2.1 Blacktown City Council

Sydney Water has consulted with Blacktown City Council via meetings, email, phone calls and site visits. Table 4-2 discusses specific consultation items and outcomes.

Table 4-2 Consultation outcomes

Aspect or location	Questions or notes	Outcomes
Blacktown Aquatic Centre – planned upgrades	Council is proposing mid-2026 construction start, and about 18 months of construction. There may be cumulative impacts between council's project and this proposal. There may also be opportunities to share compounds and construct this section of pipeline while the aquatic centre is closed, to minimise disruption. Access to the netball courts to be maintained and no permanent parking loss.	Sydney Water will schedule a follow up meeting to discuss any updates. Sydney Water to advise on vegetation impacts within the International Peace Park at Seven Hills and impacts to walkway access. Sydney Water to organise a construction agreement with council. Access to the netball courts will be maintained and there will be no permanent parking loss.
Barometric loop	Council proposed alternative locations, but these were unsuitable as they were not at a high point, or too close to private property.	Sydney Water will work with council on future consultation about a mural or artwork treatment for the barometric loop to minimise visual impacts.
Green space (Harvey Park)	This park is one of council's busiest. Access to the sports fields and bicycle tracks needs to be maintained.	Sydney Water to organise pipeline construction and compound use for when the park is less busy (generally mid-December to early February).

Aspect or location	Questions or notes	Outcomes
		Sydney Water to organise a construction agreement with council ('access to reserve' application).
Green space (Lynwood Park)	The field is used for soccer and cricket. It will be impacted during construction for HDD launch pit and pipe stringing.	Sydney Water to organise a construction agreement with council ('access to reserve' application) and consult with sporting clubs.
Vegetation impacts	Council would like to see vegetation impacts minimised as much as possible.	Although vegetation impacts can't be avoided, we want to minimise these impacts as much as possible. Sydney Water plans to discuss opportunities for offsets and restoration with council.
Impacts to council land	Public spaces including existing amenities, parks and vegetation should not be negatively impacted. Any easements should not exclude the public from public land.	Impacts to public spaces can't be completely avoided. We will manage and mitigate impacts by following the edges of reserves.

We have incorporated relevant mitigation measures to address these items in Sections 6.9.5, 6.15.4 and 6.14.4.

4.2.2 State government agencies

4.2.2.1 General

Sydney Water held an agency meeting in March 2024 attended by a range of government agencies including Department of Climate Change, Energy, the Environment and Water (DCCEEW), Department of Planning, Housing and Infrastructure (DPHI), EPA, Greater Sydney Parklands, NSW Health and WaterNSW. Relevant items discussed during the briefing include:

- size of pipeline and whether it is installed above or below ground
- whether the NSOOS needs to be upgraded to support additional flows from the brine pipeline
- the need for the WRRF upgrades to meet EPL requirements.

Sections 3.2 and 3.4 discuss these proposal details.

4.2.2.2 Transport for NSW (TfNSW)

Sydney Water has engaged with TfNSW about potential impacts to State roads, traffic signalling and rail lines. Sydney Water will need to provide detailed designs to minimise construction impacts on their assets.

Interface with these assets are road crossings (open trenching) near signalised intersections (Falmouth Road and Breakfast Road). Section 6.12 discusses the proposal's traffic impacts.

4.2.2.3 DCCEEW (NSW)

Sydney Water has engaged with NSW DCCEEW on proposal aspects including Aboriginal heritage and flooding. Sydney Water briefed DCCEEW (Heritage NSW) on the proposal in 2024, with no concerns raised. Discussions on flooding related to the approach to the flood impact assessment including use of specific models and best practice guidelines. Sections 6.7 and 6.6 assess impacts on Aboriginal heritage and flooding respectively.

4.2.2.4 EPA

Sydney Water met with the EPA in August 2025 about the proposal's alignment with the Quakers Hill sewage treatment system EPL and the proposal to transfer brine to the NSOOS. This consultation was undertaken in conjunction with the Greater Parramatta and Olympic Peninsula water cycle management (GPOP) project, given both projects propose transferring brine to the NSOOS. The EPA supported the proposal's approach to store brine at Quakers Hill WRRF to mitigate wet weather overflow volume, frequency and water quality risks. The EPA also requested more detail about:

- how brine would affect load limits at North Head WRRF
- the fate of nutrients and microcontaminants in different treatment streams across the proposal and the GPOP water cycle management project.

Section 6.3.4.3 includes more detail about North Head WRRF load limits and Sydney Water will work with the EPA to provide further information on the requested topics.

4.2.2.5 Department of Primary Industries and Regional Development (DPIRD Fisheries)

Sydney Water met with DPIRD Fisheries in April 2024. The meeting included discussion of the quality of the brine stream, concentration and diversity of contaminants, and whether this changes releases from North Head WRRF. DPIRD Fisheries were also interested in any changes to flows that would impact Eastern Creek. These potential impacts are further discussed in sections 6.3 and 6.4.

4.2.3 Businesses

Businesses along Gate Road in Blacktown have been engaged given access to and from the businesses will be impacted during pipeline construction (HDD intermediate shaft and compounds). A briefing was provided to one of the landowners south of the cul-de-sac in February 2025. The landowner advised of the tenancy agreement, construction they are planning on the site, and a request to keep at least one of the 3 driveways open at all times for vehicles and for emergencies. Section 6.12 considers this in more detail.

4.2.4 Residential properties

Residents near the proposal have been engaged through letterbox drops in October 2024 and March 2025. These newsletters reached 36,700 households and businesses in October 2024 and 42,350 letterboxes in March 2025. The newsletters provided project updates, contact details for the project team and project

website address. An open day at the Purified Recycled Water (PRW) Discovery Centre was advertised to residents in the vicinity of Quakers Hill WRRF in January 2025 and 43 people attended.

Doorknocking was undertaken in several areas adjacent to the proposal:

- 24 properties around Billy Goat Hill Reserve in Blacktown were approached in March 2025 to gain feedback about the construction and location of the proposed barometric loop. We spoke with 9 residents. No concerns or objections were raised and there was some support for an artwork on the barometric loop structure.
- 115 properties around Lynwood Park were approached in July 2025 to gain feedback about the proposed nearby HDD launch pit and pipe stringing. We spoke with 29 residents. Some residents identified that they work from home during the day, so construction noise may be disruptive. However, no objections were raised and the responses were generally supportive.
- 144 properties around Marayong Park were approached in August 2025 to inform them about the proposed HDD launch pit, and to gather feedback on the planned work. We spoke to 44 residents and left 100 ‘sorry we missed you’ cards along with a project fact sheet. Residents were generally supportive of the project, with one indicating a sensitivity to noise, and another expressing a concern about potential water or electricity interruptions during construction. Where construction has the potential to impact these residents, we will provide them with direct advanced notice.

Notifications with contact details were left in letterboxes for those who weren’t home. Several pop-up events were held in the Blacktown LGA to provide residents in the wider area the opportunity to engage with the proposal, including:

- Blacktown National Aboriginal and Islanders Day Observance Committee (NAIDOC) event, Blacktown Showground on 13 July 2024
- Flavours of Blacktown event, Nurragingy Reserve on 17 August 2024
- Bunnings Blacktown on 24 August 2024.

4.2.5 Other stakeholders

Various stakeholders such as schools and places of worship were emailed with an offer for Sydney Water to provide a project briefing. As of August 2025, none of these offers had been accepted.

Sydney Water met with the Great West Walk volunteer group in June 2025. The meeting helped identify where construction of the brine pipeline will overlap with sections of the Great West Walk. Section 6.12 outlines how Sydney Water has committed to providing advance notice to the group on timing and duration of construction impacts to help plan appropriate detour routes.

4.3 Consultation on this REF

We will invite the community and stakeholders to comment on this REF. We will provide information about the proposal and the REF process and we will invite comment through the proposal's website and other planned engagement activities.

The REF will be available to download from the proposal's website during the display period identified on the website. Submissions must be made in writing and received by the date identified on the website, to the email on the website.

We will collect information in written representations to help us assess the proposal. The information may be disclosed to appropriate agencies such as the EPA. If the respondent indicates at time of submission that the information should remain confidential, Sydney Water will attempt to ensure this. However, there may be legal justification for its release, such as under the *Government Information (Public Access) Act 2009*.

At the end of the public display period, we will consider all submissions and prepare a Decision Report. This will be available on the proposal's website.

4.4 Consultation required under State Environmental Planning Policies and other legislation

Appendix C summarises State Environmental Planning Policy (Transport and Infrastructure) 2021 (TISEPP) consultation requirements. Under the TISEPP, Sydney Water must consult with councils and other authorities for work in sensitive locations or where the work may impact other agencies' infrastructure or land.

Consultation with Blacktown City Council was required under section 2.10 of TISEPP. The proposal will impact access to public spaces and involves excavation of public roads and footpaths. Section 4.2.1 summarises this consultation.

The proposal overlaps with Key Fish Habitat mapped along Breakfast Creek between Quakers Hill WRRF and Marayong Park. However, no dredging or reclamation within Key Fish Habitat will occur. Notifying DPIRD Fisheries under s199 of the *Fisheries Management Act 1994* is not required.

5. Legislative requirements

5.1 Previous approvals

The wastewater treatment processes at Quakers Hill WRRF were upgraded as part of the Lower South Creek Treatment Program (LSCTP) under the *Quakers Hill and St Marys Water Recycling Plants Process and Reliability Renewal Improvement Project* REF (Sydney Water 2017). This scope included demolition of the IDALs at Quakers Hill WRRF. However, the works delivered under the LSCTP only progressed to decommissioning. Demolition of the IDALs has yet to be undertaken and will be completed as part of this proposal as discussed in section 3.6. To mitigate biodiversity impacts from the LSCTP, offset areas have been planted at Quakers Hill WRRF. The proposal will avoid these offset areas.

A REF was also prepared for a PRW demonstration plant (the PRW Discovery Centre) at Quakers Hill WRRF (Sydney Water 2021). The main objective of the demonstration plant is to provide an example of a functioning PRW treatment process to demonstrate how proven technology can produce high-quality drinking water. The facility is also used for engaging with stakeholders and regulators. Construction works for that project have been completed. Car parking for visitors and operational staff was provided onsite for the demonstration plant. During construction of the proposal, there may be some impact on this existing car parking as discussed in section 6.12.

5.2 Strategic context

Table 5-1 summarises the strategic plans relating to the proposal.

Table 5-1 Summary of relevant strategic plans

Strategic Plan	Relevance to the proposal
NSW Water Strategy: Towards 2050 (Department of Planning, Industry and Environment (DPIE) 2021)	This strategy provides an umbrella framework for 12 regional water strategies and 2 metropolitan water strategies. The overarching objectives of the strategy focus on developing resilience, security and reliability, and quality in NSW's water resources. Priority 3 of the strategy is to improve river, floodplain and aquifer ecosystem health, and system connectivity. The proposal directly supports the strategy in this regard through increasing wastewater treatment servicing capacity and standards. This reduces impact upon water quality, particularly from nutrient loading, in waterways and associated effects on aquatic ecology.
Greater Sydney Water Strategy: Water for a thriving, sustainable and resilient Sydney (DPIE 2022)	This strategy recognises Sydney's growing population places significant pressure on an ageing wastewater network as it reaches capacity, creating a need to invest in new assets and renew old ones for the wastewater system to service a growing population. The strategy outlines the priorities and actions for delivering essential water services to support a sustainable, liveable and productive Greater Sydney. The proposal will contribute to improving wastewater management in Greater Sydney. It will enable more wastewater collected in the catchment to be treated to a higher quality for release to waterways and for use for a range of recycled water purposes. As Greater Sydney continues to become denser and extend

Strategic Plan	Relevance to the proposal
	into new areas, the reuse and recycling of wastewater is important to support a more productive and sustainable region.
Greater Sydney Region Plan – A Metropolis of Three Cities (NSW Government, 2018)	This plan sets a 40-year vision (to 2056) and establishes a 20-year plan to manage population growth and change for Greater Sydney in the context of social, economic and environmental matters. It aims to create new jobs, provide more housing choices, improve transport connectivity, and enhance the natural and built environment. The proposal directly supports the plan's key strategies through Sydney Water's delivery of critical wastewater infrastructure, improving and expanding wastewater servicing. This enhances liveability for current and future populations.
Blacktown Local Strategic Planning Statement 2020 (LSPS) (Blacktown City Council 2020)	This strategic planning statement sets out the local planning priorities and actions for Blacktown City Council. The statement identifies a need to maintain and enhance the areas open spaces, bushland and waterways, with specific actions set to protect and improve the health and enjoyment of waters and to manage water and waste efficiently. The proposal will increase the scale of wastewater treatment and improve the quality of treated wastewater from within the City of Blacktown before releasing it to the local waterway network and / or transferring the product for reuse. It will also enable potential future recycled water uses through the provision of high-quality feedwater. This means the proposal will directly support the priority actions set by the LSPS. Additionally, given most infrastructure for the proposal outside of Quakers Hill WRRF will be located below ground, it is unlikely to significantly affect the council's ability to implement any future land use plans.
Regulating nutrients from sewage treatment plants in the Lower Hawkesbury Nepean River catchment (NSW Environment Protection Authority (EPA) 2019)	The EPA has developed a regulatory framework to manage nutrient load inputs to the Hawkesbury Nepean River from wastewater treatment plants. The objective is to meet the community's environmental values for the river and provide WRRF operators with alternatives to meet those nutrient loads. The framework includes limits on nutrient concentrations, interim caps on nutrient loads and a framework for nutrient trading and offsets. The proposal will improve the treatment capability and water quality being released to Breakfast Creek from Quakers Hill WRRF. This means the proposal will reduce nutrient loads in the Hawkesbury Nepean catchment, contributing to Sydney Water's compliance with the framework.

5.3 Environmental legislation

Sydney Water is the proponent and determining authority under the EP&A Act. The proposal does not require development consent and is not classified as State significant infrastructure. We have assessed this proposal under Division 5.1 of the EP&A Act. This REF has concluded that the proposal is unlikely to have a significant impact on the environment.

The following environmental planning instruments (Table 5-2) and legislation (Table 5-3) are relevant to the proposal. Table 5-3 also documents any licences and permits required, and timing and responsibility for obtaining them where applicable.

Table 5-2 Environmental planning instruments relevant to the proposal

Environmental Planning Instrument	Relevance to proposal
State Environmental Planning Policy (Transport and Infrastructure) 2021 (TISEPP)	Section 2.126 of the TISEPP permits the following as development without consent if it is by or on behalf of a public authority: • Sewage treatment plants on any land in a prescribed zone. Quakers Hill WRRF is on land in a prescribed zone (SP2). The secondary wastewater upgrade and AWTP are for the purposes of a sewage treatment plant. • Sewage reticulation systems on any land. The brine pipeline is a sewage reticulation system. As Sydney Water is a public authority, the proposal is permissible without consent. The TISEPP has some limitations on works in National Parks, but the proposal is not on National Parks land. Section 4.4 describes consultation required under the TISEPP.
Blacktown Local Environmental Plan 2015 (Blacktown LEP)	The proposal is located on land zoned: • RE1 Public Recreation • SP2 Infrastructure • R2 Low Density Residential • R1 General Residential • E3 Productivity Support. Section 5.10 of the LEP requires proponents to identify, conserve and promote Blacktown City's environmental heritage and significance. Section 5.23 requires the proponent to protect and ensure the ecological viability of bushland, including native flora. The LEP also sets requirements relevant to flood risk. While the provisions of the Blacktown LEP do not strictly apply given development consent is not required, the general principles of some of these aspects such as heritage protection, environmental protection and flood mitigation are considered in relevant sections of the REF.
State Environmental Planning Policy (Biodiversity and Conservation) 2021 (BCSEPP)	**Vegetation in non-rural areas (Chapter 2)** Chapter 2 of this SEPP aims to protect the biodiversity and amenity value of trees and other vegetation in non-rural areas of NSW. The proposal is in an area or zone listed in subsection 2.3(1). However, subsection 2.4(1) states: 'This Policy does not affect the provisions of any other SEPP….', and as the works are permissible under the TISEPP, a council permit to clear vegetation under this SEPP is not required. **Water catchments (Chapter 6)** Chapter 6 of this SEPP applies as the proposal is within the Hawkesbury-Nepean Catchment, a regulated catchment. Chapter 6 of this REF assesses potential environmental impacts on water quality and quantity, aquatic ecology, flooding, access, cultural heritage, flora and fauna, and scenic quality. The assessment confirmed that potential impacts are minimal and meet the requirements of part 6.2 of the SEPP.
State Environmental Planning Policy	Chapter 3 of SEPP (Resilience and Hazards) requires a preliminary hazard analysis (PHA) for developments classified as potentially hazardous or offensive. This ensures that risks are thoroughly assessed and managed to protect public health and the environment. The proposal falls under this category, and a PHA has been completed.

Environmental Planning Instrument	Relevance to proposal
(Resilience and Hazards)	The assessment confirmed that the proposal can be designed, constructed and operated to meet relevant regulations, standards and policies to minimise hazardous impact to the public. The assessment determined that the proposal is not a hazardous industry, outlined in section 6.16.

Table 5-3 Consideration of environmental legislation relevant to the proposal

Legislation	Relevance to proposal	Permit or approval	Timing and responsibility of future approvals
Protection of the Environment Operations Act 1997 (POEO Act)	The POEO Act aims to, among other matters, protect, restore and enhance the quality of the environment in NSW. It defines offences relating to environmental pollution and establishes a framework for environment protection licences for scheduled operations or activities in NSW. Sewage treatment is a scheduled activity under the POEO Act. The proposal is part of Quakers Hill WRRF and will therefore be regulated under EPL 1724. The brine pipeline will connect to the NSOOS and become part of the North Head EPL 378. Sydney Water will consult with the EPA before commissioning the proposal to seek any amendments to these EPLs if needed. Construction of the proposal is not scheduled development work under section 47 of the POEO Act as it will be carried out at Quakers Hill WRRF, and the brine pipeline will be part of the North Head sewerage system. Both systems already have a scheduled activity EPL. As discussed in section 2.2.1, Quakers Hill, Riverstone, and St Marys WRRFs, along with the USC AWRC share a common (‘bubble’) licence load limit under the Sackville 2 subzone. All treatment plants have separate EPLs, but nitrogen and phosphorus discharges are jointly regulated. This 'bubble licence' scheme allows each plant to adjust its individual releases, provided the total pollutant load limit for the scheme is not exceeded. Pollutant loads are discussed further in section 6.3. The delivery contractor is responsible for immediately reporting incidents in accordance with Sydney Water’s environmental incident management and emergency preparedness procedure (SWEMS0009).	EPL	During construction and operation, Sydney Water
Protection of the Environment Operations (Clean Air) Regulation 2022	This Regulation provides regulatory controls for sources of domestic and commercial emissions to air from scheduled activities. Operation of the proposal does not involve any activities scheduled under this Act. Section 6.11 discusses impacts associated with operational emissions.	N/A	N/A

Legislation	Relevance to proposal	Permit or approval	Timing and responsibility of future approvals
Protection of the Environment Operations (Waste) Regulation 2014	This Regulation provides requirements for waste management, including tracking, recording, transportation and disposal. Waste spoil will be generated during construction and is required to be managed in line with this Regulation. Waste is discussed further in section 6.13 of this REF.	N/A	N/A
Biodiversity Conservation Act 2016 (BC Act)	The BC Act (section 7.3) requires a 'Test of Significance' (ToS) if listed threatened species, populations and ecological communities could be impacted by a project. The impact of the proposal on threatened species, communities and their habitat is described in section 6.9 and Appendix J. Significant impacts to threatened species, communities or their habitats are unlikely.	REF	N/A
Biosecurity Act 2015	The Biosecurity Act 2015 provides a framework to prevent, eliminate and minimise biosecurity risks and manage biosecurity matters. Schedule 1 of this Act sets special provisions for weeds, including the duty of land occupiers to control and manage weeds. Section 6.9 of this REF discusses biosecurity matters and identifies weeds within the proposal's impact area and measures to manage them.	N/A	N/A
National Parks and Wildlife Act 1974 (NPW Act)	This Act provides for the establishment, preservation and management of designated areas such as national parks, state conservation areas, nature reserves, and Aboriginal areas. It also provides for the protection of Aboriginal heritage, including Aboriginal objects and places. The proposal is not within or adjacent to national parks, state conservation areas or nature reserves. Impacts to Aboriginal heritage are assessed in section 6.7. An Aboriginal Heritage Impact Permit is not required for the proposal as it will not disturb a known Aboriginal object or declared Aboriginal place.	N/A	N/A

Legislation	Relevance to proposal	Permit or approval	Timing and responsibility of future approvals
Heritage Act 1977	The *Heritage Act 1977* aims to protect and preserve items of state and local heritage significance and outlines processes for approval of development that may impact items of environmental heritage owned by Sydney Water. Impacts to non-Aboriginal heritage items have been assessed in section 6.8. No direct impacts are expected and no approvals are required.	N/A	N/A
Fisheries Management Act 1994 (FM Act)	The FM Act protects listed threatened species, populations and communities of fish and marine vegetation, commercial and recreational fishing areas in NSW waters. The proposal does not involve dredging or land reclamation and does not impact key fish habitat. As a result, no permit or notification is required under Part 7 of the FM Act. The proposal could lead to changes in flows in Breakfast Creek and Eastern Creek, which are mapped as key fish habitat. Section 6.3 assesses potential impacts on aquatic ecology.	N/A	N/A
Water Act 1912 / Water Management Act 2000 / Water Management (General) Regulation 2018	Section 60A of the Water Management Act 2000 requires a licence to take water. As a public authority, Sydney Water is exempt from needing a Water Access Licence (WAL) under section 21 of the Water Management (General) Regulation 2018. The groundwater assessment in section 6.5 identifies that < 3 ML of groundwater will be extracted during construction of the proposal. As such, a water supply work approval (WSWA) is required under section 90(2) of the Water Management Act 2000 to dewater up to 3 ML of groundwater.	WSWA	Following REF exhibition, Sydney Water
Roads Act 1993	Section 138 of this Act requires approval for works in, on, or over a public road, including the digging up or disturbing the surface of a public road. Temporary road closures needed during construction of the proposal require prior approval from the relevant roads authority. Traffic and access impacts of the proposal are discussed in section 6.12.	Licence for road closures (i.e. Road Occupancy Licence)	Pre-construction, delivery contractor

Legislation	Relevance to proposal	Permit or approval	Timing and responsibility of future approvals
Contaminated Land Management Act 1997 (CLM Act)	This Act establishes a framework for investigating and (where appropriate) remediating contaminated land, in the view of the EPA. Section 6 of this Act identifies when a person is responsible for contamination of land. There is a duty to report contaminated land to the EPA in writing in accordance with section 60 of this Act. Section 6.2 assesses the proposal's contamination impacts.	N/A	N/A
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act is the principal environmental law administered by the Commonwealth. It provides for the protection of matters of national environmental significance (MNES). MNES encompass sites of either ecological, heritage, or natural resource value, as well as listed species and ecological communities. Under the EPBC Act, an action that is likely to have a significant impact on a MNES must be referred to the Commonwealth Minister for Environment and Water. The proposal will not impact any MNES except for biodiversity matters. Section 6.9 assesses the proposal's potential impacts on biodiversity MNES, which concludes no significant impacts are expected. Therefore, the proposal has not been referred under the EPBC Act.	N/A	N/A
Crown Land Management Act 2016	The proposal interacts with 2 areas of mapped Crown waterways around Quakers Hill WRRF and Harvey Park, as well as an area of mapped Crown Land at International Peace Park. Sydney Water has powers of entry to work on Crown Land and easements are not expected to be needed.	N/A	N/A
National Greenhouse and Energy Reporting Act 2007	The National Greenhouse and Energy Reporting Act provides a framework for standardised monitoring and reporting GHG emissions. A greenhouse gas assessment has been undertaken on the proposal's concept design, as summarised in section 6.17 of this REF.	N/A	N/A

Legislation	Relevance to proposal	Permit or approval	Timing and responsibility of future approvals
	Sydney Water monitors and reports greenhouse gas emissions at an organisational level annually as part of the Environmental Performance Improvement Program. Actual emissions from the construction and operation of the proposal will be captured in future reporting.		

6. Environmental assessment

This section describes the existing environment and assesses direct and indirect impacts of construction and operation for relevant environmental aspects**.** It also identifies mitigation measures to minimise impacts. These will be incorporated into contract documents and a Construction Environmental Management Plan (or similar) before starting work.

6.1 Existing environment

As the proposal includes work within an existing WRRF and construction of an 8 km pipeline across multiple suburbs, the surrounding existing environment is diverse.

The Quakers Hill WRRF began operating in 1968 and the operational land has been mostly cleared. However, stands of native vegetation remain on site. A grave site of a child of a previous landowner is located within the operational land and is regularly maintained. Breakfast Creek follows the south-west boundary of the WRRF and receives treated wastewater from the WRRF. Surrounding land use is mostly low-density residential properties. The WRRF is adjacent to Quakers Hill Parkway and the M7 Motorway.

The brine pipeline will be installed in previously disturbed areas such as shared paths, road corridors, public parks, and under businesses and houses. The brine pipeline between the Quakers Hill WRRF and Marayong Park largely follows a shared path next to Breakfast Creek. Through this section, Breakfast Creek is lined with vegetation but has been modified and part of it rebuilt as a concrete channel. The section of brine pipeline constructed by HDD will travel under some residential properties and an established industrial area between the T1 Western rail line and Sunnyholt Road. The brine pipeline between Lynwood Park and the International Peace Park at Seven Hills is mostly along local roads with low-density residential properties from either side. Once the brine pipeline enters the International Peace Park, it will follow a footpath bordered by vegetation. It will also intersect carparks used to access the sports fields, netball courts and aquatic centre before connecting to the existing wastewater network.

6.2 Soils and contamination

A preliminary site investigation (PSI), sampling and analysis quality plan (SAQP) and detailed site investigation (DSI) of the impact assessment area were carried out for the proposal. The PSI involved a review of publicly available mapping and databases, previous investigations and historic land use, and a site inspection. The DSI involved soil and groundwater sampling and testing for contamination in accordance with the SAQP. The results of the PSI and DSI are summarised in the following sections.

6.2.1 Existing environment

6.2.1.1 Soils

A review of soil mapping of the impact assessment area was undertaken for the PSI and identified the following characteristics:

- Soil landscapes – There are 2 main soil landscapes in the impact assessment area – South Creek (alluvial landscapes along Breakfast Creek and Blacktown Creek) and Blacktown (all other land). Both

landscapes are susceptible to water erosion. In Blacktown soil landscapes, water erosion is most likely to occur in cleared areas. For the South Creek soil landscape, erosion would commonly occur when there are concentrated flows.

- Salinity – Areas along Breakfast Creek and Blacktown Creek have a high salinity potential and the remaining impact assessment area has moderate salinity potential.
- Acid sulfate soils (ASS) – The impact assessment area has an extremely low probability of occurrence of ASS. Extremely low probability means 1-5% chance of occurrence, with occurrences in small localised areas.

Quakers Hill WRRF

Previous soil investigations at the WRRF indicate fill material is present beneath some areas, consisting of gravelly sand and trace clays (WSP, 2024). Reported fill depths generally ranged from 1.3 m to 4.8 m below ground level with one location reporting fill depths of 16 m below ground level (GHD 2010). Natural soils at the site consist of medium to high plasticity clays with trace fine sands and gravels at shallower depths (WSP, 2024). The full extent of filling across the site is unknown.

A soil stockpile from a previous Sydney Water project is located in the north-eastern part of the site, adjacent to the PRW Discovery Centre. This stockpile is referred to as 'QHSP01' and is about 36,000 m^3 with a height of more than 10 m above the surrounding ground level. Inspection of QHSP01 as part of the investigations for the proposal observed that it generally comprised gravelly clay and sandy clay with man-made materials such as concrete fragments, plastic, metal fragments and asphalt.

Brine pipeline

Drilling of 10 boreholes along the brine pipeline to inform the DSI found soils that comprise shallow fill materials up to 3.6 m below ground level underlain by alluvial and residual soils that extend between 0.5 to 4 m to bedrock. Bedrock is between 1.2 m and 5 m below ground level.

6.2.1.2 Contamination

Quakers Hill WRRF

The WRRF has known soil contamination including hydrocarbons, heavy metals, polychlorinated biphenyls (PCBs), per- and poly-fluoroalkyl substances (PFAS) and asbestos from past burial of fill, grit and screenings, sludge and building wastes. Groundwater at the WRRF is known to contain elevated concentrations of nutrients (based on historical data), selected heavy metals and microbiological organisms.

There is potential for contamination of the concrete liner and earth fill used to construct the IDALs if wastewater has leaked from the IDALs. If the IDALs have leaked they may have also contaminated groundwater. Whether wastewater leakage from the IDALs has occurred can only be confirmed when they are demolished.

Past activities that may have caused contamination in other parts of the WRRF include:

- infilling of the former sludge lagoons, due to residual sludge and potential use of contaminated fill

- leaks and spills from WRRF operations including aboveground storage tanks, underground structures and pipes, and substations/ transformers
- asbestos in soils from weathering and / or poor demolition practices of building materials from WRRF structures and / or historical farm buildings (from the previous land use)
- historical importation of fill for use at the WRRF site from unknown sources and unknown contamination status
- historical application of herbicides, pesticides, fertilisers and other chemical use associated with agricultural activities.

A stockpile containing known asbestos is present north of the site carpark. The stockpile is about 10,000 m^3 and is the subject of an Asbestos Management Plan. The stockpile is also likely to contain select heavy metals and microbiological contaminants.

QHSP01 was subject to a contamination assessment in 2023 that involved the excavation of 22 test pits to a maximum depth of 3 m. Samples collected and analysed did not report contamination above the adopted criteria (PRM 2023). Additional sampling and analysis of QHSP01 was carried out as part of the investigations for the DSI to determine whether contaminants are present below the depth of the 2023 assessment. A total of 19 test pits or trenches were excavated across QHSP01 using a 20-tonne excavator to get a representative profile from top to bottom. The samples collected were laboratory tested for a range of contaminants. The results were compared to human health and environmental site assessment criteria. The criteria were set at levels that provide confidence that contaminant concentrations below the criteria will not adversely affect human health or on-site terrestrial ecosystems.

The laboratory testing of the QHSP01 samples identified:

- two samples exceeded the ecological site assessment criteria for perfluorooctanesulfonic acid (PFOS, a type of PFAS)
- chrysolite asbestos as fibre cement material was identified in one sample. However, it was present at a concentration below the commercial/industrial limit for asbestos containing materials
- all other contaminants analysed were below the adopted criteria.

Brine pipeline

A review of previous land use within 500 m of the brine pipeline indicates that historically there have been some potentially contaminating activities. These activities include chemical manufacturing, electrical, engine works, dry cleaning, iron and steel works and printing shops. Legacy contamination from these activities may have construction and human health impacts if not managed appropriately.

A desktop review and site inspection of the impact assessment area along the brine pipeline was undertaken for the PSI to identify locations that may represent a contamination exposure risk during construction. These locations were categorised as high, medium or low risk. The high-risk locations identified are:

- Snackbrands Australia Pty Ltd – 30 Bessemer Street, Blacktown. This site is within the Kings Park industrial estate and has a frontage to Gate Road. The site is immediately south of the proposed HDD

retrieval pit. There is a current EPL for the site for 'general agricultural processing'. The site has potential for soil and/or groundwater contamination.

- Hans Continental Small Good Pty Ltd – 25 Bessemer Street, Blacktown. This site is also within the Kings Park industrial estate and is immediately north-west of the intersection of Gate Road and Bessemer Street. At its nearest this site is within about 20 m of the HDD section of the brine pipeline and about 50 m from the HDD retrieval pit. The site was previously the subject of an EPL for 'general animal products production'. An EPL non-compliance was reported for pollution of waters in 2001. The site has potential for soil, groundwater and/or vapour contamination.
- Kings Park industrial estate – In addition to site-specific contamination, there is potential for soil, groundwater and/or vapour contamination across Kings Park industrial estate due to historical and current commercial / industrial land uses. This area extends from the railway line in the west to Sunnyholt Road in the east.
- Stockpiles of unknown origin on the northern side of Breakfast Creek in Melrose Park, to the south of Quakers Hill WRRF. These stockpiles have the potential for soil contamination.

The whole impact assessment area along the brine pipeline was identified as moderate risk due to historical agricultural activities and cutting, filling, and levelling of the area to support historical development. Possible past agricultural activities with the potential for soil and groundwater contamination include the application of herbicides, pesticides and fertilisers, chemical storage (pesticides, herbicides, fuel, oil), chemical use (widespread spraying, dip sites, fertiliser use) and waste disposal. Historical cutting, filling, and levelling activities with the potential to have caused soil contamination include development of formalised drainage lines and public open space such as those along Breakfast Creek and Blacktown Creek.

Soil sampling and testing

As noted above, 10 boreholes were drilled along the brine pipeline to carry out soil sampling and analysis to inform the DSI. The laboratory testing identified:

- asbestos-containing material in fill soils sampled from the borehole drilled in Billy Goat Hill Reserve. The asbestos was detected within soils between 0.1 to 2 m below ground level (fill depth at this borehole was 3.6 m below ground level). Asbestos-containing material was not detected in any other samples
- heavy metals, pesticides, PFAS, phenols, and petroleum hydrocarbons were below the laboratory limit of reporting and/or below the site assessment criteria for all samples, except for one sample in Billy Goat Hill Reserve. This sample had zinc levels above the ecological site assessment criteria.

Groundwater sampling and testing

Four groundwater wells were installed along the brine pipeline. The wells were installed on the brine pipeline alignment at Harvey Park, near the HDD launch pits in Marayong Park and Lynwood Park and near the connection to the NSOOS in International Peace Park.

Groundwater samples were laboratory tested for a range of contaminants and the results compared to human health and environmental site assessment criteria. The laboratory testing identified:

- concentrations of PFOS above the ecological criteria in all four wells

- concentrations of one or 2 heavy metals above the ecological criteria in all wells except at Lynwood Park.

6.2.2 Potential impacts – construction

6.2.2.1 Soils

Table 6-1 discusses the potential impacts to soils during construction.

Table 6-1 Potential impacts to soils during construction

Impact description	Impact location	Scale of impact	Likely impacts
Saline soils Disturbing saline soils through excavation and stockpiling	Highest risk along creek lines	• Low magnitude and short-term localised impacts	• Saline soils mixing with topsoil • Saline soils could run off into waterways • Ecological impacts to soil structure and plant growth
Soil fertility Mixing and compacting topsoil	All locations where soil disturbance and stockpiles are required	• Low magnitude, impacts restricted to areas with earth disturbance	• Reduced soil productivity
Erosion and sedimentation Removing groundcover, increasing area of exposed soil	All locations where soil disturbance and stockpiles are required	• Moderate magnitude due to groundcover disturbance • Impacts will depend on construction methodology	• Soil exposed to wind and erosion can travel offsite • Water quality impacts from turbidity and sediment • Excavations that are open for longer (e.g. HDD/tunnelling pits) will have higher risk.

6.2.2.2 Contamination

Table 6-2 discusses potential contamination impacts during construction.

Table 6-2 Potential contamination impacts during construction

Impact description	Impact location / activities which will cause an impact	Scale of impact	Likely impacts
Known contaminants in soil Disturbing, mobilising and distributing known contaminants in soil	• Excavating to install assets at Quakers Hill WRRF • IDAL backfilling with material from the asbestos stockpile and QHSP01 • Excavating in the vicinity of Billy Goat Hill Reserve	• High likelihood of impact due to known contaminants • Long-term exposure to known contaminants • Localised impacts around Billy Goat Hill Reserve	• Human health impacts from exposure to known contaminants • Ecological impacts from contaminants mobilising to waterways
Unknown contaminants in soil Disturbing, mobilising and distributing unexpected contaminants in soil	All locations where ground disturbance or filling is required, including: • excavating for open trenching for brine pipeline • IDAL demolition • importing soil from off-site.	• High likelihood of impact due to potential unknown contaminants • Localised impacts along brine pipeline	• Disturbance of contaminants not previously discovered during investigation • Import of poor quality soil from off-site
Known contaminants in groundwater and dewatered areas Disturbing and distributing known contaminants in groundwater and rainwater collected in excavations	• Open trenching for brine pipeline construction, and excavation within the WRRF • Groundwater within HDD launch and retrieval pits • Groundwater encountered during HDD works will be	• Medium likelihood at WRRF– groundwater is unlikely to be encountered in shallow excavations • High likelihood at brine pipeline • Groundwater needs treatment before reuse	• Ecological impacts from contaminated groundwater entering waterways

Impact description	Impact location / activities which will cause an impact	Scale of impact	Likely impacts
	mixed in with the drilling mud	• Short-term and intermittent interactions	
Contaminated spoil waste streams Generating waste streams from spoil, drilling, and excavating unsuitable materials	All locations where contaminated spoil is produced. For example: • excavations for the secondary treatment plant upgrade and other ground disturbance works at the WRRF • work on the asbestos stockpile, QHSP01 and the IDALs • excavation in Billy Goat Hill Reserve.	• Short-term localised impacts where contaminated spoil is excavated and stored	• Mixing contaminated and clean spoil, which would generate an increased volume of contaminated spoil • Disturbing contaminants not previously discovered during investigation
Exposure to asbestos Disturbing, stockpiling, reusing and disposing known and previously unknown asbestos containing material	Known asbestos is found at: • the asbestos stockpile and QHSP01 at Quakers Hill WRRF • Billy Goat Hill Reserve. Beyond these locations, there is potential to encounter unknown asbestos wherever excavations occur in fill material.	• Medium human health risk and low environment risk • Asbestos will be disturbed but impact is temporary	• Potential to find previously undisturbed asbestos • Long-term human health risk from exposure

Impact description	Impact location / activities which will cause an impact	Scale of impact	Likely impacts
Construction hazardous chemicals use Spills and leaks when handling or storing hazardous chemicals	Construction compounds and other locations where hazardous chemicals are handled or stored. Spills and leaks may arise from specific construction activities such as on-site servicing of plant and equipment.	• Low magnitude, spills are small and likely able to be managed on site	• Residual contamination from any spills or leaks

6.2.3 Potential impacts – operation

6.2.3.1 Soils

Operational impacts to soils could occur from:

- new infrastructure and sealed surfaces (increasing hardstand area)
- unsuitable landscaping and groundcover not sufficiently re-instated
- leaks from the brine pipeline.

Operational impacts to soils are expected to be minimal and low magnitude, since any impacts are expected to be localised, infrequent and short-term. The above impacts are unlikely to happen if mitigation measures are applied.

6.2.3.2 Contamination

Quakers Hill WRRF

The use and storage of hazardous materials and chemicals at the WRRF presents a potential contamination risk. The likelihood of spills is high, but the magnitude of impacts is expected to be low. Spills are likely to be small volumes, and chemicals stored on site will be bunded and stored in appropriately sized containers. There is also the potential for leaks of wastewater and hazardous materials from operating infrastructure. The WRRF is an existing operational site with procedures in place for safely managing the use of hazardous materials and monitoring for and managing leaks.

Brine pipeline

Residual contamination may be present along the brine pipeline if existing contamination has not been suitably managed during construction. This is considered a low risk, given the minimal contamination identified by the DSI along the brine pipeline and because no further soil disturbance is proposed during brine pipeline operation.

Operational impacts to contaminated land are expected to be minimal with the implementation of mitigation measures.

The brine pipeline has the potential to leak resulting in an uncontrolled release of brine to the environment. The existing brine pipeline has a similar risk of leaking and the existing procedures for managing this risk would also be applied to the new brine pipeline.

6.2.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-3, impacts to soils and contamination risks can be adequately managed, and residual impacts are expected to be low.

Mitigation measures in other sections of this REF (e.g. hazard and risk, groundwater, waste and hazardous materials) will also contribute to mitigating impacts to soils and contamination risks.

Table 6-3 Environmental mitigation measures — soils and contamination

Mitigation measures	Timing
Design of ground surface levels, drainage and landscaping is to avoid channelling and concentrating stormwater across unprotected soils.	Detailed design
Design to minimise erosion during operation (e.g. energy dissipation at release locations, design scour valves on pipeline to minimise erosion, stormwater management, restore cleared areas).	Detailed design
Design to remove high-risk contamination runoff and chemical spill risks.	Detailed design
Design all operational chemical storage and delivery areas to have sufficient storage volumes to contain a worst-case spill, including the full volume being delivered and the full volume stored simultaneously.	Detailed design
Develop a Construction Soils and Water Management Plan (CSWMP) as a sub plan of the Construction Environmental Management Plan (CEMP) and will outline measures to manage soil and water quality impacts associated with the construction works, including erosion and sedimentation, and a surface water quality monitoring program to monitor the performance of management measures.	Pre-construction
Delivery contractor to ensure imported material is Virgin Excavated Natural Materials (VENM) or meets a relevant NSW EPA Resource Recovery Order and Resource Recovery Exemption, or is a commercially supplied material that is not waste. If using materials that are subject to a NSW EPA Resource Recovery Order/Exemption the Delivery contractor must ensure the conditions in that Order/Exemption are strictly adhered to.	During construction
Prepare a construction Contamination Management Plan (must be prepared by a suitably qualified person) as a sub plan of the CEMP and reviewed by Sydney Water's Environmental Representative and the Contaminated and Hazardous Materials team. The plan must identify the type and location of known/potential contamination, landowner notification requirements, controls for known and unknown contamination, management requirements (waste minimisation, segregation and classification) and reuse, offsite recycling and/or disposal measures.	Pre-construction
Develop and implement an unexpected contamination finds procedure to include: • responsibilities, actions and reporting requirements • stopping work in the immediate vicinity of suspected contamination. Indicators of contamination include discoloured soil, anthropogenic material within fill, asbestos, chemical or petrol odours and leachate • inspection and verification of the area by a contaminated lands consultant. The consultant may recommend collection of soil samples and analysis for contaminants of potential concern identified by the inspection • management, risk assessment or remedial action based on the type, extent, waste implications and significance of the contaminants of potential concern • notification to the EPA under section 60 of the CLM Act (where the contamination is on Sydney Water land and triggers the notification requirements) • notification of owners where contamination is identified on lands other than Sydney Water	Pre-construction During construction

Mitigation measures	Timing
• containing disturbed material on an impermeable surface and cordon areas off • management actions to prevent exposure to asbestos in the event it is found • notifying the Sydney Water Project Manager and the Environmental Representative (who will contact Contamination and Hazardous Materials team) to agree on proposed management approach. All site personnel must be inducted into the procedure.	
Develop a Spoil and Stockpile Management Plan as sub plan of the CEMP. The plan will require tracking of all project-generated spoil from its source to its final destination, regardless of whether it is retained onsite or removed offsite. Additionally, the Spoil and Stockpile Management Plan will include types of materials that can be imported from offsite sources and procedures for verifying materials are suitable for import. The plan should also include detail on: • segregating spoil into stockpiles of topsoil, fill, natural material and other types as required • exact locations of stockpiles including locating stockpiles and equipment storage areas away from drainage pathways and flood prone areas and, where possible, in elevated positions or at alternative sites • minimising the number of stockpiles and ensuring adequate contingency measures are in place to prevent sedimentation of waterways in the event of a large flood event. The height, slopes and batters of stockpiles should be documented together with proposed erosion and sediment controls • minimising stockpile size and ensuring delineation between different stockpiled material to prevent mixing and cross contamination • erosion and sediment control management e.g. inspecting controls at least weekly and immediately after rainfall, rectifying damaged controls and removing controls once surfaces have been stabilised, including removing trapped sediment in drainage lines • considerations for future maintenance and restoration of stockpiles. The Spoil and Stockpile Management Plan will be approved by the Sydney Water Project Manager in consultation with the Environmental Representative and Contamination and Hazardous Materials team.	Pre-construction
Develop an Asbestos Management Plan as a sub-plan of the CEMP to manage disturbance of asbestos impacted material during construction. Movement and excavation of asbestos contaminated fill will be undertaken by an appropriately licenced asbestos removalist in accordance with the Asbestos Management Plan.	Pre-construction
On-site reuse of asbestos contaminated material at Quakers Hill WRRF can only occur in accordance with the site's Asbestos Management Plan.	During construction
Segregate saline soil stockpiles from topsoil.	During construction
Develop and implement a soil sampling program to assess excavated soils for salinity when on-site reuse is proposed.	During construction

Mitigation measures	Timing
Manage saline soils in accordance with best practice guidelines e.g. *Salinity Training Manual* (Department of Primary Industries (DPI) 2014).	During construction
Contain any spills that occur outside the containment area within a first flush structure across roads and hardstand. Once full, flow bypass to surrounding waterways via the stormwater management system.	During operation
Develop a Contaminated Land Management Plan for the operational phase of the proposal to manage the asbestos containing material backfilled into the IDALs.	Pre- operation
Where residual contamination is on land owned by another party, inform them of final residual contamination extents.	Pre- operation
Adopt controls for storage and handling of chemicals, as outlined in the relevant Material Safety Data Sheets for each chemical.	During operation
Implement an operational spill response plan and incident response procedure. This may include update of existing plans and procedures if needed to incorporate proposal infrastructure.	During operation
Monitor disturbed areas that have been restored to ensure groundcover has been reinstated effectively for the duration of the delivery contractor's defects liability period. Implement corrective actions where needed.	During operation
Monitor brine pipeline for volume loss and evidence of leaks.	During operation

6.3 Surface water and aquatic ecology

Appendix D includes the surface water and aquatic ecology impact assessment completed for the proposal. This section summarises key findings of that assessment. The study area incorporates a 500 m buffer around the proposal, to include the areas likely to be directly or indirectly impacted. Field investigations were carried out for sections of the receiving waterways upstream and downstream of the current WRRF discharge location to assess aquatic habitat condition. Proposed releases to waterways will occur at the same location as the current releases.

The proposal is not in an area administered by WaterNSW and a Neutral or Beneficial Effect on Water Quality (NorBE) assessment is not required.

6.3.1 Existing environment

6.3.1.1 Quakers Hill WRRF

Quakers Hill WRRF is located within the Wianamatta South Creek sub-catchment which drains into the upper reaches of the Hawkesbury River near the Fitzroy Bridge at Windsor. The 2 main waterways in this catchment are South Creek and Eastern Creek, which join near Riverstone.

Quakers Hill WRRF discharges into Breakfast Creek (as shown on Figure 6-1) which flows into Eastern Creek about 500 m downstream from the discharge location. Quakers Hill WRRF has a first flush system, where potentially contaminated stormwater is directed to the head of works of the WRRF for treatment. This improves the quality of stormwater runoff from the plant. Stormwater which is unlikely to be contaminated by operation of the WRRF is directed to the Blacktown City Council stormwater system.

Figure 6-1 Quakers Hill WRRF release point into Breakfast Creek

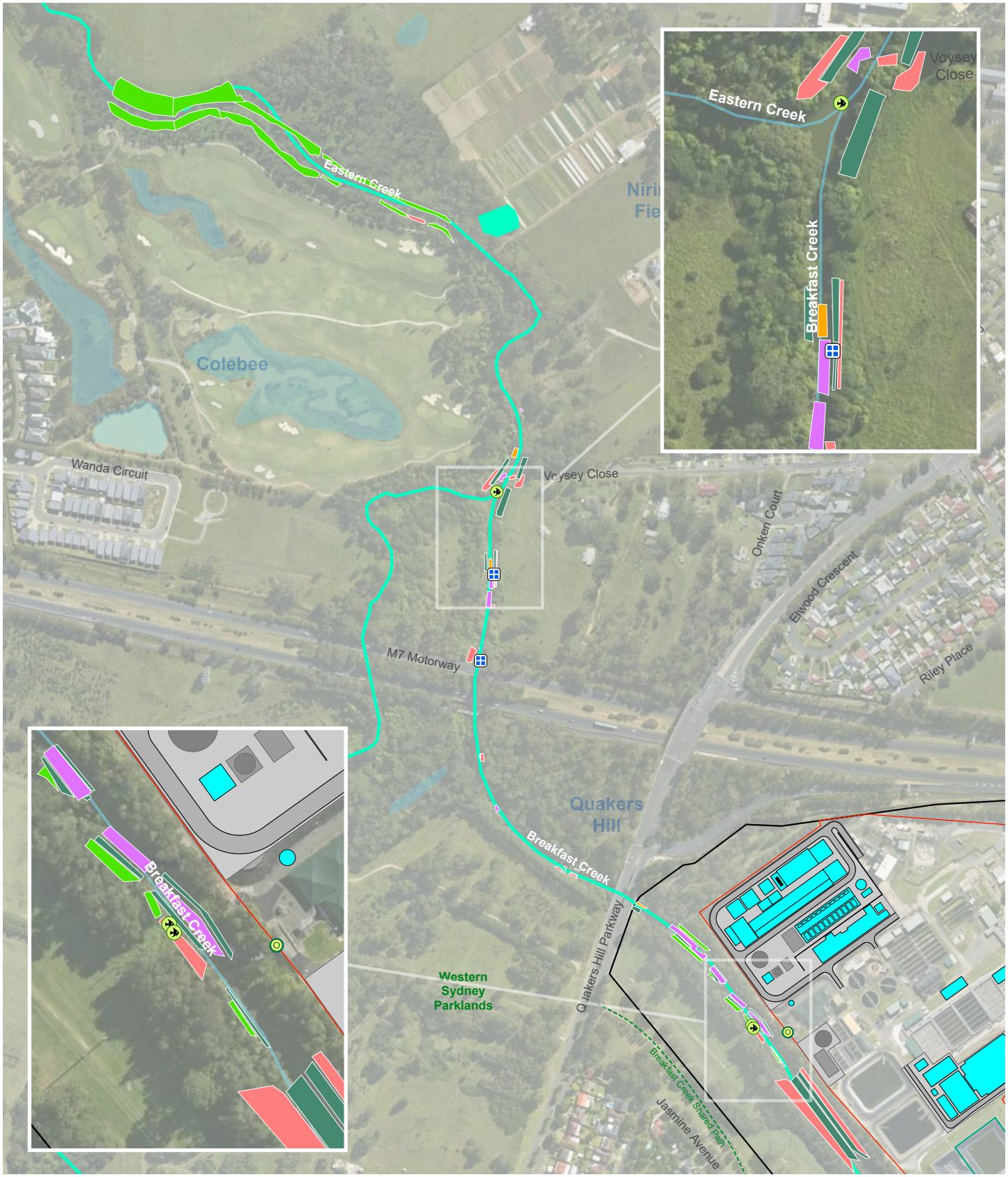
Breakfast Creek

Breakfast Creek is naturally ephemeral and stormwater-dependent, with the reaches upstream of Quakers Hill WRRF frequently experiencing low or no flow. Downstream of Quakers Hill WRRF, the flow in Breakfast Creek is very consistent due to the steady treated effluent releases, with almost no low flow or cease-to-flow events. The creek has been significantly modified, including a 900 m concrete channel upstream of Quakers Hill WRRF with numerous barriers to fish that disrupt natural flow and connectivity to the floodplain.

Water quality in Breakfast Creek has been monitored by Sydney Water and Blacktown City Council and is considered poor. Monitoring results show that water quality is generally poorer downstream of Quakers Hill WRRF.

In September 2024, Jacobs completed an aquatic ecology survey of Breakfast Creek from the storm drain upstream of Falmouth Road to the confluence with Eastern Creek as shown in Figure 6-2. Riparian vegetation within the waterway was sparse or non-existent. Submerged macrophytes (*Vallisnera* sp., Blunt Pondweed), emergent macrophytes (reeds and bullrushes), and Swamp Sheoaks (*Casuarina glauca*) were common from Quakers Hill Parkway to the confluence with Eastern Creek. Figure 6-3 and Figure 6-4 show examples of this vegetation. Dominant invasive weeds were observed throughout including:

- Trad (*Tradescantia fluminensis*)
- Mustard (*Brassica sp.)*
- Alligator Weed (*Alternanthera philoxeroides*)
- Canadian Pondweed (*Elodea canadensis*)
- Canna Lilies (*Canna sp.*)
- Umbrella Sedge (*Cyperus involucratus*).



- Quakers Hill WRRF
- Impact area
- Advanced treatment upgrade infrastructure
- Plant access
- Plant hardstand
- Key Fish Habitat (NSW DPI)
- Discharge point
- Storm drain
- Carp observed

Dominant vegetation

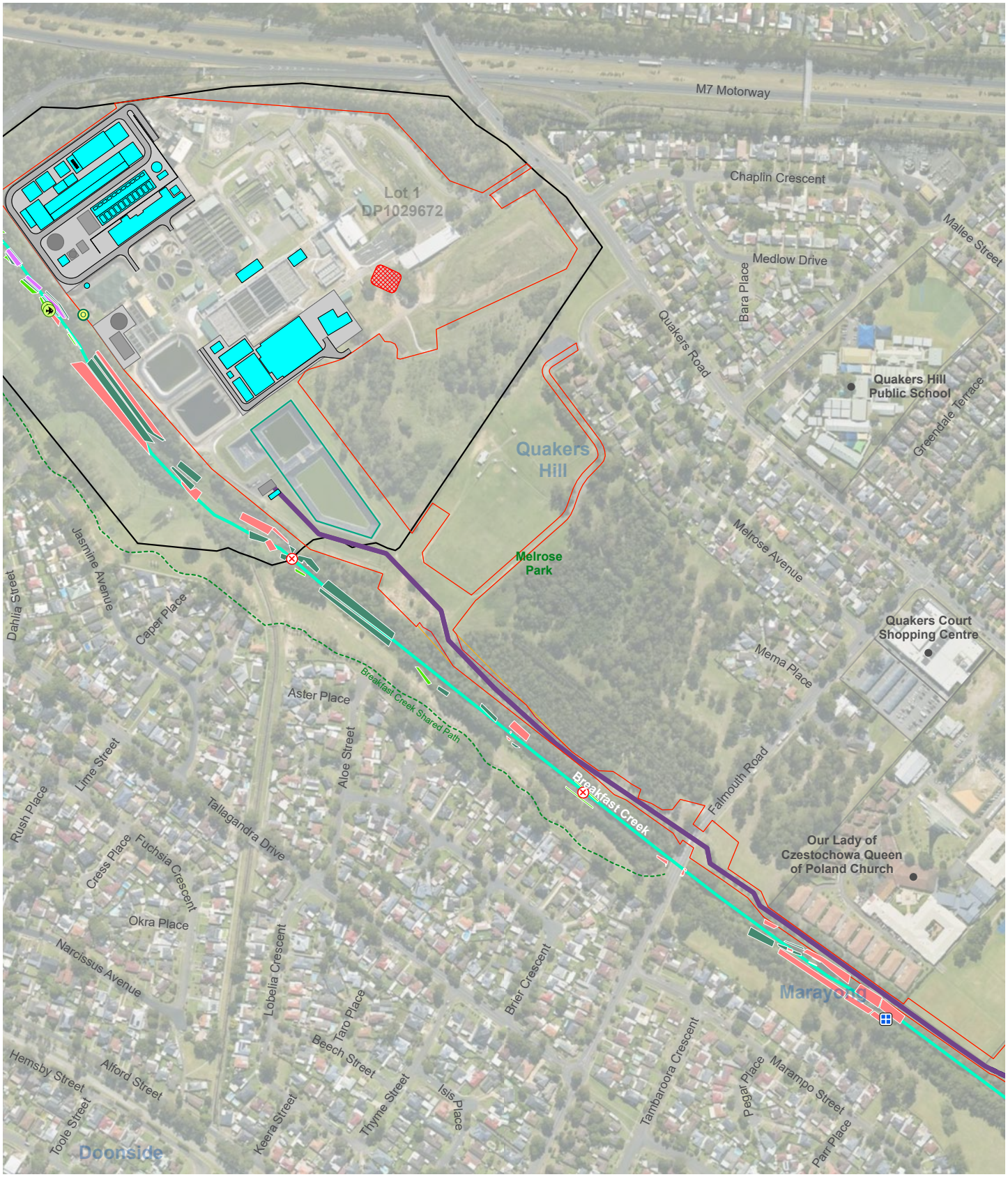
- Swamp Sheoak
- Invasive Herbaceous Weeds
- Vallisneria sp.
- Mixed water-dependent natives
- Blunt Pondweed

Figure 6-2a Ground truthed aquatic vegetation

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025

Scale: 1:6,000 @ A4
GDA2020 MGA Zone 56



Quakers Hill WRRF
Impact area
Brine pipeline construction method
Open trench
HDD pipe string
Advanced treatment upgrade infrastructure
Plant access
Plant hardstand
Key Fish Habitat (NSW DPI)

Discharge point
Storm drain
Carp observed
Flow obstruction
Dominant vegetation
Swamp Sheoak
Invasive Herbaceous Weeds
Vallisneria sp.
Mixed water-dependent natives
Blunt Pondweed

Figure 6-2b Ground truthed aquatic vegetation

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:6,000 @ A4
GDA2020 MGA Zone 56

Banks are well vegetated with dense grasses, reeds and shrubs. Both submerged and emergent vegetation was visible in sections of the creek

Un-culverted crossing, buildup of sediment and rubbish blocking fish passage

Figure 6-3 Photographs showing environment upstream of Quakers Hill WRRF

Submerged aquatic plants and emergent aquatic vegetation, water clarity was generally good, particularly in areas of rocky substrate, but where sediment was the dominant substrate water appeared slightly murky

Figure 6-4 Photographs showing environment downstream of Quakers Hill WRRF

Upstream of Quakers Hill WRRF, Breakfast Creek was seen to be negatively impacted by poor condition riparian vegetation corridors, barriers to flow and fish passage, and areas of heavy silting. Downstream of Quakers Hill WRRF, Breakfast Creek habitat was somewhat improved. It had less silting on the streambed, more habitat features such as aquatic macrophytes and woody debris, and less frequent breaks in native riparian vegetation. Rubbish and debris were common at field survey locations upstream of Falmouth Road, and an oily sheen on the water surface was also observed.

Breakfast Creek is classified as a third order stream according to the Strahler ranking system and is mapped as key fish habitat (KFH). Waterway class can be used to assess the impacts of certain activities on fish habitats in conjunction with the habitat sensitivity type (DPI 2013). Class is determined using indicators such as hydraulic geometry, frequency of stream flows, presence of aquatic habitat, presence of threatened or protected fish species and other native fish, and connection to adjacent habitats. Breakfast Creek is ranked as Class 3-Minimal fish habitat due to the multiple barriers to fish passage in the form of the 2 un-culverted road crossings. The freshwater fish community status for Breakfast Creek is ranked as 'fair' in accordance with Fisheries Spatial Data Portal (DPIRD 2025). The introduced fish species Common Carp (*Cyprinus carpio*) was observed during the aquatic ecology survey just downstream of the discharge point and has also been recorded in the region.

Sensitive receiving environments (SREs) have a high conservation value or support ecosystem or human uses of water that are particularly sensitive to pollution or degradation of water quality. The potential for SREs was assessed within the study area 500 m buffer (upstream and downstream) based on:

- waterway classification
- KFH mapping
- KFH field assessment completed in accordance with the requirements of DPI (2013), KFH type was determined based on the presence of habitat features such as snags, woody debris, macrophytes, and boulders
- predicted presence of threatened aquatic species listed under Commonwealth and state legislation
- groundwater and surface water dependent vegetation and fauna communities listed in Commonwealth and state legislation
- proximity to a drinking water catchment
- areas that contribute to aquaculture and commercial fishing.

With the results of the aquatic ecology survey and other inputs on the aquatic habitat of Breakfast Creek, it can be concluded that Breakfast Creek does not constitute a SRE.

Eastern Creek

From the confluence with Breakfast Creek to Stonecutters Ridge Golf Club, Eastern Creek is predominantly slow-flowing and deep. The water quality of Eastern Creek has been monitored by Sydney Water and Blacktown City Council. The ecological health of Eastern Creek has been variable and generally reports as fair, meaning water quality indicators are within guideline limits 70% of the time (BCC 2024).

In September 2024, Jacobs completed an aquatic ecology survey for a 1 km stretch of Eastern Creek downstream of the confluence with Breakfast Creek as shown on Figure 6-2. Macrophytes such as

Vallisnera sp. were observed during field survey just downstream of the confluence with Breakfast Creek, but aquatic vegetation was mostly absent in this reach. The banks were dominated by Swamp Sheoak and little other riparian vegetation was present for much of the surveyed area.

Figure 6-5 shows some examples of aquatic vegetation in Eastern Creek. Habitat features that were commonly present included snags and boulders, alternating riffle/pool sequences, and a lack of silting. These features can offer shelter and breeding grounds for fish and macroinvertebrates. The environment includes submerged aquatic plants and good quality riparian vegetation including Swamp She-oak. Water clarity is variable, with a greenish tint observed at some sites, suggesting the presence of algae.

Figure 6-5 Photographs showing environment in Eastern Creek

Eastern Creek is a fourth order stream according to the Strahler ranking system and classified as KFH based on Strahler classification. The freshwater fish community status is ranked as 'Fair' in accordance with Fisheries Spatial Data Portal (DPIRD 2025). Although the aquatic habitat of Eastern Creek is moderately disturbed, it is defined as a SRE in the vicinity of the study area due to the KFH categorisation and presence of some habitat features for aquatic life.

6.3.1.2 Brine pipeline

The brine pipeline will run adjacent to Breakfast Creek from Quakers Hill WRRF to Marayong Park. The pipeline will be adjacent to Blacktown Creek for about 600 m to the connection with the NSOOS. Blacktown Creek is in the Parramatta River catchment and drains eastwards. The Blacktown Creek corridor is highly modified with large sections of concrete channels and adjacent open space. It is influenced by stormwater runoff and wet weather wastewater overflows.

The water quality of Blacktown Creek has been monitored by Blacktown City Council at Powers Road, Seven Hills, about 1.2 km downstream of where the brine pipeline will connect to the NSOOS. The results indicate that the water quality of Blacktown Creek is poor and does not meet the recommended guidelines for protection of aquatic ecosystems, predominantly due to elevated nutrient concentrations.

The riparian health of Blacktown Creek is rated as poor indicating dominance of weeds and low diversity of riparian vegetation (BCC 2024). Blacktown Creek is not designated as KFH (DPIRD 2025). Due to the lack of KFH status and poor habitat quality, Blacktown Creek is not assessed to be an SRE.

Threatened species

Two threatened fish species have the potential to be present in the study area as shown in Table 6-4.

Table 6-4 Threatened aquatic species presence recorded in the study area

Species	EPBC Status	FM Act Status	Protected Matters Search Tool	Fisheries Spatial Data Tool	Bionet Atlas	Atlas of Living Australia
Macquarie Perch (*Macquaria australasica*)	Endangered	Endangered	Species or species habitat may occur within area	Not mapped in area	No records	No records
Australian Grayling (*Prototroctes maraena*)	Vulnerable	Endangered	Species or species habitat may occur within area	Not mapped in area	No records	No records

No Macquarie Perch or Australian Grayling have been recorded in Breakfast Creek, Eastern Creek, or Blacktown Creek. Field investigations identified that Breakfast Creek is unlikely to support Macquarie Perch or Australian Grayling. Upstream of Quakers Hill WRRF, the creek is largely narrow and shallow, without slow-flowing pools to support adult fish. Its ephemeral nature and obstructions to flow and fish passage mean habitat for Australian Grayling is unlikely. Breakfast Creek downstream of Quakers Hill WRRF and Eastern Creek lack the deep pools preferred by Macquarie Perch. The waterway downstream of Quakers Hill WRRF is also uniformly quick-flowing, with Australian Grayling usually inhabiting moderate flowing waters. Therefore, the species are unlikely to be present in the study area or be impacted by construction and operation of the proposal. No threatened aquatic invertebrates or plants are recorded or modelled in the study area.

As a result, no further assessment of impacts to threatened aquatic species is needed.

6.3.2 Environmental values and water quality criteria

The environmental values for the waterways within the study area include:

- aquatic ecosystems
- visual amenity
- secondary contact recreation
- irrigation water supply
- cultural activities.

These environmental values have been considered in the assessment of existing water quality conditions and potential impacts associated with the proposal.

Key water quality indicators and related numerical criteria have been nominated for each environmental value using the ANZG (2018) water quality guidelines and the site-specific trigger values (SSTV) for waterways in the Wianamatta-South Creek catchment (DPE 2022). Table 6-5 shows these values. Blacktown Creek is in the Parramatta River catchment so the SSTVs developed for waterways in the Wianamatta-South Creek catchment do not apply. The SSTVs for urban streams with 6%–19% impervious surfaces (Tippler et al. 2013) have been adopted for Blacktown Creek and are also provided in Table 6-5.

Table 6-5 Key water quality indicators and numerical criteria for environmental values

Environmental value	Indicator	Guideline value - Breakfast Creek and Eastern Creek (lowland river)	Guideline value – Blacktown Creek
Aquatic ecosystems – maintaining or improving the ecological condition of waterbodies and riparian zones over the long term	Total nitrogen (milligrams per litre; mg/L)	1.72[b]	0.5[c]
	Dissolved inorganic nitrogen (mg/L)	0.74[b]	-
	Ammonia (mg/L)	0.08[b]	0.04[c]
	Oxidised nitrogen (mg/L)	0.66[b]	0.11[c]
	Total phosphorus (mg/L)	0.14[b]	0.05[c]
	Filterable reactive phosphorus (mg/L)	0.04[b]	-
	Turbidity (Nephelometric Turbidity Unit; NTU)	50[b]	11[c]
	Total suspended solids (mg/L)	37[b]	7[c]
	Conductivity (µS/cm^2)	1,103	371[c]
	pH	6.20–7.60[b]	< 7.88[c]
	Dissolved oxygen (% saturation or mg/L)	43–75%[b] 8[b]	> 65%[c]
	Chlorophyll-*a* (micrograms per litre; µg/L)	3[a]	
	Toxicants	As per ANZG (2018) toxicant default guidelines values (95% level of protection for slightly to moderately disturbed ecosystems and 99% level of protection for toxicants that bioaccumulate) [a].	
Visual amenity – aesthetic qualities of waters	Visual clarity and colour	Natural visual clarity should not be reduced by more than 20%. Natural hue of water should not be changed by more than 10 points on the Munsell Scale. The natural reflectance of the water should not be changed by more than 50%[a].	
	Surface films and debris[a]	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour. Waters should be free from floating debris and litter. No quantitative value specified.	
	Nuisance organisms[a]	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches should not be present in unsightly amounts. No quantitative value specified.	

Environmental value	Indicator	Guideline value - Breakfast Creek and Eastern Creek (lowland river)	Guideline value – Blacktown Creek
Secondary contact recreation – maintaining or improving water quality of activities such as boating and wading, where there is a low probability of water being swallowed	Faecal coliforms, enterococci, algae and blue-green algae	As per the NHMRC (2008) Guidelines for managing risks in recreational water.	
	Nuisance organisms	As per the visual amenity guidelines. Large numbers of midges and aquatic worms are undesirable.	
	Chemical contaminants	Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable of recreation. Toxic substances should not exceed values in Table 9.3 of NHMRC (2008) guidelines.	
	Visual clarity and colour	As per the visual amenity guidelines.	
	Surface films	As per the visual amenity guidelines.	
Irrigation water supply – protecting the quality of waters applied to crops and pastures	Algae and blue-green algae	Should not be visible. No more than low algal levels are desired to protect irrigation equipment.	
	Salinity (electrical conductivity)	To assess the salinity and sodicity of water for irrigation use, several interactive factors must be considered including irrigation water quality, soil properties, plant salt tolerance, climate, landscapes and water and soil management. For more information, refer to Chapter 4.2.4 of ANZECC & ARMCANZ (2000) Guidelines.	
	Thermotolerant coliforms (faecal coliforms)	Trigger values for thermotolerant coliforms in irrigation water used for food and non-food crops are provided in table 4.2.2 of the ANZECC & ARMCANZ (2000) Guidelines.	
	Heavy metals and metalloids	Long term trigger values (LTV) and short-term trigger values (STV) for heavy metals and metalloids in irrigation water are presented in table 4.2.10 of the ANZECC & ARMCANZ (2000) guidelines	

Notes:

Sources: ANZG (2018), DPE (2022) SSTV and Tippler et al. (2013).

[a] ANZG (2018) guideline value.

[b] DPE (2022) SSTV.

[c] Tippler et al. (2013).

6.3.3 Potential impacts – construction

6.3.3.1 Quakers Hill WRRF and brine pipeline

During construction, the proposal will involve vegetation removal, excavation, the establishment of temporary soil stockpiles and storage areas for fuel and chemicals. The main construction impacts on surface water quality and aquatic ecology include erosion, sedimentation, concrete works and accidental

spills and leaks. Poor site management may lead to potential sedimentation impacts to Breakfast Creek and Blacktown Creek.

Sedimentation can increase turbidity, reduce water clarity, and lead to smothering of aquatic organisms (i.e. by clogging fish gills or smothering aquatic plants). Sediments may contain high concentrations of nutrients which can lead to algal blooms and subsequently result in reduced light penetration and limit growth of aquatic vegetation. Sediments may also contain high concentrations of metals and other chemical contaminants which can cause toxic effects in aquatic organisms, as well as reduce the suitability of the water for other beneficial uses (e.g. recreation and irrigation). Given the relatively flat to low sloping gradient of the proposal area and the small amount of vegetation to be removed (2.29 ha of native vegetation communities), the risk that runoff from excavated areas may transport sediment downstream is expected to be low. Sediment basins will be required at Quakers Hill WRRF during construction to collect sediment-laden runoff from the disturbed areas. Three basins have been proposed as shown in Figure 6-6, with sizing detailed in Appendix D. The design of these may be revisited to aligns with any changes to infrastructure proposed at Quakers Hill WRRF during detailed design, with the intent of achieving the same outcome.

Figure 6-6 Proposed erosion and sediment controls for Quakers Hill WRRF

Concrete work can generate concrete dust, concrete slurries or result in washout water being discharged to downstream waterways. Concrete and its by-products, if mobilised to downstream waterways, can increase alkalinity and pH which can be harmful to aquatic life. The direct risk to water quality and aquatic ecology from concrete works associated with the proposal is low as no concreting will occur near waterways nor within the riparian zone. The risk of indirect impacts from concrete works on aquatic ecology from proposal-related concrete works is considered unlikely with the implementation of mitigation measures.

Tunnelled construction activities result in less surface disturbance but can still pose a risk to surface water quality and aquatic ecology. Accidental discharge or leakage during construction, also referred to as 'frac-out' events, may contain drilling fluids such as bentonite clay and lead to elevated turbidity if large volumes are discharged to downstream waterways.

Water used for testing and commissioning of the brine pipeline is expected to be of poor quality and will need to be captured and disposed offsite or treated before release to waterways.

Construction impacts to the surrounding waterways (Breakfast Creek, Eastern Creek and Blacktown Creek) and aquatic ecology are considered unlikely, as they will be managed in accordance with the measures in Table 6-3 and Table 6-12.

We do not expect construction activities to impact the quality of treated wastewater releases into Breakfast Creek. Construction works will be scheduled to maintain operation of the WRRF and comply with the EPL.

6.3.4 Potential impacts – operation

6.3.4.1 Quakers Hill WRRF – treated water releases

The release of treated water from Quakers Hill WRRF has the potential to impact water quality and hydrology of the receiving waterway. Depending on the level of treatment, treated water can contain elevated levels of nutrients (including nitrogen and phosphorus) and other contaminants that can degrade aquatic ecosystems in the short and long term. Releases of additional water can also alter the hydrology of a waterway, by altering flow patterns, volumes and water depths. Impacts to hydrology are covered in section 6.3. The changes in hydrology are considered insignificant and present low risk to the ecological communities of Breakfast Creek and Eastern Creek. The reduced flow conditions are slightly closer to, although still exceeding, the South Creek Waterway Objectives and will still support the local ecosystem which is adapted to an already highly modified waterway.

The main driver for the proposal is to improve the quality of treated water released to Breakfast Creek by providing higher levels of treatment at Quakers Hill WRRF. As the wastewater entering Quakers Hill WRRF will receive a higher level of treatment under the proposal, concentrations of most indicators are lower when compared to existing. The tables in this section focus on the indicators that exceed existing treated water quality and/or guideline values. All other indicators will be higher quality in the proposed releases and/or meet guideline values, and Appendix D tabulates the results for these.

This section compares the treated water quality to be released under the proposal, with the existing releases and water quality in Breakfast Creek. Water quality for the different release scenarios discussed in section 3.3.2 was compared to the guideline values in Table 6-5. Wet weather conditions have been compared to

existing water quality of Breakfast Creek and guideline values only, as Quakers Hill WRRF sampling point does not capture these flows.

ADWF median water quality

Table 6-6 shows the modelled ADWF median (50th percentile) concentrations that exceed existing treated water quality and/or guideline values.

Table 6-6 ADWF 50th percentile indicators that exceed existing and/or guideline concentrations

Indicator	Modelled ADWF 50th Percentile	Existing ADWF 50th Percentile	EPL (average)	Guideline
Total suspended solids (mg/L)	4	2	N/A	37[1]
Filtered aluminium (mg/L)	0.08	0.065	0.12	0.055[2]
Total iron (mg/L)	0.07	0.047	N/A	0.3[3]

Notes:

Blue numbers exceed existing but not guideline, orange numbers exceed guideline value. There is no 50th percentile EPL limit for aluminium, value is the average limit

1 DPE (2022 Performance Criteria)

2 ANZG (2018) toxicant guidelines for 95% species protection. Aluminium guideline specified for pH > 6.5

3 ANZECC & ARMCANZ (2000) interim guideline

The modelled results show that:

- all indicators will be lower than the existing releases, except for total suspended solids, total iron, and filtered aluminium. These are slightly higher due to the need for lime dosing of the reverse osmosis permeate, to reduce total phosphorus and meet EPL concentration limits
- all indicators except for filtered aluminium will meet the recommended guideline limits for Breakfast Creek
- all indicators will be lower than EPL concentration limits (noting that EPL limits do not exist for all indicators)
- ammonia will comply with the recommended DPE (2022) performance criteria and the ANZG (2018) toxicant guidelines but will be slightly higher than the median ammonium concentration recorded at the monitoring sites downstream of Quakers Hill WRRF discharge point.

ADWF 90th percentile water quality

Table 6-7 shows the modelled ADWF 90th percentile concentrations that exceed existing treated water quality and guideline values.

Table 6-7 ADWF 90th percentile indicators that exceed existing and/or guideline concentrations

Indicator	Predicted ADWF 90th Percentile	Existing ADWF 90th Percentile	EPL 90th Percentile	Guideline
Ammonia (mg/L as N)	0.1	0.49	1.4	0.08[1]/ 0.9[2]
Total suspended solids (mg/L)	8	2	N/A	37[1]
Filtered aluminium (mg/L)	0.1	0.102	0.19	0.055[2]
Chromium (µg/L)	1.74	1.09	4	1[1]
Copper (µg/L)	1.97	4.22	6	1.4[2]
Total iron (mg/L)	0.28	0.074	N/A	0.3[3]
Zinc (µg/L)	14.41	30	41	8[2]

Notes: Blue numbers exceed existing but not guideline, orange numbers exceed guideline value.

1 DPE (2022 Performance Criteria)

2 ANZG (2018) toxicant guidelines for 95% species protection. Aluminium guideline specified for pH > 6.5

3 ANZECC & ARMCANZ (2000) interim guideline

The modelled results show that:

- all indicators will be lower than the existing discharge, except for total suspended solids, total iron, and chromium
- ammonia will exceed recommended DPE (2022) performance criteria but will comply with the ANZG (2018) toxicant guideline
- zinc, copper, and aluminium will exceed the ANZG (2018) toxicant guidelines, however all are lower than those in the existing discharge
- chromium will exceed the ANZG (2018) toxicant guidelines and is slightly higher than the existing discharge
- all indicators (as applicable) will be lower than EPL concentration limits.

3x ADWF and 6x ADWF

The modelled results show that all nutrient species will exceed the recommended guidelines and median background concentrations during wet weather. Although Sydney Water does not monitor the quality of treated water releases in these wet weather flow events, the additional treatment to be implemented by the proposal means that the quality of these releases is expected to improve.

Analysis of results

For the indicators that have been highlighted as exceeding guidelines:

- Filtered aluminium will exceed the recommended ANZG (2018) toxicant guideline criteria under all scenarios and is greater than median concentrations recorded in Breakfast Creek both upstream and downstream of the existing discharge point. Despite the higher modelled concentrations, it remains below the EPL specified limits, therefore no toxicity modelling has been completed.
- Median concentrations of ammonia are expected to be higher than those recorded downstream of Quakers Hill WRRF. However, the concentration in the discharge is lower than median concentrations recorded upstream and in the existing discharge. This suggests Breakfast Creek provides enough dilution to reduce concentrations and/or has the capacity to naturally assimilate ammonia through biological processes such as nitrification and is unlikely to impact water quality.
- Chromium will exceed the ANZG (2018) toxicant guidelines for the ADWF 90th percentile. However, the guideline value is specific to hexavalent chromium (chromium VI) while the modelled concentrations are for total chromium. Total chromium includes trivalent (chromium III) and hexavalent chromium. Trivalent chromium is generally less toxic to aquatic life than hexavalent chromium. The use of a coagulant (ferric chloride or aluminium sulphate) as part of the treatment process is expected to reduce hexavalent chromium in the effluent to trivalent chromium. As a result, risk to aquatic life from chromium is anticipated to be much lower than indicated by the concentration.
- Although the ADWF 90th percentile concentrations of some toxicants (aluminium, copper, and zinc) will continue to exceed guideline values, they are modelled to be in lower concentrations than at present, which does not represent an increase in risk to aquatic life. Higher total suspended solids in the discharge are expected to be relatively inert and free of organic matter. While an increase in sedimentation of the streambed is expected as a result, this is anticipated to cause minimal impacts on the receiving water quality and aquatic ecology of Breakfast Creek.

The results show that while some modelled indicators exceed the corresponding guideline values, these are similar to the existing releases, and modelled concentrations are all below the EPL limits. Therefore, further toxicity assessment (including near field modelling to identify mixing zones) for ammonia, aluminium, chromium, copper and zinc has not been completed. Aquatic life in Breakfast Creek and Eastern Creek is unlikely to be negatively impacted by the new release concentrations.

Exceedances during wet weather are predicted, however the frequency of such occurrences is low. With the additional treatment to be implemented by the proposal, the quality of these releases is expected to improve compared with existing releases. It has been estimated that over the modelling period, flows will exceed 3x ADWF about 1% of the time. Wet weather water quality projections are also conservative and assume that nutrient concentrations reach the maximum levels permissible under the EPL. Although these discharges are of poorer quality, they are typically of short-duration and highly diluted by instream wet weather flows which typically have high nutrient concentrations from stormwater runoff.

Overall, the projected releases are unlikely to degrade existing water quality in Breakfast Creek and Eastern Creek, or increase risk to aquatic life, as improved treatment will reduce overall pollutant concentrations compared to current conditions.

Treated water releases when AWTP not operating

The above analysis assumes the AWTP is operating. There may be times when treated water needs to be released to Breakfast Creek without full advanced water treatment. Situations when this could occur include:

- an unforeseen failure of the reverse osmosis process preventing treatment of all or some of the feedwater
- planned maintenance, which requires the reverse osmosis process to be taken offline
- shut down of the AWTP to avoid damage during prolonged periods of wet weather or during other planned or unforeseen events.

Modelling has allowed for some outage of the reverse osmosis systems. Only outages that are longer than planned for, or total power outages (including failure of backup power), would have potential to impact on water quality.

As a worst case, water will be treated to a tertiary level (including primary and secondary treatment) and may be higher in contaminants such as dissolved solids, heavy metals, microorganisms, and nutrients that are usually removed during reverse osmosis. However, the quality of water released will be equivalent to the current operating situation. Therefore, water released during times that the AWTP is not operating will still meet the EPL and most guideline criteria. Lasting impacts (such as increased toxicity to aquatic organisms, altered nutrient cycles, and increased risk of algal blooms) are unlikely since these releases will be short-lived.

Compliance with Hawkesbury Nepean Nutrient Framework

As discussed in section 5.2, the EPA has developed a regulatory framework to manage nutrient load inputs to the Hawkesbury Nepean River from wastewater treatment plants (EPA, 2019). The objective is to meet the community's environmental values for the river and provide wastewater treatment plant operators with alternatives to meet those nutrient loads. The framework has been applied to Sydney Water's existing EPLs, including Quakers Hill WRRF EPL. The framework includes limits on nutrient concentrations and caps on nutrient loads.

Under the Hawkesbury Nepean Nutrient Framework, Quakers Hill WRRF discharges into the Sackville 2 Subzone. Quakers Hill, Riverstone, and St Marys WRRFs, along with the Upper South Creek AWRC, share a common 'bubble' licence load limit in the Sackville 2 subzone. Table 6-8 summarises past plant performance for 2023/2024. The Upper South Creek AWRC is not included as it is not yet operational.

Table 6-8 Sackville 2 subzone nutrient load limits past performance 2023 – 2024

Annual discharge	Total Nitrogen (kg/yr)	Total Phosphorus (kg/yr)
Riverstone WRRF	25,459	309
Quakers Hill WRRF	74,703	2,841
St Marys WRRF	76,202	1,805
Total	**176,364**	**4,955**

Annual discharge	Total Nitrogen (kg/yr)	Total Phosphorus (kg/yr)
Sackville 2 subzone limit	**222,000**	**2,300**

New total nitrogen and total phosphorus annual load limits came into effect in July 2025 and are shown in Table 6-9. This table also summarises the predicted future nutrient loads for the Sydney Water treatment plants within this subzone during a wet and dry year. The estimates include future growth predictions and planned upgrades at treatment plants.

Table 6-9 Dry and wet year performance against future (2036) nutrient load limits Sackville 2 subzone

Performance	Total Nitrogen (kg/yr)	Total Phosphorus (kg/yr)
Dry year	76,895	1,647
Wet year	109,248	4,294
Sackville 2 subzone limit (effective 1 July 2025)	**126,000**	**2,710**

The Sackville 2 load limits are also required to be met over a 5-year rolling average. As loads vary during dry and wet years, representative scenarios demonstrating what this may look like are presented in Table 6-10.

Table 6-10 Example 5-year rolling average performance

Performance	Total Nitrogen (kg/yr)	Total Phosphorus (kg/yr)
2 dry years + 3 wet years	96,307	3,235
3 dry years + 2 wet years	89,836	2,706
4 dry years + 1 wet year	83,365	2,176
Sackville 2 subzone limit (effective 1 July 2025)	**126,000**	**2,710**

Results indicate that total nitrogen compliance will be achieved during dry and wet years once the proposal is operational. However total phosphorus is predicted to exceed the load limit during wet years. Sydney Water is investigating further opportunities to reduce nutrients at Riverstone WRRF and to obtain nutrient load offsets through bank remediation to comply with the load limits. It is noted that nutrient reduction through offsets presents an opportunity that may reduce the flows requiring treatment through the AWTP.

The proposal is sized to treat up to 48 ML/d of wastewater, and assets may be installed incrementally in a staged approach aligned to increasing service demand.

Concentration limits for total nitrogen and total phosphorus are also captured in Quakers Hill WRRF EPL. As discussed earlier, all modelled concentrations are predicted to be below the EPL limits.

The reduction in nutrient loads will result in water quality improvements including:

- lower risk of algal blooms as the reduced nutrient concentrations will help prevent eutrophication and minimise the likelihood of nuisance algal growth, improving aquatic habitat and recreation value
- better ecosystem health and long-term sustainability as the lower pollutant loads will support healthy fish and macroinvertebrate populations and improve overall biodiversity.

6.3.4.2 Quakers Hill WRRF surface water and stormwater

Once constructed, the proposal will increase the impervious areas that discharge surface runoff to Breakfast Creek. Without mitigation, this will increase annual average pollutant loads to the creek, with the main pollutants of concern being total suspended solids, total phosphorus and total nitrogen.

Annual pollutant loads for current and future (proposal related) conditions were estimated using the eWater Model for Urban Stormwater Improvement Conceptualisation (MUSIC X model). The modelling is consistent with the Wianamatta-South Creek catchment stormwater management targets (DPE 2022), and indicates that that there will be the following increase in annual pollutant loads:

- Total suspended solids - 11% increase.
- Total phosphorus - 6% increase.
- Total nitrogen - 7% increase.

Mitigation to reduce these pollutant loads is to be explored further as design progresses. Options to be considered include incorporation of a first flush system in the AWTP, a water quality basin, or gross pollutant trap with cartridge filtration.

With the implementation of mitigation measures, increases in pollutant loads can be reduced so that they do not exceed those for existing conditions. No increase in annual pollutant loads to Breakfast Creek is anticipated.

6.3.4.3 Brine pipeline

Transfer of brine to the NSOOS wastewater system has the potential to impact the North Head WRRF EPL pollutant load and concentration limits. In addition to brine generated from the AWTP, up to 10 ML/d of brine will continue to be transferred from St Marys AWTP to Quakers Hill WRRF, before being transferred to the NSOOS.

Table 6-11 compares the expected annual loads for key pollutants of brine (including St Marys) with current EPL load limits and actual loads in 2023/24. Brine is not proposed to be released into Blacktown Creek, so comparison with waterway guidelines is not required.

Table 6-11 Forecast brine loads compared to NSOOS EPL limits

Indicator	NSOOS Current load (2023-24) (kg/year)	EPL licensed load (kg/year)	Modelled 50th percentile (brine) (kg/year)	Modelled 90th percentile (brine) (kg/year)
Biochemical oxygen demand	24,532,850	35,010,800	41,367	124,100
Total suspended solids	25,300,414	35,010,800	4,137	4,137
Total nitrogen	6,730,340	7,957,000	132,952	263,919
Total phosphorus	863,572	1,909,680	4,286	21,693
Cadmium	8	283	8	8
Chromium	766	3,011	25	83
Copper	15,399	37,583	124	207
Lead	544	3,568	-	-
Mercury	4	60	-	-
Selenium	67	2,387	-	-
Zinc	33	51,066	951	792
Pesticides and polychlorinated biphenyls	2	370	-	-

The forecast loads of key contaminants in the brine are expected to have a minimal impact on the annual loads discharged at the North Head WRRF. Total nitrogen which currently is at 85% of total load limit will increase to 87.9% of load limit, but other indicators such as biochemical oxygen demand, total suspended solids and copper will increase by less than 1%.

To avoid brine overflows during wet weather due to capacity constraints within the NSOOS, brine will be stored onsite in the existing Quakers Hill WRRF brine storage ponds. The ponds have a capacity of up to 28 ML and will hold the brine for most wet weather events. However, when the storage ponds reach capacity, the advanced treatment process will be temporarily switched off, so brine does not continue to be produced. Modelling shows that this will occur about 5 days per year. These measures will avoid brine being released to local waterways through wet weather overflows in the wastewater system.

Overall, it is considered that the brine stream loads will comprise a small percentage of the overall loads and therefore will not impact on compliance with the EPL nor the on the environment.

During operation there is a risk with all pipelines for failure to occur. Incidental discharges of brine water from pipe leaks or bursts could impact the water quality of Breakfast Creek or Blacktown Creek. Based on the expected concentrations of contaminants in the brine, the key risk to water quality will be increased salinity and the introduction of toxic substances in elevated concentrations. There could also be an increase in turbidity from scouring where the leak or burst occurs.

Should a pipe leak or burst occur, the impacts are expected to be temporary and localised and will be managed in accordance with the Sydney Water's standard management and operational controls.

Brine pipeline surface water and stormwater

The brine pipeline will be located below ground, so there will be no increase in impervious areas and no impacts to surface water and stormwater during operation. The barometric loop will result in a minor increase to impervious area in Billy Goat Hill Reserve, but this is expected to have a negligible impact on surface water and stormwater.

6.3.5 Mitigation measures

With the implementation of the mitigation measures in Table 6-12, impacts to surface water and aquatic ecology can be adequately managed, and residual impacts are expected to be low.

Mitigation measures in other sections of this REF (e.g. soils and contamination, groundwater, hydrology and geomorphology) will also contribute to mitigating surface water and aquatic ecology risks.

Table 6-12 Environmental mitigation measures — surface water and aquatic ecology

Mitigation measures	Timing
Further consider location and details of all water quality controls (including but not limited to temporary sediment basins) during pre-construction to align with any detailed design changes. • The measures should be designed to achieve equivalent outcomes to those in Figure 8-1 in Appendix D.	Detailed design
Develop a Construction Erosion and Sediment Control Plan as a sub-plan of the CSWMP to detail the erosion and sediment control measures to be implemented at all works sites in accordance with the principles and requirements in Managing Urban Stormwater – Soils and Construction Volume 1 (Landcom 2004) and Volume 2D (NSW Department of Environment Climate Change and Water 2008), commonly referred to as the 'Blue Book'. The ESCP will include but not be limited to: • plans for temporary drainage, scour protection and control measures to reduce erosion and water quality impacts from increased sediment loads from construction and ancillary sites. These water quality controls will likely consist of sediment fencing and sediment basins. The Construction Erosion and Sediment Control Plan will identify locations of proposed construction sediment basins. • the location of construction sediment basins, sediment fences, diversion drains, etc • truck loads to be adequately covered when transporting loose material (i.e. spoil) • dust suppression, spoil rehabilitation/emplacement to ensure no sedimentation or air quality impacts.	Pre-construction

Mitigation measures	Timing
The CSWMP will include the following measures: • store all chemicals and fuels in accordance with relevant Australian Standards and Safety Data Sheets. Record stored chemicals on site register. Ensure bunded areas have 110% capacity of the largest chemical container, or an additional 25% capacity of the total volume stored within (whichever is greater). Tightly secure chemicals and fuels in vehicles. Clearly label all chemicals keep a functioning spill kit on site for clean-up of accidental chemicals/fuels spills. Spill kits will be stocked and located for easy access and all site personnel will be appropriately trained in the use of spill response equipment • prepare a spill response procedure in accordance with the Australian Spill Control Industry Standard for Spill Response Kits (ASCIS 2695) • 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.	Pre-construction
CEMP to outline procedures to capture, contain, and appropriately dispose of any concrete waste for concrete works associated with the establishment of slabs for pumps, tanks and other structures.	Pre-construction
Before disposing construction water collected in sediment basins, water should be treated to the appropriate standard specified in the CSWMP and repurposed on site wherever possible. Water that cannot be repurposed on site will require the Construction Contractor to seek approval and discharge criteria from the relevant Sydney Water Network Area Manager before discharging water to the wastewater system. Otherwise, tanker construction discharges by a licenced waste contractor and disposed off-site to an appropriately licenced facility.	During construction
Locate the HDD launch and retrieval pits back from the channel, beyond the top of bank to allow containment of any sediment or other substances above the top of bank. Restore launch and retrieval pits to pre-construction conditions.	During construction
Store materials excavated from the trench above the top of bank until the materials can be backfilled into the trench.	During construction
Develop a Construction Surface Water Monitoring Program to include in the CEMP. The purpose is to establish baseline conditions, to observe any changes in surface water quality and condition in watercourses that have the potential to be directly impacted during construction of the proposal and inform appropriate management responses. This can include approaches such as existing monitoring sites, new monitoring sites and/or visual monitoring. Should the results of monitoring identify that the water quality management measures are not effective in adequately mitigating water quality impacts, works would stop until suitable additional mitigation measures are identified and implemented, as required.	Pre-construction During construction
Install appropriate erosion and sediment controls in accordance with the Blue Book to protect adjacent waterways when soil is being exposed.	During construction
Follow Sydney Water SWEMS0009 incident response procedure in the event of a pipeline leak.	During construction

Mitigation measures	Timing
	During operation
Maintain treated water release quality in compliance with the EPL. Sydney Water will continue to conduct monitoring activities as required by the EPL.	During construction During operation
Rehabilitate disturbed areas of riparian vegetation as soon as practical, progressively and in accordance with the Restoration Plan. Rehabilitation of removed riparian vegetation will involve replacing topsoil and re-planting native trees and plants.	During operation

6.4 Hydrology and geomorphology

Appendix E includes the hydrology and geomorphology impact assessment completed for the proposal. This section summarises key findings of that assessment.

The assessment considered how changes to the releases of treated water from Quakers Hill WRRF may impact the instream water conditions in the receiving waters of Breakfast Creek and Eastern Creek.

Hydrologic and hydraulic modelling was undertaken to support the assessment. Waterway objectives for Wianamatta-South Creek catchment (DPE 2022) were used to assess the hydrologic metrics. These include daily mean and median flow rates, and the number/duration of freshes (75th flow percentile) and high spell events (90th flow percentile). The assessment focused on 4 hydraulic metrics - water surface elevation, wetted perimeter, velocity, and shear stress.

Field inspections were carried out along the receiving waterways, upstream and downstream of the current discharge location.

6.4.1 Existing environment

6.4.1.1 Quakers Hill WRRF

Breakfast Creek and Eastern Creek have a step-pool morphology where there are several higher elevation sections along the channel that create a series of pools between them. Flows in the Breakfast Creek and Eastern Creek catchments have been significantly altered by urbanisation and discharge from Quakers Hill WRRF. The WRRF has been operational since the 1960s. Combined with stormwater runoff from urbanisation, the streamflow patterns in both creeks are highly modified and support habitat conditions that have adapted to this modified baseline flow regime.

The sections of Breakfast Creek within the study area have a narrow vegetated riparian corridor, and bank undercutting. Breakfast Creek is in poor geomorphic condition. It has been straightened both upstream and downstream from Quakers Hill WRRF as shown in Figure 6-7, and has un-culverted road crossings that act as barriers to flow. There is increasing hydraulic and geomorphic diversity downstream of Quakers Hill

WRRF near the confluence with Eastern Creek. Flows in Eastern Creek downstream of the confluence with Breakfast are generally continuous, and there is good hydraulic and geomorphic diversity.

As a result of extensive urban development in the catchments, and the release of treated flows from the WRRF, the current flow regime in Breakfast Creek and Eastern Creek exceeds several of the recommended Wianamatta South Creek catchment waterway flow objectives.

Figure 6-7 Historic aerial imagery comparison - Breakfast Creek at Quakers Hill

Note: Quakers Hill WRRF is circled in red. Source: http://portal.spatial.nsw.gov.au/

6.4.1.2 Brine pipeline

The brine pipeline runs adjacent to a section of Blacktown Creek, and a short unnamed tributary upstream of the main Blacktown Creek channel adjacent to International Peace Park at Seven Hills. The main channel of Blacktown Creek is a partly confined, platform-controlled waterway. It has constrained embankments, a discontinuous floodplain and poor geomorphic stream condition.

6.4.2 Potential impacts – construction

6.4.2.1 Quakers Hill WRRF and brine pipeline

Construction activities for the proposal including vegetation clearing and excavation have the potential to cause geomorphic impacts on waterways including:

- bank instability and exposed soils increasing erosion potential and change in sediment concentrations
- bank and/or bed erosion, changing substrate composition and change in sediment concentrations
- mobilisation of dispersive soils known to be present in the South Creek catchment.

There is one waterway crossing associated with the brine pipeline at Breakfast Creek. As the pipeline crossing will be a tunnelled (HDD) methodology, no hydrologic or geomorphic impacts to Breakfast Creek are expected during construction. Where the pipeline is trenched adjacent to Breakfast Creek and Blacktown Creek, or where construction works occur within the WRRF boundary adjacent to Breakfast Creek, mitigation measures have been outlined to address potential geomorphic impacts.

During construction there will be no change to the current treated water discharged from the WRRF. Therefore, no construction impacts are expected in relation to WRRF discharge to Breakfast Creek.

6.4.3 Potential impacts – operation

6.4.3.1 Quakers Hill WRRF

Hydrologic and hydraulic modelling was undertaken using a baseline scenario (existing conditions) and future scenario (the proposal) to support the assessment of changes to waterway flows in Breakfast and Eastern Creeks. The assessment considers the maximum change in flows that will be achieved following the upgrade. Therefore, the change in flows and associated impacts will occur gradually in line with growth in the catchment.

Scenario timeseries were developed for the hydrologic modelling using average dry weather and wet weather flow data from an Eastern Creek flow gauge, and Quakers Hill WRRF discharge scenarios. The scenario timeseries were imported into the software package River Analysis Package (RAP) by eWater and an R-based model using the Hydrostats package developed by Professor Nick Bond.

Hydraulic modelling was completed using the industry standard modelling package HEC-RAS. The 1D model was created to simulate a range of flow conditions in the creeks based on flow gauge data and WRRF discharge scenarios. These simulations identified any changes in hydraulic conditions such as water surface elevation (depth), wetted perimeter, velocity and shear stress (force of moving water acting on the channel bed and banks, influencing sediment transport and erosion).

Topographic and bathymetric survey was used to identify instream geomorphic conditions such as benches and pools.

Hydrology and hydraulics

The flow volumes in Breakfast Creek and Eastern Creek will generally reduce by less than 10% as shown in Figure 6-8 and Figure 6-9. Although the volume of flows to be treated at Quakers Hill WRRF will increase under the proposal, some of the treated water byproduct will be transferred to the brine pipeline, which means not all flows are transferred to Breakfast Creek. The creeks will remain effectively perennial with minimal changes to the frequency of freshes (75^{th} flow percentile) and high spells (90^{th} flow percentile).

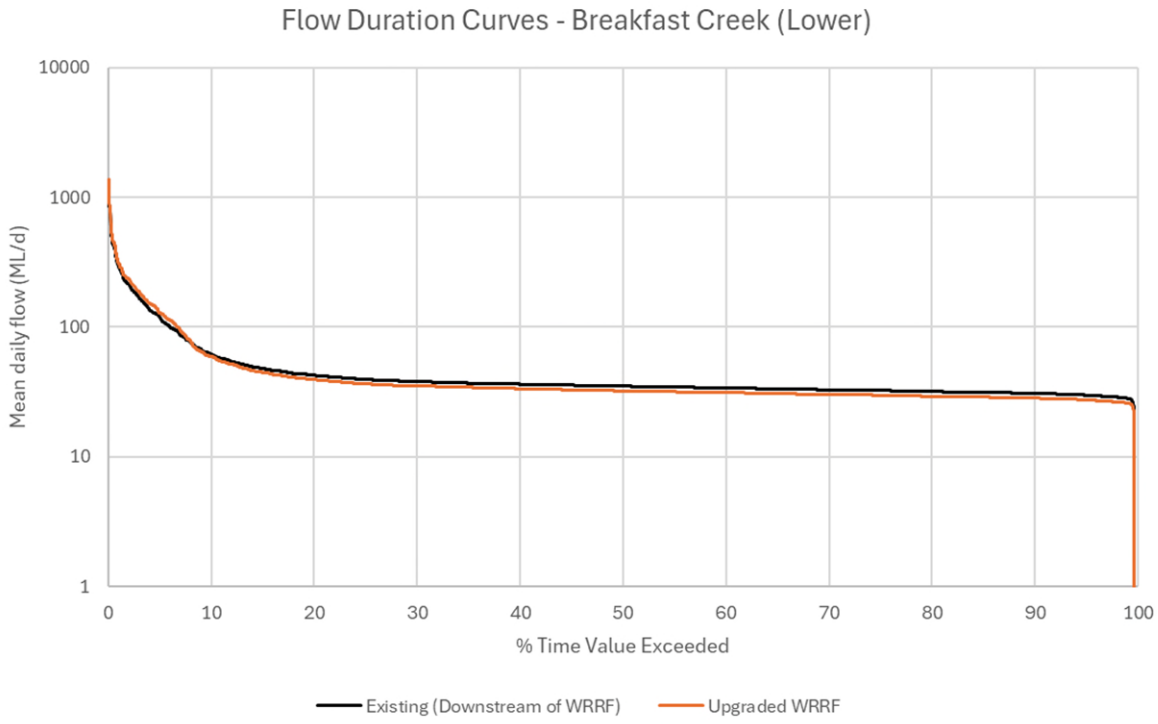


Figure 6-8 Breakfast Creek flow duration curve existing and future scenario

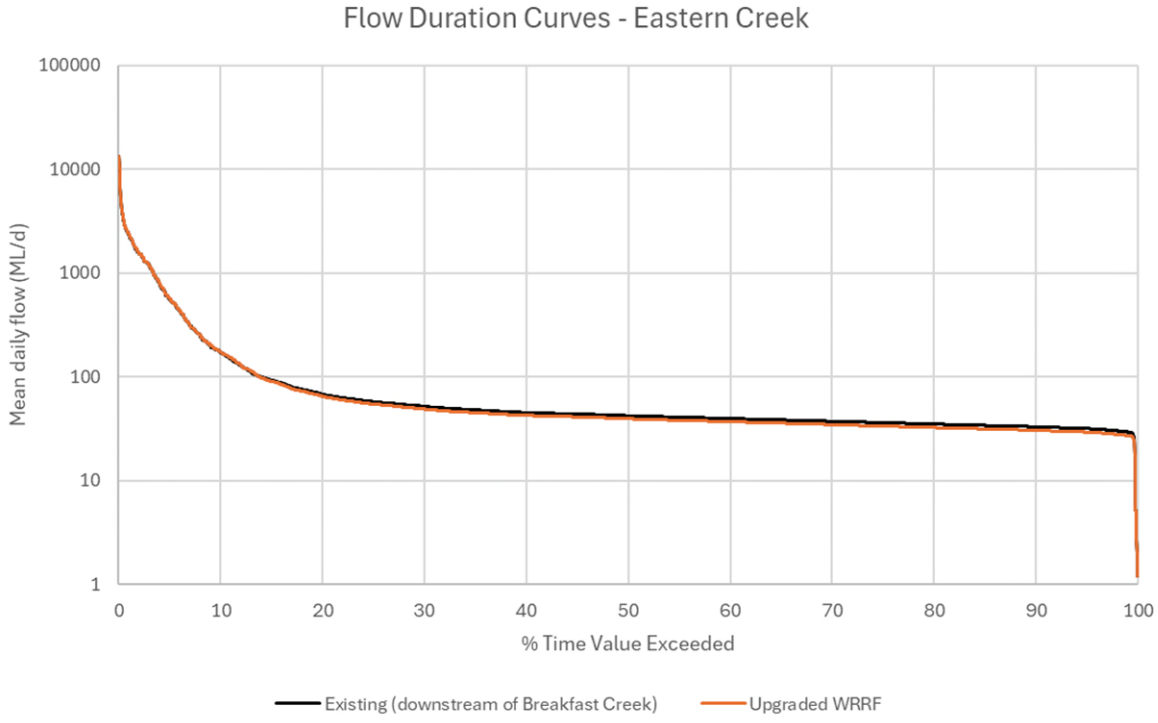


Figure 6-9 Eastern Creek flow duration curve existing and future scenario

There will be minimal change to the depth, velocity or wetted perimeter along the Breakfast Creek channel downstream of Quakers Hill WRRF. The length of Breakfast Creek downstream of Quakers Hill WRRF where the shear stress threshold for mobilisation of different types of sediment is exceeded during fresh and high spell events will be less than under existing conditions. Sediment in the creek channel will continue to move due to fresh and high spell events, refreshing the creek bed to create a diversity of habitat, with long term siltation of the channel unlikely.

The change in the hydrologic and hydraulic metrics for Eastern Creek will also be minor. There will be minimal changes in the depth, velocity or wetted perimeter along the Eastern Creek channel below the confluence with Breakfast Creek. The length of Eastern Creek downstream of Quakers Hill WRRF where the shear stress threshold for mobilisation of different types of sediment is exceeded during fresh and high spell events will be less than under existing conditions. There will be minimal change to the duration of fresh events, although the frequency of these events remains the same.

Geomorphology

Appendix E provides a full description of the approach taken to assess risk of geomorphic impacts. In summary the assessment found:

- Geomorphic change in Breakfast Creek from changes in hydraulic conditions is considered possible given its low to moderate geomorphic sensitivity and moderate resilience/adaptive capacity. The consequences are considered insignificant given the small to negligible change in the hydrologic and hydraulic metrics.
- Geomorphic change in Eastern Creek from changes in hydraulic conditions is considered unlikely given its low to moderate geomorphic sensitivity and moderate resilience/adaptive capacity. The consequences are considered minor to insignificant given the small to negligible change in the hydrologic and hydraulic metrics.

Hydrologic and geomorphic impacts to Breakfast Creek and Eastern Creek resulting from changes to the treated water releases are likely to be minor and limited to the operational phase.

Brine pipeline

The potential operational impacts to Breakfast Creek and Blacktown Creek from the brine pipeline, and new infrastructure at Quakers Hill WRRF are expected to be minimal during the operational phase. Potential impacts will be associated with maintenance activities and system malfunctions, such as leaks or bursts. The impacts are expected to be temporary and local in nature.

6.4.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-13, impacts to hydrology and geomorphology can be adequately managed, and residual impacts are expected to be low.

Mitigation measures in other sections of this REF (e.g. soils and contamination) will also contribute to mitigating hydrology and geomorphology risks.

Table 6-13 Environmental mitigation measures — hydrology and geomorphology

Mitigation measures	Timing
Design and implement construction methodologies for works in waterways to appropriately manage site-specific geomorphic conditions in each waterway (for example dispersive soils in Breakfast Creek), seeking inputs from a qualified geomorphologist where needed. This might also include: • further investigation to understand conditions that may affect disturbance of soils or vegetation on the local streambank or floodplain • where not already known, further investigate the local streambed physical structure to ensure that slumping or cracking (and leaks) can be avoided • undertaking local on-ground site assessments by a qualified geomorphologist, including upstream and downstream implications, before the final approval for a works plan.	Detailed design
Monitor the receiving waterways at fixed point locations including: • baseline monitoring of the bed and vegetation condition, to be completed before the upgraded WRRF treated water releases. • ad-hoc (typically every 6 months) visual monitoring for bed siltation and bank slumping, and vegetation condition monitoring following extended (> 3 month) periods of dry weather flow conditions, for up to 2 years following completion of construction. Monitoring can be completed using fixed photo-points at strategic locations particularly where critical vegetation has been identified. Potential locations have been identified in the hydrology and geomorphology impact assessment, and should be confirmed during detailed design.	Pre-construction During operation
Determine failure-threshold criteria to indicate when a tunnelled crossing method (e.g. HDD) has failed, and construction works will be stopped. Examples of failure-threshold criteria may include: • an in-water frac-out that cannot be contained or mitigated • streambed slumping • schedule delays resulting from unexpected equipment failure or weather. Determine an alternative crossing method (e.g. contingency crossing plan) in the event the tunnelled crossing method is not successful.	Pre-construction During construction
Isolate works immediately adjacent to waterways using booms, silt curtains or similar to contain sediment that could become suspended.	During construction

6.5 Groundwater

Appendix F includes the groundwater impact assessment completed for the proposal. This section summarises key findings of that assessment.

The study area incorporates a 1 km buffer around the proposal, to include the areas likely to be directly or indirectly impacted.

To inform the assessment, 8 piezometers were installed at Quakers Hill WRRF in 2024, and 4 piezometers were installed along the brine pipeline alignment in 2025. Piezometers were used for groundwater level monitoring, hydraulic conductivity testing, and water quality sampling.

6.5.1 Existing environment

Groundwater in the study area is generally brackish to saline, with electrical conductivity values ranging from 1,800 µS/cm to over 29,000 µS/cm. Groundwater quality monitoring at Quakers Hill WRRF and for the brine pipeline identified exceedances of ANZECC 2000 and ANZG 2018 guideline values.

Groundwater levels are typically 1.5 to 3.5 m below ground level, with shallow groundwater flow direction generally following surface topography.

Soils have poor drainage, which means groundwater recharge through rainfall infiltration is limited. This is compounded by the urban environment and high percentage of roofs and paved areas increasing runoff and limiting potential for infiltration.

The proposal lies within the Sydney Basin Central Groundwater Source of the Water Sharing Plan (WSP) for the Greater Metropolitan Region Groundwater Sources (2023). The Sydney Basin Central Groundwater Source is a porous rock aquifer. No high priority groundwater-dependent ecosystems (GDEs) are mapped in this WSP for the study area. The brine pipeline traverses areas categorised as low to medium High Ecological Value Aquatic Ecosystems (HEVAE). The main medium HEVAE value areas are associated with Breakfast Creek and Harvey Park. There are also no groundwater dependent culturally significant areas listed in the WSP in the vicinity of the proposal.

There are 6 registered groundwater bores within the study area. These were installed in 1960, 1961 and 1970 for water supply or industrial water supply. Given their age and more recent development at these locations, it is unlikely that they still exist.

6.5.2 Potential impacts – construction

6.5.2.1 Quakers Hill WRRF

The groundwater impact assessment calculated that groundwater could be encountered during foundation excavations for the fine screen feed pump wet well. It was estimated that 0.02 ML may require dewatering from this excavation.

Excavations for the bioreactor and membrane bioreactor tanks will be above the groundwater table, and dewatering is not expected to be required. Shallower excavations at Quakers Hill WRRF (e.g. for the installation of services) are not anticipated to intersect groundwater.

6.5.2.2 Brine pipeline

The groundwater impact assessment calculated that about 20% of the pipeline trenching will intersect the groundwater table and require dewatering. The total cumulative inflow was estimated at 0.11 ML.

There are 4 registered groundwater bores within 50 m of the proposed pipeline trenching. All these bores are noted as being for monitoring purposes, so are not expected to be impacted by dewatering.

Launch and retrieval pits for horizontal directional drilling are also expected to be below the groundwater table, however, as these will be filled with drilling muds, groundwater dewatering is not expected.

Overall, the proposal is expected to require about 0.13 ML of dewatering throughout construction, and a Water Supply Works Approval will be required before starting dewatering. Groundwater drawdown is expected to be limited to within about 6 m of excavation areas and be of short duration. Dewatering is anticipated for up to 5 days for individual sections of pipeline trenching, and up to 30 days for excavations at Quakers Hill WRRF. Should excavations be open longer, the volume of dewatering could increase. Figure 6-10 shows the sections of the brine pipeline where dewatering is expected.

Groundwater that is dewatered is not expected to be suitable for direct discharge to the environment due to elevated salinity and exceedance of default guideline values.

No groundwater dependent ecosystems are expected to be impacted. The predicted extent of drawdown is very localised to the areas of excavation, typically within about 6 m of the edge of the excavation. As stated in Appendix F, the magnitude of drawdown will also rapidly diminish away from the excavation.

For any GDE within the area of predicted drawdown:

- drawdown will be limited in magnitude and unlikely to extend beyond the root zone depth or lateral spread of the groundwater dependent vegetation
- dewatering does not remove all soil moisture. Only freely draining water will be removed with most vegetation still readily able to access soil moisture
- the dewatering and associated drawdown is temporary with full recovery anticipated within weeks of backfilling of excavations.

Due to the limited magnitude and extent of the expected drawdown, and the temporary nature of dewatering drawdown, impacts to GDE are not anticipated.

The works can be classified as ‘minimal impact activity’, as per the Aquifer Interference Policy.

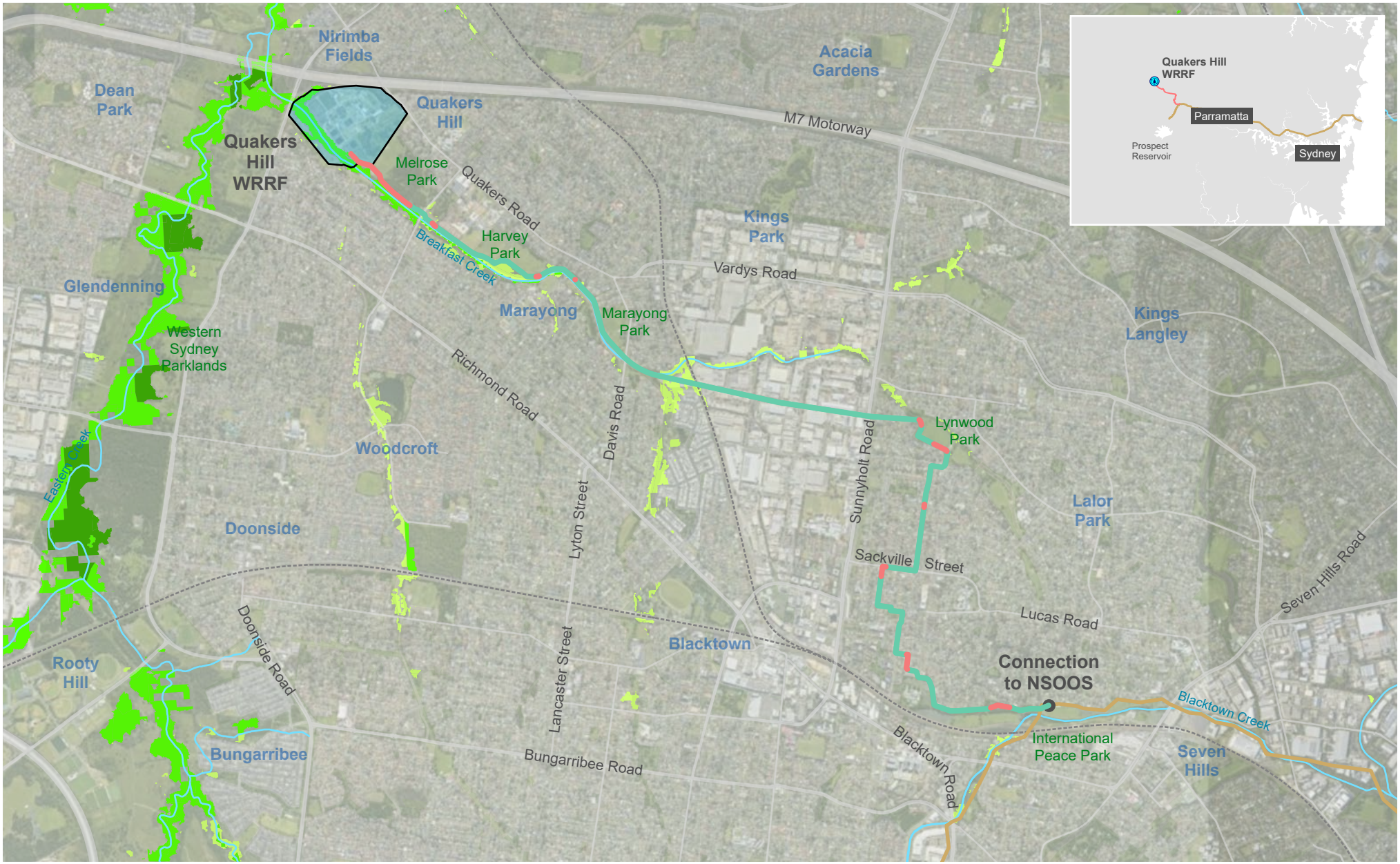


Figure 6-10 Brine pipeline indicative dewatering locations

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:35,000 @ A4
GDA2020 MGA Zone 56

6.5.3 Potential impacts – operation

6.5.3.1 Quakers Hill WRRF

There is the potential for the foundations for the fine screen feed pump wet well to be subject to ongoing seepage. This will be confirmed during construction. The groundwater impact assessment noted that should this occur, the magnitude and extent of drawdown will be similar to volumes expected during construction and will not result in impacts to groundwater users or GDE.

6.5.3.2 Brine pipeline

There is potential for the brine pipeline to behave as a barrier impeding shallow groundwater flow. However, due to the low permeability of surrounding soils and the design of the bedding materials, this is unlikely to occur.

6.5.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-14 impacts to groundwater can be adequately managed, and residual impacts are expected to be minor.

Mitigation measures in other sections of this REF (e.g. soils and contamination, surface water and aquatic ecology) will also contribute to mitigating groundwater risks.

Table 6-14 Environmental mitigation measures — groundwater

Mitigation measures	Timing
Prepare a Dewatering Management Plan (DMP) as a sub plan of the CSWMP which will outline: • the method for dewatering excavations, including requirements for monitoring of dewatering volumes and water quality • required treatment and storage of dewatering and methods and locations for dewatering disposal • supervision requirements • staff responsibilities and training.	Pre-construction
Sydney Water will obtain a groundwater Water Supply Works Approval. The delivery contractor is responsible for: • preparing a Dewatering Management Plan at least 4 months before construction • complying with the approval conditions (such as protecting water quality; minimising aquifer extraction volumes, monitoring extraction with flow meters and recording volumes).	Pre-construction
Discharge all water in accordance with Sydney Water's Water Quality Management During Operational Activities Policy (D0001667) including erosion controls, discharge rate, dechlorination, monitoring. Re-use drinking water / groundwater where possible and quality is suitable.	During construction

Mitigation measures	Timing
Groundwater to be tested for suitability and approved by Sydney Water before on-site reuse.	During construction

6.6 Flooding

Appendix G includes the flood impact assessment for the proposal. This section summarises key findings of that assessment.

6.6.1 Existing environment

Flood events are defined in terms of an annual exceedance probability (AEP). For example, a 1% AEP event has a 1% chance of being equalled or exceeded in any year. A probable maximum flood (PMF) is the largest flood that could conceivably occur at a particular location and defines the extent of the floodplain.

Flooding at Quakers Hill WRRF and along the brine pipeline is a combination of mainstream flooding and overland flooding. This section discusses the 1% AEP and PMF flood events across the proposal's impact assessment area. Appendix G discusses a range of other flood events, including 5% AEP, and 1% AEP with climate change.

6.6.1.1 Mainstream flooding

Mainstream flooding is the result of flood flows from the main catchments causing water levels to rise out of waterways and inundate adjacent floodplains. Flooding in Breakfast Creek is the main cause of mainstream flooding at Quakers Hill WRRF. Flooding may also be influenced by high tailwater levels downstream of Quakers Hill WRRF site caused by flooding in Eastern Creek, South Creek, or the Hawkesbury River.

Blacktown City Council developed a mainstream flood model for Eastern Creek and its tributaries, including Breakfast Creek. The flood model was updated by others to support the Westlink M7 Widening project and that version has been used to model the proposal's flood impacts.

Eastern Creek has a history of flooding, given its location in the Hawkesbury-Nepean floodplain, which is prone to flooding from heavy rainfall and the potential for water to 'back up' from the Hawkesbury River. Historic flood information across the Blacktown LGA is reported in the Local Overland flow study (CSS 2020). The largest contemporary historic events on record occurred in the 1980s and 1990s. However, significant development throughout the catchment since then (e.g. stormwater basins and subdivisions) means that the current catchment conditions are significantly altered.

Blacktown City Council has records of flooding 'black spots', which represent known flood-prone locations based on council or local resident experiences. No flooding black spots are recorded near the proposal.

Quakers Hill WRRF site

A small part of Quakers Hill WRRF on the northern bank of Breakfast Creek is subject to flooding in a 1% AEP event, as shown in Figure 6-11. The proposed location of the AWTP is not subject to flooding in the PMF event but more than half of Quakers Hill WRRF is, with a maximum inundation of up to 1.8 m. Flood

water flow velocities are 1 m/s in the 1% AEP event and up to 3 m/s in the PMF. A summary of mainstream flood depth, affected locations and flood flow velocity at Quakers Hill WRRF is presented in Table 6-15, with further detail provided in Appendix G.

Table 6-15 Mainstream flood depth and flow velocity at Quakers Hill WRRF in 1% AEP and PMF events

Parameter	1% AEP	PMF
AWTP area		
Maximum flood depth	Not subject to flooding	Not subject to flooding
Flow velocity	N/A	N/A
Secondary treatment upgrade area		
Maximum flood depth	Up to 0.3 m affecting southern assets such as the MBR, associated pumps and blower room	Up to 1.8 m, with southern assets such as the MBR, associated pumps and blower room the worst affected
Flow velocity	1 m/s	3 m/s

Flood hazard at the proposed location for the AWTP is typically H1 (safe for people, vehicles and buildings) up to and including a 1% AEP event. In the PMF event, the flood hazard is up to H5 (unsafe for people and vehicles with buildings requiring special engineering design and construction).

Construction compounds

The proposed location of construction compounds C1 to C9 (as shown on Figure 3-2) are partially impacted by mainstream flooding in Breakfast Creek in a 5% AEP event. By extension, these compounds are impacted by a 1% AEP and PMF event.

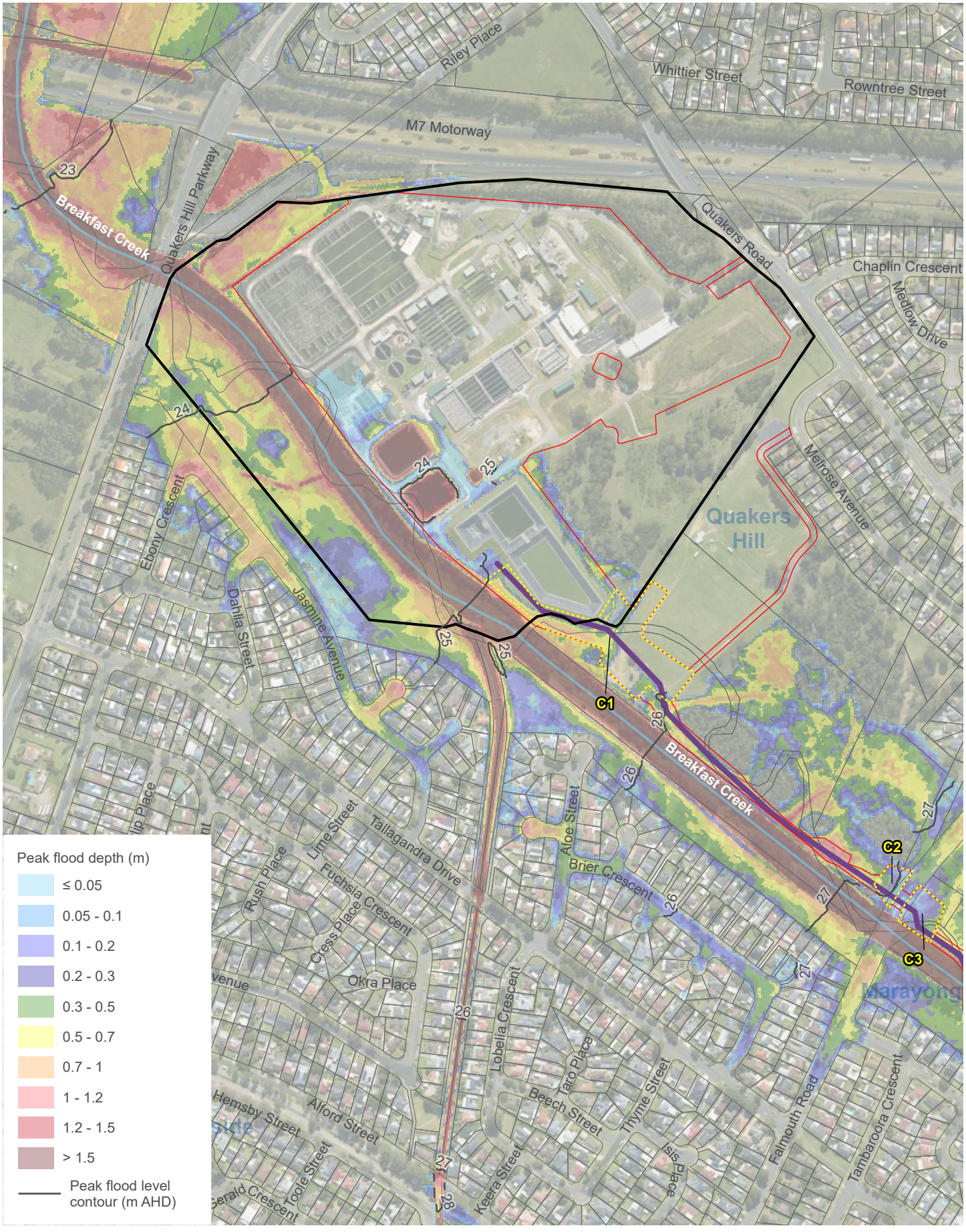


Figure 6-11 Mainstream peak flood depth and peak flood level - 1% AEP event

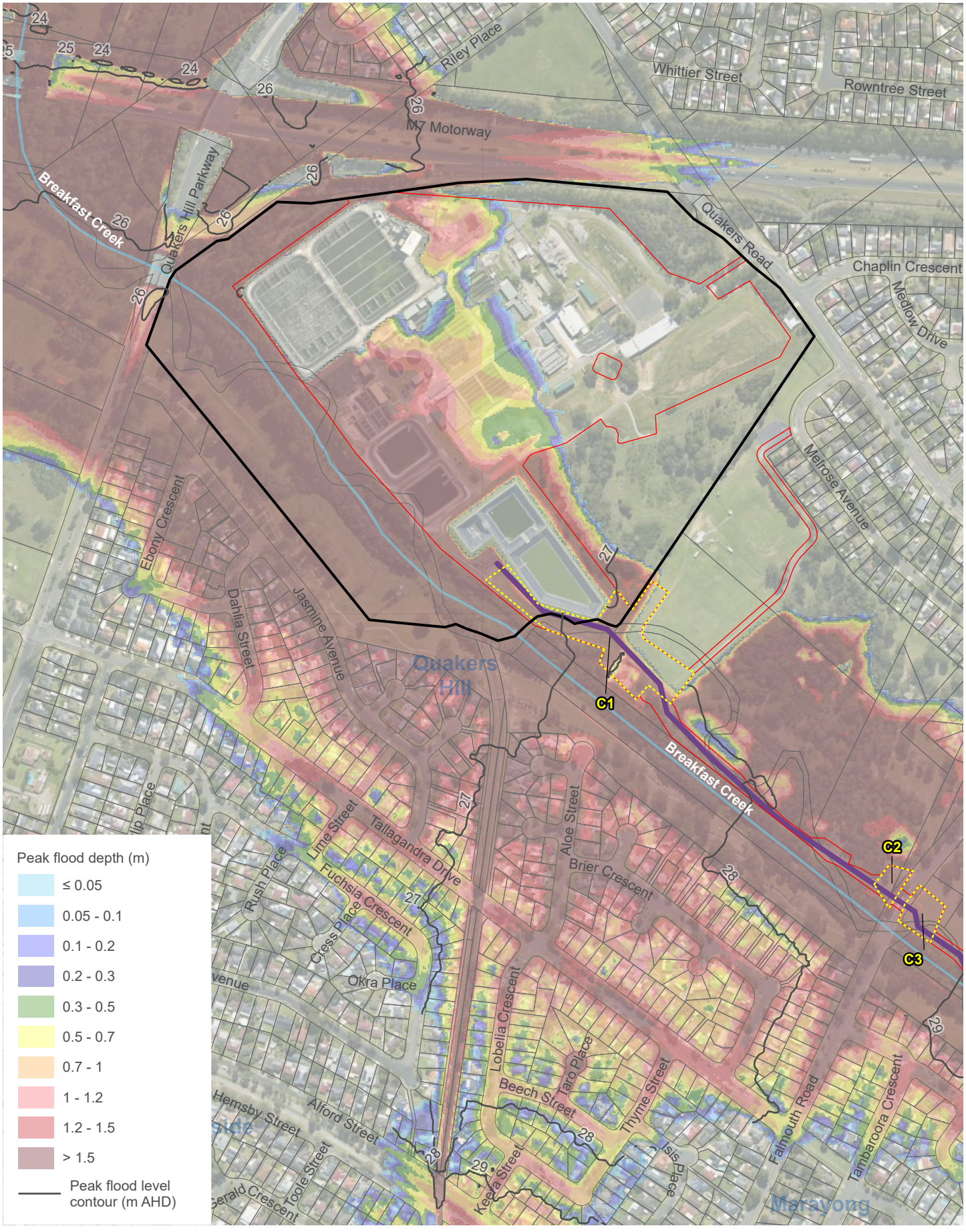


Figure 6-12 Mainstream peak flood depth and peak flood level - PMF event

0 300 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: Metromap

Scale: 1:6,000 @ A4
GDA2020 MGA Zone 56

6.6.1.2 Overland flooding

Overland flooding results from local runoff into surface flow paths causing inundation of areas as it drains to receiving waterways. Overland flooding of Quakers Hill WRRF site is primarily caused by the catchment area of the site itself. The site also receives minor external inflows through the main road entrance on Quakers Road and from an open channel drain on Melrose Avenue. The stormwater drain south of the WRRF between Breakfast Creek and Astral Drive is also subject to overland flooding.

The Eastern Creek overland flood model (CSS, 2020) includes the Eastern Creek and Breakfast Creek catchment areas. Similarly, the Upper Parramatta River Catchment (UPRC) overland flood model (CSS, 2020) covers the Blacktown Creek, Girraween Creek, and Toongabbie Creek catchments within the Blacktown LGA. These models have been used to assess potential impacts on local overland flooding during shorter storm events.

Quakers Hill WRRF site

The proposed location of the AWTP is not subject to flooding in the 1% AEP event or PMF event. The proposed location of the secondary treatment upgrade is subject to flooding of up to 0.15 m in a 1% AEP event and up to 2.05 m in a PMF event. Peak flow velocities at areas where new infrastructure is proposed on Quakers Hill WRRF are less than 0.5 m/s in flood events up to and including a 1% AEP event, but up to 1.75 m/s in the PMF event.

Flood hazard at the proposed AWTP and secondary treatment upgrade areas is H1 up to and including a 1% AEP event. In the PMF event flood hazard is up to H5.

Construction compounds

Construction compounds C18 to C20 (as shown on Figure 3-2) are partially impacted by overland flooding in Blacktown Creek in the 5% AEP event and are therefore impacted in the 1% AEP and PMF event.

Barometric loop

The proposed location for the barometric loop at Billy Goat Hill Reserve is not subject to flooding up to and including the PMF event.

6.6.2 Potential impacts – construction

Where construction activities are in flood-prone land there is potential for floodwater to damage construction equipment, delay works and pose a safety risk to construction workers. Section 6.6.4 includes mitigation measures to minimise the potential for flooding to impact on construction activities.

This section focuses on the potential for construction activities to change flood behaviour that could have flow-on impacts to flooding in adjacent areas or other impacts downstream. Construction flood impacts are assessed qualitatively, because construction activities are temporary. In addition, layout of construction sites is not yet available and will be developed as detailed design progresses. Table 6-16 outlines mitigation measures relating to preparing for and managing any flood incidents that may occur at Quakers Hill WRRF or along the brine pipeline.

6.6.2.1 Quakers Hill WRRF

During construction at Quakers Hill WRRF, the following activities have the potential to cause flooding impacts:

- Excavation, levelling, stockpiling, hardstand construction and vegetation clearing – this will disturb surfaces and increase the risk of sediment transport into nearby waterways during flood events.
- Establishing construction compounds, laydown areas, ancillary facilities and stockpiles – due to proximity to Breakfast Creek, these activities have the potential to impact on the flood behaviour by obstructing the passage of floodwater and overland flow.

6.6.2.2 Brine pipeline

The activities outlined above for Quakers Hill WRRF also have the potential to cause flooding impacts during brine pipeline construction. In addition, open trenching and tunnelling for pipeline construction have the potential to re-distribute flood flow and result in new areas flooding. The tunnelling launch and exit pits have potential to be inundated during storm events.

The highest risk to flooding from brine pipeline construction is expected to be construction compounds. Up to 20 construction compounds will be located along the brine pipeline and most are located near waterways including Breakfast Creek and Blacktown Creek. Construction compounds C1 to C9 are partially impacted by mainstream flooding in Breakfast Creek in a 5% AEP event (and in 1% AEP and PMF events). Construction compounds C18 to C20 are partially impacted by overland flooding in Blacktown Creek in the 5% AEP event (and in 1% AEP and PMF events).

6.6.3 Potential impacts – operation

6.6.3.1 Quakers Hill WRRF

The proposed permanent works for the proposal have the potential to impact on flooding patterns within Quakers Hill WRRF and downstream of the site due to an increase in the rate and volume of runoff from the proposed works. These impacts are described below but overall, increases in flood levels are consistent with relevant performance criteria up to and including the 1% AEP event. Minor increases in flood levels for the PMF event are expected to have minor impacts on existing community emergency management arrangements.

Changes in peak flood levels and depths of inundation

Increases in peak flood levels and depths of inundation outside Quakers Hill WRRF once operational are:

- Mainstream flooding:
  - less than 0.01 m increase in flood levels in the 1% AEP event shown in Figure 6-13. This means flood mapping shows no areas impacted outside Quakers Hill WRRF.
  - up to 0.06 m increase in flood levels adjacent to the Quakers Hill WRRF boundary in the PMF event, as shown in Figure 6-14.
- Overland flooding:

- 0.02 m increase in flood levels in a 1% AEP event as shown in Figure 6-15, in some small areas of public open space adjacent to Quakers Hill WRRF
- between 0.01 and 0.03 m increase in flood levels at 18 properties located on Elwood Crescent during a PMF flood event as shown in Figure 6-16. Flood levels increase by up to 0.04 and 0.03 m respectively on M7 cycleway and the Westlink M7 Motorway. The impacted sections of M7 cycleway and the Westlink M7 Motorway are subject to more than 1.5 m depth of inundation in the existing case.

Changes in flow velocities

The proposal will have minor impacts on maximum mainstream and overland flow velocities during modelled flood events. Increases in maximum flow velocities in Breakfast Creek and on its floodplain will be typically less than 10% and where it is greater than this, maximum velocity during operation will be less than 1 m/s. As a result, the proposal is expected to have a minor impact on the scour potential in the receiving drainage lines. However, there is a potential for increased erosion near the outlets of drainage structures within Quakers Hill WRRF due to localised increases in flow velocity.

Changes in extent and duration

There will be minor changes in the extent of inundation and duration of all mainstream and overland flood events up to the PMF (i.e. less than one hour increase), due to the minor increases in peak flood levels and the depth of inundation.

Changes in flood hazard

Given the minor nature of the changes in the depth of inundation and velocity of flow that are attributable to the proposal, it is also expected to have a minor impact on the hazardous nature of flooding. The small and isolated areas of increased flood hazard from low to high will have no adverse impacts on personal safety or damage property.

Climate change on flood behaviour

The flooding impacts were assessed for a climate change scenario to identify the resilience of the proposal to climate change conditions, which would be in the form of higher intensity storm events. Blacktown City Council has adopted a 20% increase in 1% AEP rainfall intensities to assess impacts of climate change on mainstream flood behaviour. Council has adopted a 19.7% increase in rainfall intensities under Representative Concentration Pathway (RCP) scenario 8.5 conditions (i.e. current greenhouse gas emissions increase in the future). Rainfall increases due to climate change will increase 1 % AEP flood levels under the existing climate by up to 0.20 m within Quakers Hill WRRF. This means that the adopted freeboard for the proposal works would be reduced from 0.5 m to 0.3 m with a 1% AEP climate change event with RCP 8.5.

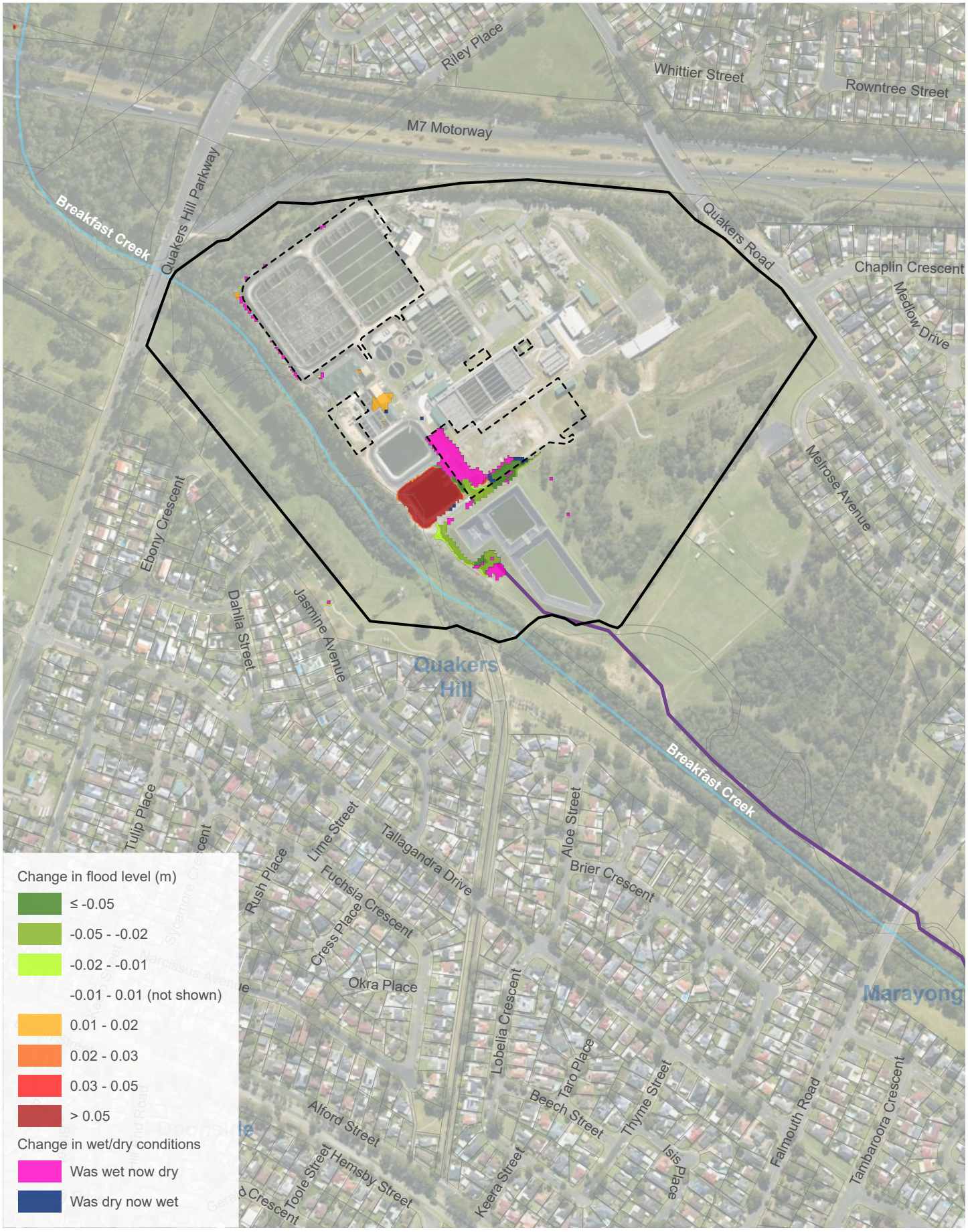


Figure 6-13 Change in mainstream flood level - 1% AEP event

0 300 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:6,000 @ A4
GDA2020 MGA Zone 56

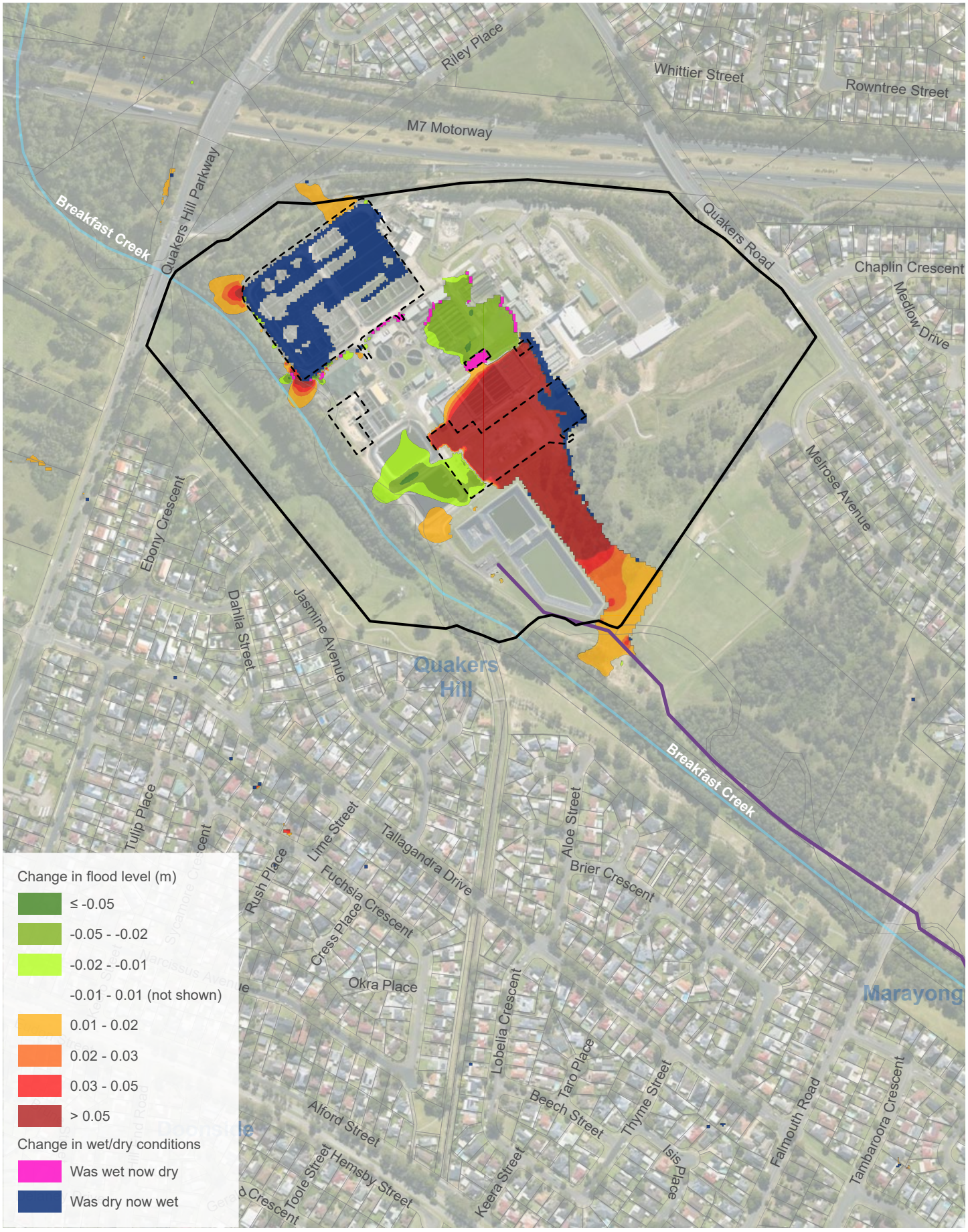


Figure 6-14 Change in mainstream flood level - PMF event

0 300 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:6,000 @ A4
GDA2020 MGA Zone 56

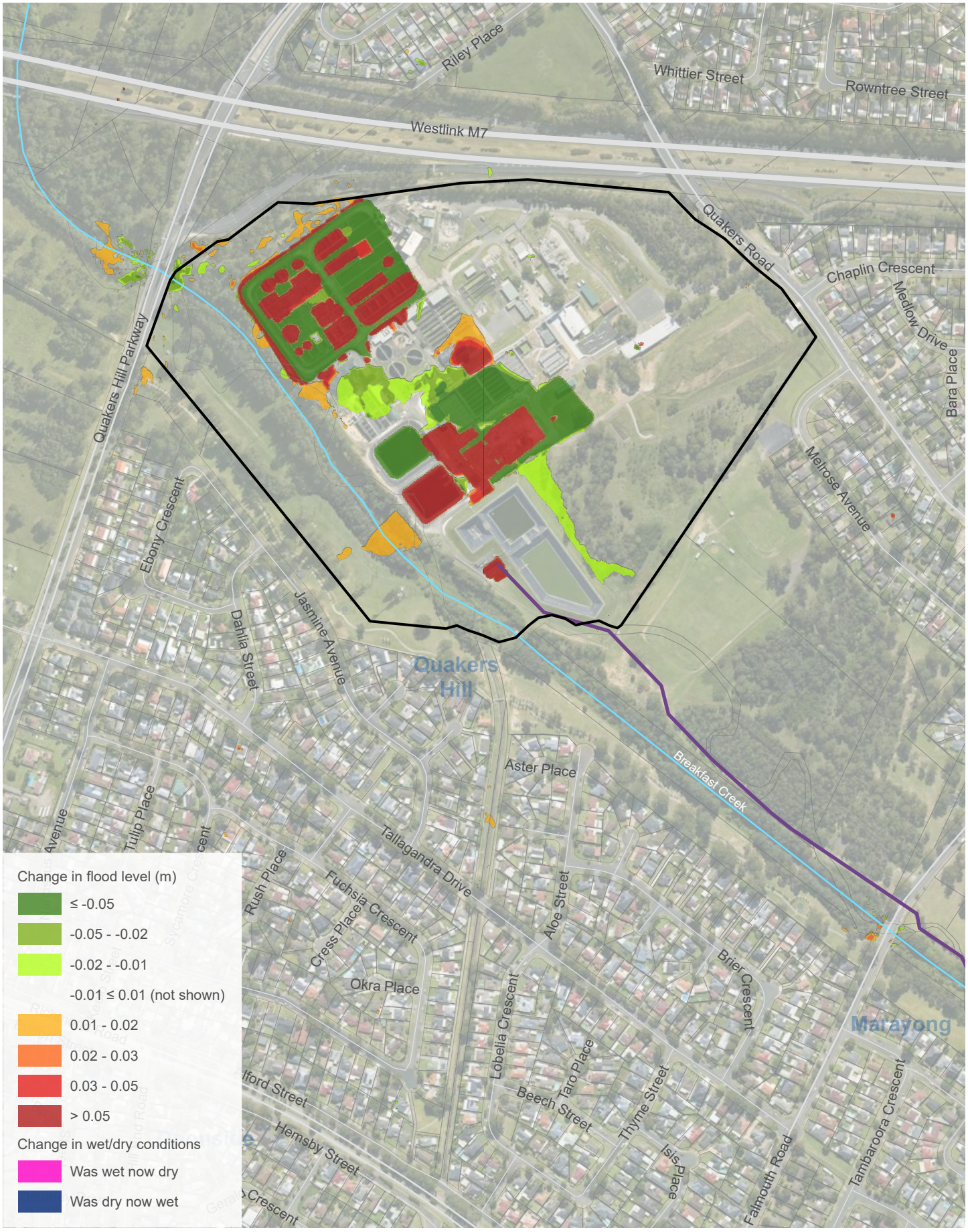


Figure 6-15 Change in overland flood level - 1% AEP event

0 300 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025

Scale: 1:6,000 @ A4
GDA2020 MGA Zone 56

N

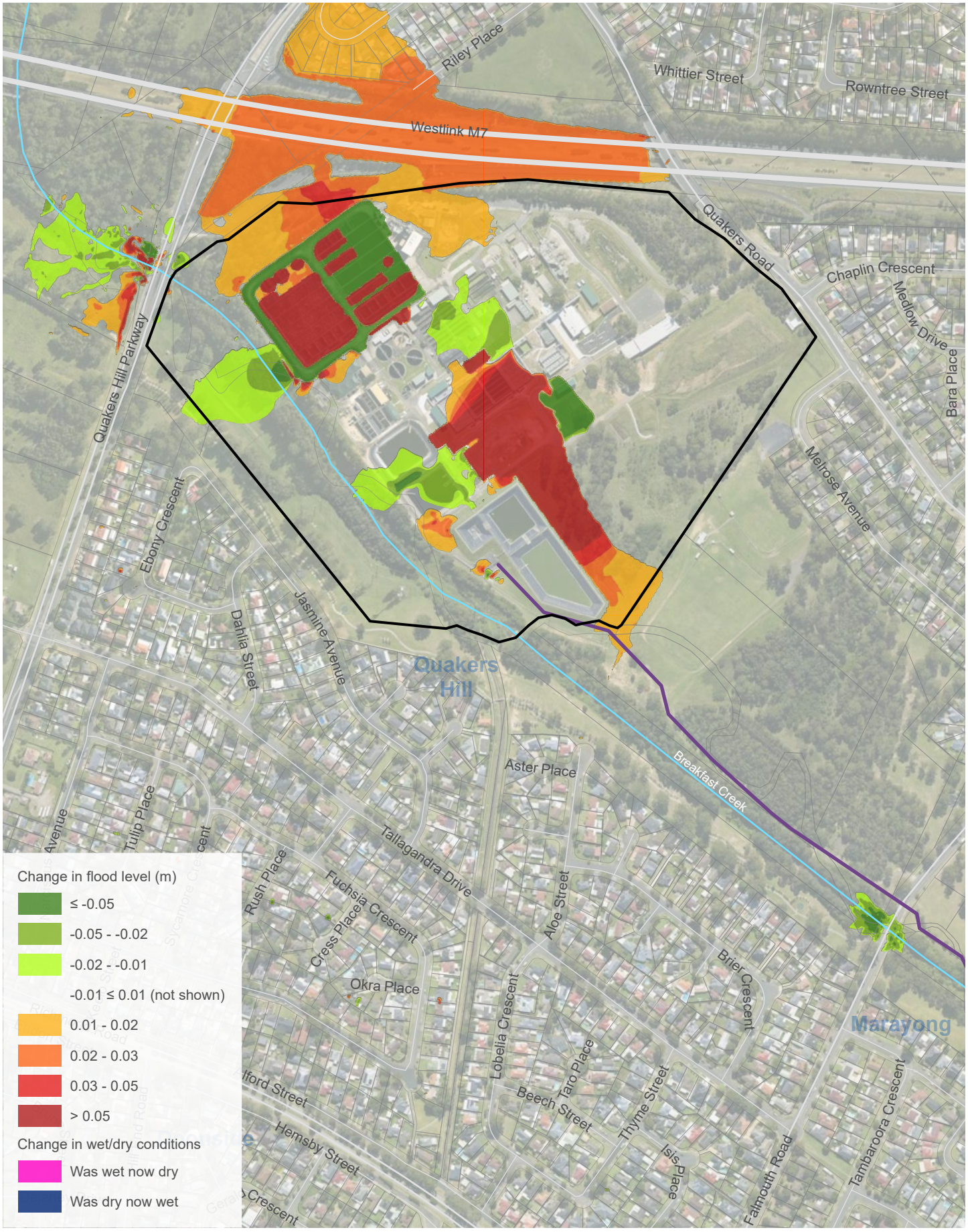


Figure 6-16 Change in overland flood level - PMF event

0 300 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025

Scale: 1:6,000 @ A4
GDA2020 MGA Zone 56

N

6.6.3.2 Brine pipeline

Once operational the brine pipeline is not expected to have impacts to flooding. The barometric loop is at a high point in the landscape and will not impact flooding.

6.6.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-16, impacts to flooding can be adequately managed and residual impacts are expected to be minor.

Mitigation measures in other sections of this REF (e.g. soils and contamination, hydrology and geomorphology) will also contribute to mitigating soils and contamination risks.

Table 6-16 Environmental mitigation measures — flooding

Mitigation measures	Timing
If there are any major updates to the design assessed in the REF, confirm the impact of the proposed works on flood behaviour. This should consider future climate change and a partial blockage of the stormwater drainage system.	Detailed design
If there are any major updates to the design assessed in the REF, design and refine the proposed works if required to minimise adverse impact on: • surrounding development for storms up to 1% AEP in intensity • critical infrastructure, vulnerable development or increases in risk to life due to a significant increase in flood hazard for floods up to the PMF.	Detailed design
Prepare a Flood Management Plan as part of the CEMP for the proposed works to describe the processes for flood preparedness, materials management, weather monitoring, flood incident management and site management. Flood incident management measures should be prepared in consultation with NSW SES and Blacktown City Council.	Pre-construction
Plan excavation of open trenches to avoid potential flooding impacts to people and property.	Pre-construction During construction
Carry out activities that may impact existing drainage systems during construction so that existing hydraulic capacity is maintained where practicable.	During construction
Locate spoil stockpiles in areas which are not subject to frequent inundation by floodwater, ideally outside the 10% AEP flood extent.	During construction
Locate construction facilities outside of high flood hazards areas based on a 1% AEP flood.	During construction
Mitigate localised increases in flow velocities at drainage outlets of the proposed works with the provision of scour protection.	During construction

6.7 Aboriginal heritage

Appendix H includes an Aboriginal Heritage Due Diligence Assessment prepared for the proposal. This section summarises key findings of that assessment.

Potential Aboriginal heritage impacts were identified through desktop assessments and visual inspections.

6.7.1 Existing environment

A search of the Aboriginal Heritage Information Management System (AHIMS) database and a review of previous Aboriginal heritage studies [redacted] are mapped in Figure 6-17 and described in more detail in Table 6-17. No Aboriginal places have been declared in or near the impact assessment area. Visual inspections of the impact assessment area in February and March 2025 [redacted] did not identify any other areas with archaeological potential.

Appendix H includes more detail of the landscape context, ethnohistorical context, archaeological context, and visual inspection results.

6.7.2 Potential impacts – construction

The proposal is in areas with widespread ground disturbance from urban redevelopment and infrastructure projects. [redacted] Aboriginal heritage sites within or overlapping the impact assessment area, all are either destroyed or have no potential for archaeological deposits, as outlined in Table 6-17.

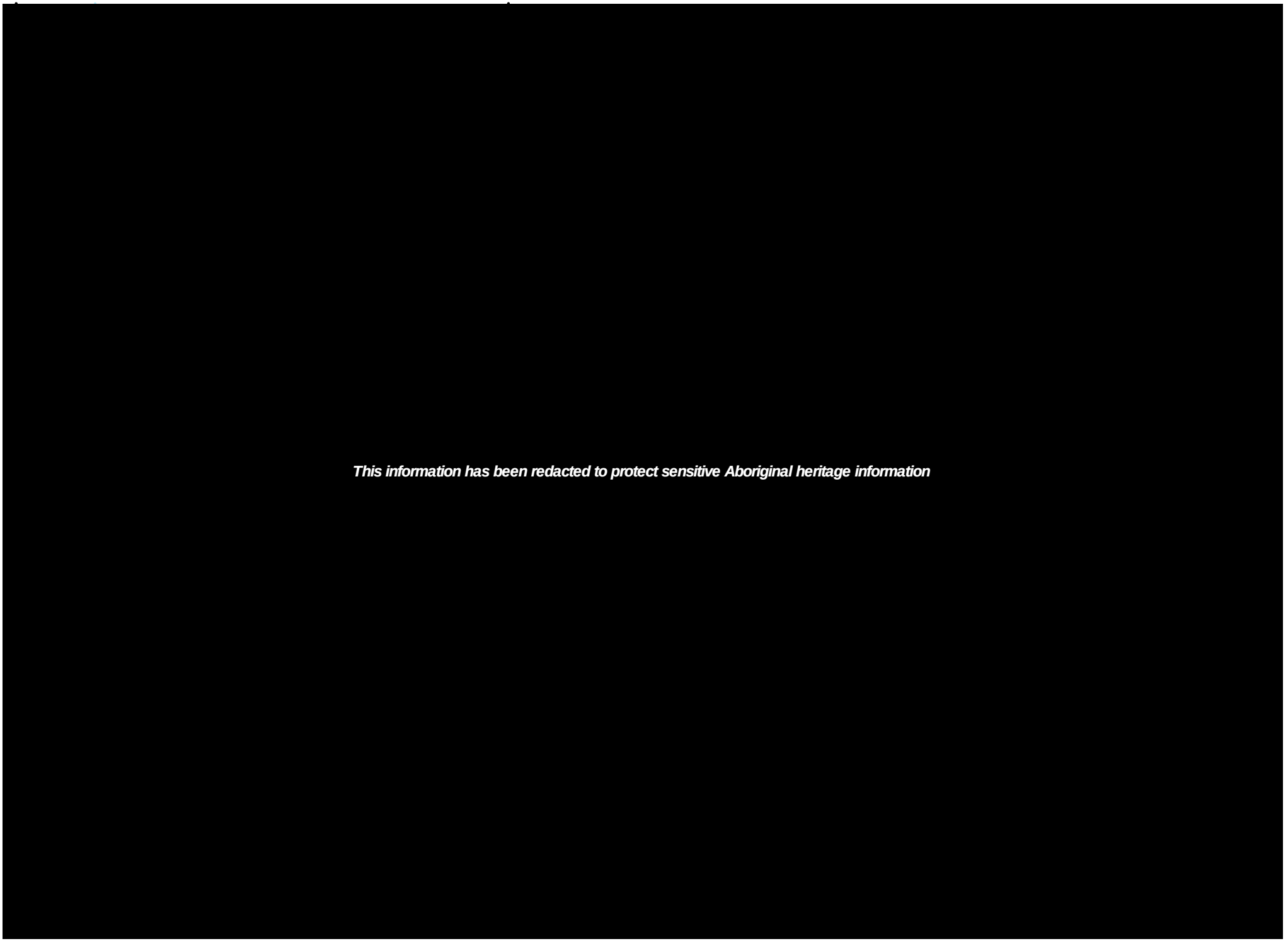
As a result, impacts to Aboriginal heritage are unlikely during construction. Table 6-18 includes a measure to manage the unlikely situation of unexpected heritage finds during construction.

6.7.3 Potential impacts – operation

Since there are no Aboriginal heritage sites in the impact assessment area and the proposal will not involve additional ground disturbance during operation, no impacts to Aboriginal heritage are expected during operation.

Table 6-17 Features of Aboriginal archaeological sites within the impact assessment area

This information has been redacted to protect sensitive Aboriginal heritage information


This information has been redacted to protect sensitive Aboriginal heritage information

6.7.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-18, impacts to Aboriginal heritage can be adequately managed, and residual impacts are not expected.

Table 6-18 Environmental mitigation measures — Aboriginal heritage

Mitigation measures	Timing
Do not make publicly available or publish, in any form, Aboriginal heritage information on sites / potential archaeological deposits, particularly regarding location.	Pre-construction During construction
Repeat the basic AHIMS search if it is older than 12 months. Conduct additional assessment if new sites are registered and could be impacted by the works.	Pre-construction During construction
If any Aboriginal object or non-Aboriginal relic is found, cease all excavation or disturbance in the area and notify Sydney Water Project Manager in accordance with SWEMS0009.	During construction

6.8 Non-Aboriginal heritage

Appendix I includes a Statement of Heritage Impact (SOHI) prepared for the proposal. This section summarises key findings of that assessment.

6.8.1 Existing environment

6.8.1.1 Quakers Hill WRRF

At least 19 other water treatment facilities comparable to Quakers Hill WRRF have been identified in NSW. The SOHI concluded the WRRF does not meet the threshold to be classed as significant for its historical, associative, aesthetic, social, research, rarity or representative value.

A grave site for Violet Emily Lee (who passed away in 1926) is in Quakers Hill WRRF site as shown on Figure 6-18. The grave site is made of bricks, sandstone and pebble stone with an inscribed plaque, and was restored by Sydney Water staff in 1985. The grave site is in an exclusion zone, so is outside the proposal impact assessment area. The SOHI concluded that the grave site is socially significant due to its strong association with Sydney Water employees and its spiritual and cultural value to the local community. However, the heritage value of the grave site is limited to community-based social significance.

Desktop review and site inspection did not identify any listed heritage assets or areas of archaeological potential within the impact assessment area at Quakers Hill WRRF. While outside the impact assessment area, the existing grave site within Quakers Hill WRRF is known to have high archaeological potential due to the likelihood of human remains and previously low levels of disturbance.

6.8.1.2 Brine pipeline

There are 5 heritage listed items within 200 m of the brine pipeline alignment, as shown in Table 6-19 and Figure 6-19. Figure 6-18 shows selected photographs of some of these items. Archaeological potential

along the brine pipeline alignment is likely to be limited to historic road surfaces. These have low heritage significance because they have limited research potential.

Fenced grave site within Quakers Hill WRRF, view south-east

Heritage item I17 (house), view south-west

Heritage item I16 (house), view south-west

View from I16 toward barometric loop, view south-west

Heritage item I12 (house), view south-west

View from I12 toward barometric loop, view south

Figure 6-18 Photographs of heritage items (source: Appendix I)

Table 6-19 Summary of heritage assets within 200 m of the impact assessment area

Name	Register	Place ID	Jurisdiction	Proximity to impact assessment area	Summary of significance
11 Harold Street (house)	Blacktown LEP 2015	I12	Local	About 112 m east of the brine pipeline	11 Harold Street is assessed as having historic and social significance as: • a private hospital in the Blacktown Estate area in the mid-1900s • an Edwardian style home from the early 1900s.
2 Sarsfield Street (house)	Blacktown LEP 2015	I16	Local	About 85 m south-west of the brine pipeline	2 Sarsfield Street is a highly intact remaining Californian bungalow representing early development in the Blacktown Estate.
5 Sarsfield Street (house)	Blacktown LEP 2015	I17	Local	About 26 m west of the brine pipeline	5 Sarsfield Street is assessed as significant in terms of its historical and aesthetic characteristics, as well as for its research potential and rarity. It is a Victorian style brick cottage in the Blacktown CBD pre-dating the Blacktown Estate.
Polish Memorial Roman Catholic Church (church)	Blacktown LEP 2015	I34	Local	About 162 m north-east of the brine pipeline	The Polish Memorial Roman Catholic Church is assessed as significant in terms of its history, associations, aesthetic and social value. It is a representative example of early modernist church design in post-WWII era Australia and is significant to the Polish community.
Northern Suburbs Ocean Outlet Sewer (NSOOS)	Sydney Water Section 170 Heritage and Conservation Register	4570286	State	Within – connects to the brine pipeline	The NSOOS is assessed as having historical and aesthetic significance, social value and research potential, as well as being an example of rare and representative major civic infrastructure of its time. It is representative of major public infrastructure engineering and construction techniques in the early 1920s.

Figure 6-19 Heritage listed items within 200 m of impact area

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:35,000 @ A4
GDA2020 MGA Zone 56

6.8.2 Potential impacts – construction

Impacts to non-Aboriginal heritage items during construction could be:

- physical impacts, relating to changes that materially affect known and / or unknown features and sites within the impact area (e.g. archaeology, listed heritage items)
- visual impacts, relating to changes that affect the views and / or setting of cultural landscapes and nearby built items within and surrounding the impact area.

6.8.2.1 Quakers Hill WRRF

Physical impacts are not expected as the impact area at the WRRF has no archaeological potential or heritage significance.

Visual impacts are also not expected during construction since the grave site does not have aesthetic significance and no listed heritage items have a line of sight to the WRRF.

6.8.2.2 Brine pipeline

Excavation to install the brine pipeline and connect into the NSOOS, and installing the barometric loop, may have some physical and visual impacts.

Although no areas of archaeological potential have been identified, archaeological resources may exist and be uncovered during construction where ground disturbance is required.

Vibration impacts may be experienced during use of the excavator with medium hammer (for heritage structures within 19 m), or vibratory roller 13-18 tonne (for heritage structures within 54 m). There are 2 heritage items within this distance that may be impacted – house at 5 Sarsfield Street (about 12 m away) and NSOOS (within the impact area).

The brine pipeline will connect into the NSOOS at a concrete maintenance hole and this is the only direct impact on a heritage item. The significant heritage fabric of the NSOOS is the original fabric built in the 1920s and 1930s. This concrete maintenance hole was built in the 1960s and is considered non-significant fabric. As the brine pipeline is connecting into non-significant fabric, little to no impact to the heritage significance of the NSOOS is expected.

Views between listed heritage buildings and the brine pipeline are obstructed by topography, vegetation, or other buildings. Views between heritage buildings and Billy Goat Hill Reserve (for constructing the barometric loop) are obscured. Therefore, visual impacts during construction are unlikely.

6.8.3 Potential impacts – operation

6.8.3.1 Quakers Hill WRRF

The introduction of new infrastructure at Quakers Hill WRRF associated with the advanced treatment upgrade will alter the setting of the grave site. New infrastructure will be outside the 20 m exclusion zone around the grave site. No operational impacts to the grave site are expected.

No listed heritage items are visible from Quakers Hill WRRF or have line of sight to the WRRF. No operational impacts to listed heritage items are expected.

6.8.3.2 Brine pipeline

No listed heritage items have a direct line of sight to the barometric loop at Billy Goat Hill Reserve. The barometric loop may be visible from the back garden of heritage item I17 (albeit screened by fences and trees) should obstructions be removed in future. Currently, no impact on the setting of heritage assets will occur from the brine pipeline or barometric loop. There will be no operational heritage impacts from the underground brine pipeline connection into the NSOOS.

6.8.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-20, impacts to non-Aboriginal heritage can be adequately managed, and residual impacts are expected to be minor to low.

Table 6-20 Environmental mitigation measures — non-Aboriginal heritage

Mitigation measures	Timing
Undertake a condition assessment of I17 (House at 5 Sarsfield Street) and the NSOOS. Confirm potential impacts to these 2 heritage items during detailed design. Where possible, develop a construction methodology that limits vibration to below the levels referenced in *German Standard DIN 4150 - Part 3 - Structural Vibration in Buildings – Effects on Structures* or other relevant standard as determined by Sydney Water.	Detailed design
Include unexpected finds protocol in CEMP.	Pre-construction
If vibration limits are expected to be exceeded and the construction methodology cannot be adjusted to below acceptable levels: • Undertake a property dilapidation survey. • Develop mitigation and management measures for each heritage item to be included in the CEMP.	Pre-construction
Maintain the 20 m exclusion zone that is currently surrounding the grave site at Quakers Hill WRRF. Ensure signage is placed on the existing fencing around the perimeter of the grave site during construction. Any instances of breaches within this exclusion, including by construction vehicles, must be reported and impacts assessed.	During construction
If any non-Aboriginal relic is found, cease all excavation or disturbance in the area and notify Environmental Representative in accordance with SWEMS0009	During construction

6.9 Terrestrial ecology

Appendix J includes a Biodiversity Assessment Report completed for the proposal. This section summarises key findings of that assessment.

The Biodiversity Assessment Report incorporates the findings of desktop studies and field surveys completed between October 2024 and June 2025. Appendix J provides information about the methodology for these surveys. Terminology used in that report includes:

- study area – generally the same as the impact assessment area. Some surveys were completed outside of the study area, including to identify nearby habitat features. Survey of the study area provides ground-truthing of data for areas where design flexibility may be required in future. This would support potential future assessments by identifying areas with higher or lower quality ecological constraints. The study area is 36.62 hectares
- construction footprint – reflects the impact area, which excludes the underground tunnelled sections. The construction footprint is 32.39 hectares.

The Biodiversity Assessment Report assessed worst-case vegetation impacts. Section 6.9.2 discusses vegetation impacts already avoided during design.

6.9.1 Existing environment

The proposal is in an urban area and extends across developed land, urban parks and playing fields, ornamental gardens, and planted and native vegetation.

6.9.1.1 Ground-truthed vegetation communities

Figure 6-20 shows examples of the 4 vegetation communities in the impact assessment area which conform to a plant community type (PCT). These vegetation communities cover 3.22 hectares of the 36.62 hectare impact assessment area. Some of these PCTs are also associated with threatened ecological communities (TECs). The remaining 33.40 hectares of the impact assessment area includes vegetation not conforming to a PCT (mixed exotic and native, exotic grassland, and weeds) and built areas such as roads and buildings.

Table 6-21 describes key features of these PCTs.

Table 6-21 Vegetation communities within the impact assessment area

PCT ID	PCT name	Associated TECs	Area (ha) in impact assessment area	TEC listing (BC Act and/or EPBC Act)	Vegetation quality/ description
3320	Cumberland Shale Plains Woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC (BC Act) Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest CEEC (EPBC Act) (where condition thresholds are met)	1.08	All 1.08 ha of PCT 3320 is consistent with the BC Act listing. The vegetation does not meet criteria for the EPBC Act listing.	In a degraded state, characterised by canopy trees and lack of native understorey vegetation.
3975	Southern Lower Floodplain Freshwater Wetland	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC (BC Act)	0.01	Does not meet criteria for BC Act listing	One small patch within the impact assessment area (Cavanagh Reserve). Within an artificial drainage channel and unlikely to be indicative of remnant wetlands. Degraded native emergent vegetation and many exotic species.
4023	Coastal Valleys Riparian Forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Coast Bioregions EEC (BC Act) Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland EEC (EPBC Act) (where condition thresholds are met)	0.62	All 0.62 ha of PCT 3320 is consistent with the BC Act listing. The vegetation does not meet criteria for the EPBC Act listing.	Mostly along Breakfast Creek and a narrow artificial tributary of Blacktown Creek within International Peace Park. Includes some individual and isolated patches of *Casuarina glauca*. Understorey generally absent or contains many weeds. No remnant stands of PCT 4023 present. Along Breakfast Creek, patches of vegetation have regenerated.
4025	Cumberland Red Gum River-flat Forest	River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC (BC Act)	1.16	All 1.16 ha of PCT 3320 is consistent with the BC Act listing. 0.88 ha of the vegetation meets	Appears in the impact assessment area across 2 condition states: high quality and lower quality. Mostly present along Breakfast Creek and Harvey Park. The assemblage within

PCT ID	PCT name	Associated TECs	Area (ha) in impact assessment area	TEC listing (BC Act and/or EPBC Act)	Vegetation quality/ description
		River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria CEEC (EPBC Act) (where condition thresholds are met)		criteria for the EPBC Act listing.	Harvey Park is higher quality and meets EPBC Act criteria. Some lower quality patches have no understorey or an exotic understorey. Includes some isolated patches of *Eucalyptus amplifolia*. Remnant assemblages and planted trees.
Mixed native and exotic	N/A	N/A	0.35	N/A	Ornamental street trees and garden vegetation
Exotic grassland	N/A	N/A	11.74	N/A	The most abundant vegetation type within the study area. Reflects that the alignment travels through multiple parks covered in exotic grass. Highly trafficked and likely to be regularly mowed – not considered priority flora or fauna habitat.
Weeds	N/A	N/A	0.11	N/A	Form part of all vegetation communities described above. Patches concentrated on park edges (e.g. Cavanagh Reserve). 28 weed species identified within the impact assessment area.

Note: CEEC = Critically Endangered Ecological Community, EEC = Endangered Ecological Community

PCT 3320

PCT 3975

PCT 4023

PCT 4025 – higher quality meeting EPBC Act criteria

PCT 4025 – lower quality meeting BC Act criteria (right)

Aquatic habitat – Breakfast Creek

Figure 6-20 Photographs of vegetation communities and potential habitat within the impact assessment area (Source: Appendix J)

6.9.1.2 Weeds and exotic vegetation

Four of the 28 weed species found during field surveys are listed as state priority weeds under the *Greater Sydney Regional Strategic Weed Management Plan 2023-2027* (Local Land Services, 2022):

- Asparagus Fern (*Asparagus aethopicus*)
- Bridal Creeper (*Asparagus asparagoides*)
- Green Cestrum (*Cestrum parqui*)
- Fireweed (*Senecio madagascariensis*).

Phytophthora cinnamomi (Phytophthora) is a soil-borne pathogen that infects tree roots and can cause damage or death to native plants. No Phytophthora records were identified nearby, and no evidence of dieback (which may indicate the presence of Phytophthora) was observed during field surveys.

6.9.1.3 Threatened flora

Desktop surveys identified 64 threatened flora species as previously recorded or predicted to occur within 10 km of the impact assessment area. Following desktop and site surveys, including habitat assessment, 6 species were considered to have a moderate or higher likelihood of occurrence. No threatened flora species were identified in the impact assessment area during site surveys. One threatened flora species was found during site surveys – a Magenta Lilly Pilly (*Syzygium paniculatum*) just outside the impact assessment area, in the International Peace Park. It is possible that this species exists as seed in the seedbank in the wider patch of vegetation (PCT 4025) which extends into the impact assessment area.

6.9.1.4 Threatened fauna

Desktop surveys identified 85 threatened fauna species as previously recorded or predicted to occur within 10 km of the impact assessment area. Another 31 threatened fauna species are also considered to have a moderate or higher likelihood of occurrence based on identified habitat features.

Seven threatened species were found during targeted field surveys. These species are:

- Cumberland Plain Land Snail (*Meridolum corneovirens*) – identified during snail surveys
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis)* – identified during microbat surveys and roosting habitat assessments (specifically ultrasonic calls)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) – identified during microbat surveys and roosting habitat assessments (specifically ultrasonic calls)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) – identified during microbat surveys and roosting habitat assessments (specifically ultrasonic calls)
- Grey-headed flying-fox (*Pteropus poliocephalus*) – identified during spotlighting
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*) – identified during microbat surveys and roosting habitat assessments (specifically ultrasonic calls)
- Little Bent-winged Bat (*Miniopterus australis*) – identified during microbat surveys and roosting habitat assessments (specifically ultrasonic calls)

No native fauna were detected from remote cameras and nest boxes installed as part of the proposal's site surveys (February to May 2025). Several native frog species were heard or observed during targeted frog surveys completed in February and March 2025, but none of these were threatened species.

6.9.1.5 Habitat features

Table 6-22 describes habitat features within the impact assessment area.

Table 6-22 Habitat features within the impact assessment area

Habitat feature	Presence	Fauna association	Importance to fauna
Hollow-bearing trees (HBT) (see Figure 6-21)	Six identified during field surveys, including: • 2 at WRRF – 1 with 3 hollows and bee hive; stag with 6 hollows and occupied by parrots • 1 at Harvey Park • 3 at International Peace Park with no signs of occupancy	Could support hollow-dependent microbats, woodland birds, arboreal marsupials, or owls	Nesting and roosting
Artificial culverts (see Figure 6-21)	Four in or near the impact assessment area	Mobile species	Refuge and connectivity in fragmented landscapes by providing shelter and safe passage
PCT 4025 Riparian Forest	1.16 ha within impact assessment area	Most mobile species	Provides highest quality habitat for threatened species within the impact assessment area as it has complex vegetation and intact groundcover
Other PCTs and other vegetation types	PCT 3320 – 1.08 ha PCT 3975 – 0.01 ha PCT 4023 – 0.62 ha	Few mobile species	Would not provide habitat for most threatened species due to degraded or absent understorey
Canopy vegetation – PCT 3320 and PCT 4025	PCT 3320 – 1.08 ha PCT 4025 – 1.16 ha	Woodland birds or nectivorous birds or other mobile species	Foraging when canopy species are flowering
Aquatic habitat	Breakfast Creek and Blacktown Creek	Threatened frog species Other water-dependent species such as Southern Myotis	Poor condition makes it unlikely that threatened species would use the area

6.9.2 Impacts avoided or minimised during design

The impact assessment area and impact area have both been refined during design. The impact area reflects the area where direct impacts during construction (e.g. excavation, storage, lane closures, vegetation removal) are most likely to occur. The impact assessment area is a wider area in some locations that allows flexibility for additional compounds or shifting the pipeline alignment without further assessment.

Impacts avoided or minimised during design have been generally outlined in section 2.2.4. This section specifically outlines locations where vegetation impacts have been avoided or minimised during design.

6.9.2.1 Quakers Hill WRRF

The impact area does not include the entire lot boundary for the WRRF. It is limited to existing operational areas which are largely hardstand and previously developed. This means that the native vegetation within the lot boundary but outside the operational area will be protected. This vegetation is managed by Sydney Water to meet offset obligations from previous projects. Vegetation within the impact area at the WRRF is limited to isolated trees and small patches of native vegetation. Although all the vegetation within the impact area is assessed to be removed, none of it is near any new assets. Therefore, unless asset locations change or trimming is required for access, detailed design will consider opportunities for it to be retained.

6.9.2.2 Brine pipeline

Refinements along the brine pipeline include:

- narrowing the impact area for the pipeline between C1 and C2 to reduce impacts to BC Act and EPBC Act listed River Flat Eucalypt Forest
- re-aligning the pipeline at Harvey Park and re-shaping a compound to divert around and avoid a stand of BC Act and EPBC Act listed River Flat Eucalypt Forest
- reshaping C8, C17 and C20 to avoid mature vegetation.

6.9.3 Potential impacts – construction

For construction, this assessment assumes all vegetation within the impact area will be removed. It is likely that the construction methodology and pipeline alignment will be further refined as detailed design and construction planning progresses. Some vegetation identified for removal within the impact area may only require trimming or could be avoided.

Native vegetation and habitat will be directly and indirectly impacted during construction. 13.25 ha of vegetation will be removed, which includes 1.97 ha of native vegetation conforming to a PCT. This will cause loss of various foraging, nesting, breeding and/or potential roosting habitat for threatened fauna species. Further detail is provided in the following sub-sections.

6.9.3.1 Ground-truthed vegetation communities

Table 6-23 and Figure 6-21 show the proposal's direct vegetation impacts. Where tests of significance have been completed, these are available in full in Appendix J.

Table 6-23 Direct impacts on vegetation communities within the impact area

PCT ID	PCT name	Associated TECs	Area (ha) in impact area	Significance	Assessment of significance
3320	Cumberland Shale Plains Woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC (BC Act)	0.95	Test of Significance (ToS) under BC Act Unlikely to have a significant impact	• The vegetation is fragmented, isolated and degraded. • Removal will not impact the long-term survival of the community.
3975	Southern Lower Floodplain Freshwater Wetland	N/A	0.01	N/A	N/A
4023	Coastal Valleys Riparian Forest	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Coast Bioregions EEC (BC Act)	0.62	Test of Significance (ToS) under BC Act Unlikely to have a significant impact	• This long, thin patch of vegetation is already highly isolated from other vegetation. • The vegetation has been modified and includes invasive species. • Removal is unlikely to place the local occurrence at risk of extinction. • Patches will not become fragmented; fragments between patches will not increase.
4025	Cumberland Red Gum River-flat Forest	River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC (BC Act) River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria CEEC (EPBC Act)	0.39	Test of Significance (ToS) under BC Act – 0.26 ha Significant Impact Criteria (SIC) assessment under EPBC Act – 0.13 ha Unlikely to have a significant impact	• Removal involves 2 strips of vegetation on the edge of larger patches. • Will not fragment or isolate any patches, and will increase the distance between them by less than 5 m. • Removal is unlikely to substantially change the composition of the broader patch.

PCT ID	PCT name	Associated TECs	Area (ha) in impact area	Significance	Assessment of significance
					• Removal is unlikely to place the local occurrence at risk of extinction.
Mixed native and exotic	N/A	N/A	0.22	N/A	N/A
Exotic grassland	N/A	N/A	11.27	N/A	N/A
Weeds	N/A	N/A	0.11	N/A	N/A

6.9.3.2 Impacts to threatened flora

Given no threatened flora were identified in the impact area, the proposal will not have any direct impacts on known threatened flora. The individual Magenta Lilly Pilly (*Syzygium paniculatum*) identified outside the study area will not be removed for the project.

Removing vegetation will cause habitat loss for threatened flora with a moderate or higher likelihood of occurring in the impact area. The only threatened flora species for which this is relevant is the Magenta Lilly Pilly. This is because there is one individual near the impact area, and it is possible for this species to exist in the seedbank of the adjacent potential habitat (PCT 4025) to be removed for the proposal.

6.9.3.3 Impacts to threatened fauna

Removing vegetation will cause habitat loss for threatened fauna with a moderate or higher likelihood of occurring in the impact area. 29 threatened fauna met these criteria and of these species impacts to 28 of them will only be impacts on potential habitat. There is a low likelihood of these species being impacted given only small areas of habitat will be removed, species are mobile and can access suitable nearby habitat, and life cycle (e.g. known breeding habitat) will not be impacted.

Table 6-24 provides a full list of the 28 threatened fauna.

Table 6-24 Impacts to threatened fauna with low likelihood of impact

Species type	Species names	Area of habitat impact	Listed under BC Act	Listed under EPBC Act
Hollow-dependent microbat species	Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	Removal of foraging habitat, up to 1.33 ha	Yes, all 7	None
	Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)			
	Greater Broad-nosed Bat (*Scoteanax rueppellii*)	Removal of foraging habitat, up to 1.96 ha		
	Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*)	Removal of foraging habitat, up to 1.97 ha		
	Little Bent-winged Bat (*Miniopterus australis*)			
	Large Bent-winged Bat (*Miniopterus orianae oceanensis)*			
	Southern Myotis (*Myotis macropus*)			
Large forest owls	Barking Owl (*Ninox connivens*)	Removal of foraging habitat, up to 1.97 ha	Yes, all 3	None
	Masked Owl (*Tyto novaehollandiae*)			
	Powerful Owl (*Ninox strenua*)			

Species type	Species names	Area of habitat impact	Listed under BC Act	Listed under EPBC Act
Raptors	White-bellied Sea-Eagle *(Haliaeetus leucogaster)* Spotted Harrier *(Circus assimilis)* Square-tailed Kite *(Lophoictinia isura)* Little Eagle *(Hieraaetus morphnoides)* Eastern Osprey *(Pandion cristatus)* Black Falcon *(Falco subniger)*	Removal of foraging and potential roosting habitat, up to 1.97 ha	Yes, all 6	White-bellied Sea Eagle only
Woodland birds	Dusky Woodswallow *(Artamus cyanopterus cyanopterus)* Varied Sittella *(Daphoenositta chrysoptera)*	Removal of foraging habitat, up to 1.97 ha	Yes, all 5	Yes, Brown Treecreeper and Regent Honeyeater
	Speckled Warbler *(Pyrrholaemus sagittatus)* Brown Treecreeper *(Climacteris picumnus victoriae)* Regent Honeyeater *(Xanthomyza phrygia)*	Removal of foraging habitat and general nesting habitat, up to 1.96 ha		
Parrots	Swift Parrot *(Lathamus discolor)* Turquoise Parrot *(Neophema pulchella)* Gang-gang Cockatoo *(Callocephalon fimbriatum)*	Removal of foraging habitat, up to 1.97 ha	Yes, all 5	Yes, Swift Parrot, Gang-gang Cockatoo, South-eastern Glossy Black-Cockatoo
	South-eastern Glossy Black-Cockatoo *(Calyptorhynchus lathami lathami)* Little Lorikeet *(Parvipsitta pusilla)*	Removal of foraging habitat, up to 1.96 ha		
Other	Grey-headed flying-fox (*Pteropus poliocephalus*)	Removal of foraging habitat, up to 2.19 ha	Yes, all	Yes, all
	White-throated Needletail *(Hirundapus caudacutus)*	Removal of foraging habitat, up to 1.97 ha		

Species type	Species names	Area of habitat impact	Listed under BC Act	Listed under EPBC Act
	Australasian Bittern (*Botaurus poiciloptilus*)	Removal of foraging and sheltering habitat, up to 1.02 ha		

Direct impacts were only identified for one species – Cumberland Plain Land Snail (*Meridolum corneovirens*). Two shells were detected outside of the impact area but near the WRRF. Another 2 shells were found in Harvey Park, adjacent to Breakfast Creek near the impact area. PCT 4025 is the only suitable habitat for this species within the impact area as it has native understorey. This is consistent with the species' habitat requirements of dense groundcover and fallen logs. PCT 4025 would provide sheltering, foraging and breeding habitat. Since the species is listed as endangered under the BC Act, a ToS was performed.

A significant impact was considered unlikely, as:

- any individuals found could be translocated during pre-clearing surveys to reduce the risk of impacting a local population
- removal of 0.39 ha of PCT 4025 is unlikely to decrease connectivity through the region or be important to the long-term survival of the species.

6.9.3.4 Habitat features

Table 6-25 summarises predicted direct and indirect impacts to habitat features.

Table 6-25 Impacts to habitat features in the impact area

Habitat feature	Type of impact	Predicted impact
Hollow-bearing trees (HBT)	Indirect	All 6 known HBTs are proposed to be retained Species using the hollows may be indirectly impacted by noise or light during construction
Artificial culverts	None	No culverts will be impacted
PCT 4025 Riparian Forest	Direct and indirect	Removing 0.39 ha of potential habitat for 29 threatened fauna species Potential fauna injury or mortality during clearing, from collisions, or accidental entrapment
Other PCTs and other vegetation types (PCT 3320, PCT 3975, PCT 4023)	Direct	Removing up to 2.19 ha of potential habitat for multiple threatened fauna species Potential fauna injury or mortality during clearing, from collisions, or accidental entrapment

Habitat feature	Type of impact	Predicted impact
Canopy vegetation – PCT 3320 and PCT 4025	Direct	Removing 1.33 ha of potential habitat for multiple threatened fauna species
Aquatic habitat	None	Breakfast Creek and Blacktown Creek unlikely to be used by threatened species

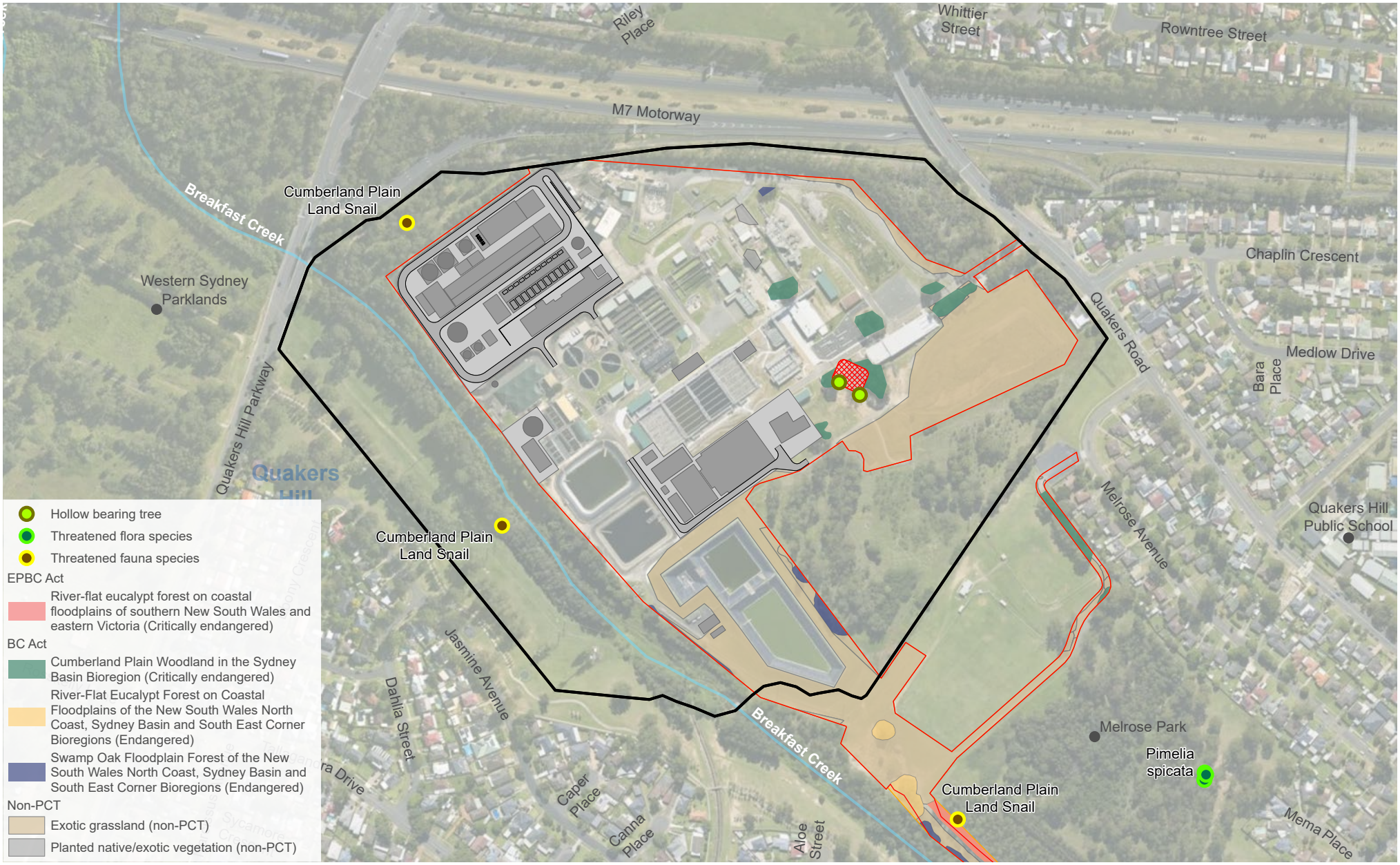


Figure 6-21a Ground-truthed vegetation, habitat features and observed threatened species in and near the impact area

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

Figure 6-21b Ground-truthed vegetation, habitat features and observed threatened species in and near the impact area

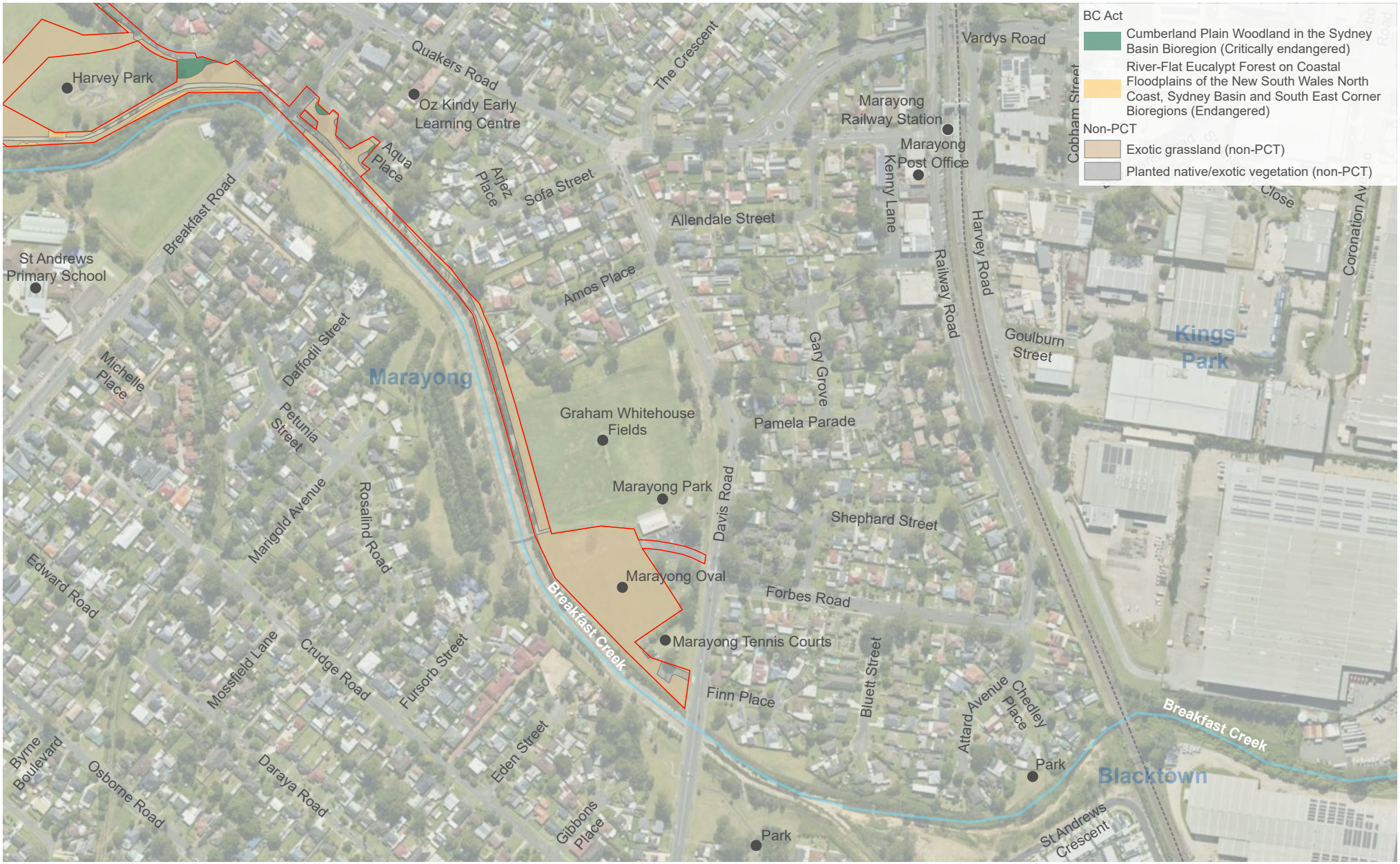


Figure 6-21c Ground-truthed vegetation, habitat features and observed threatened species in and near the impact area

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025

Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

Figure 6-21d Ground-truthed vegetation, habitat features and observed threatened species in and near the impact area

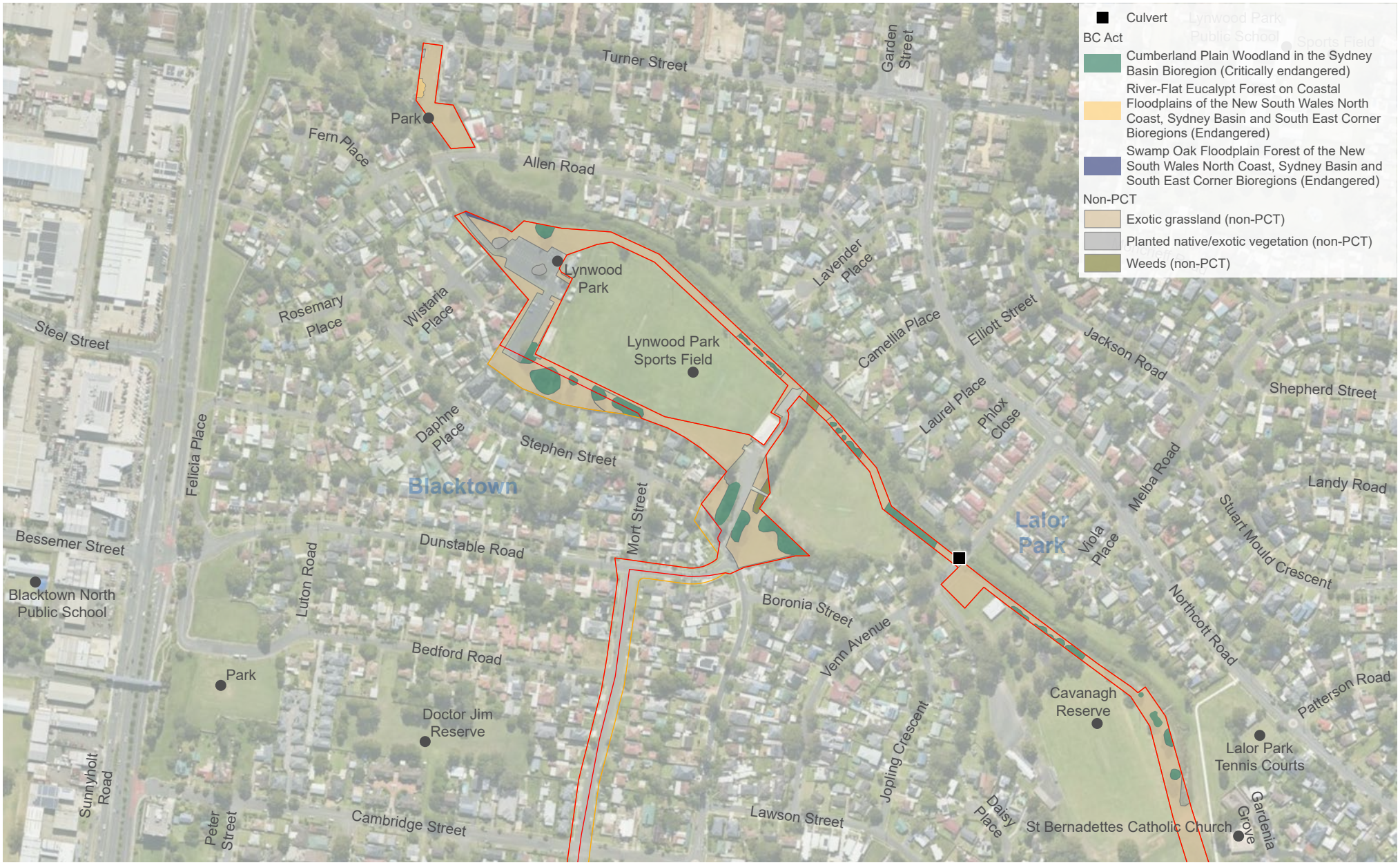


Figure 6-21e Ground-truthed vegetation, habitat features and observed threatened species in and near the impact area

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

Impact area

Impact assessment area

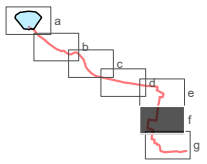


Figure 6-21f Ground-truthed vegetation, habitat features and observed threatened species in and near the impact area

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025

Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

N

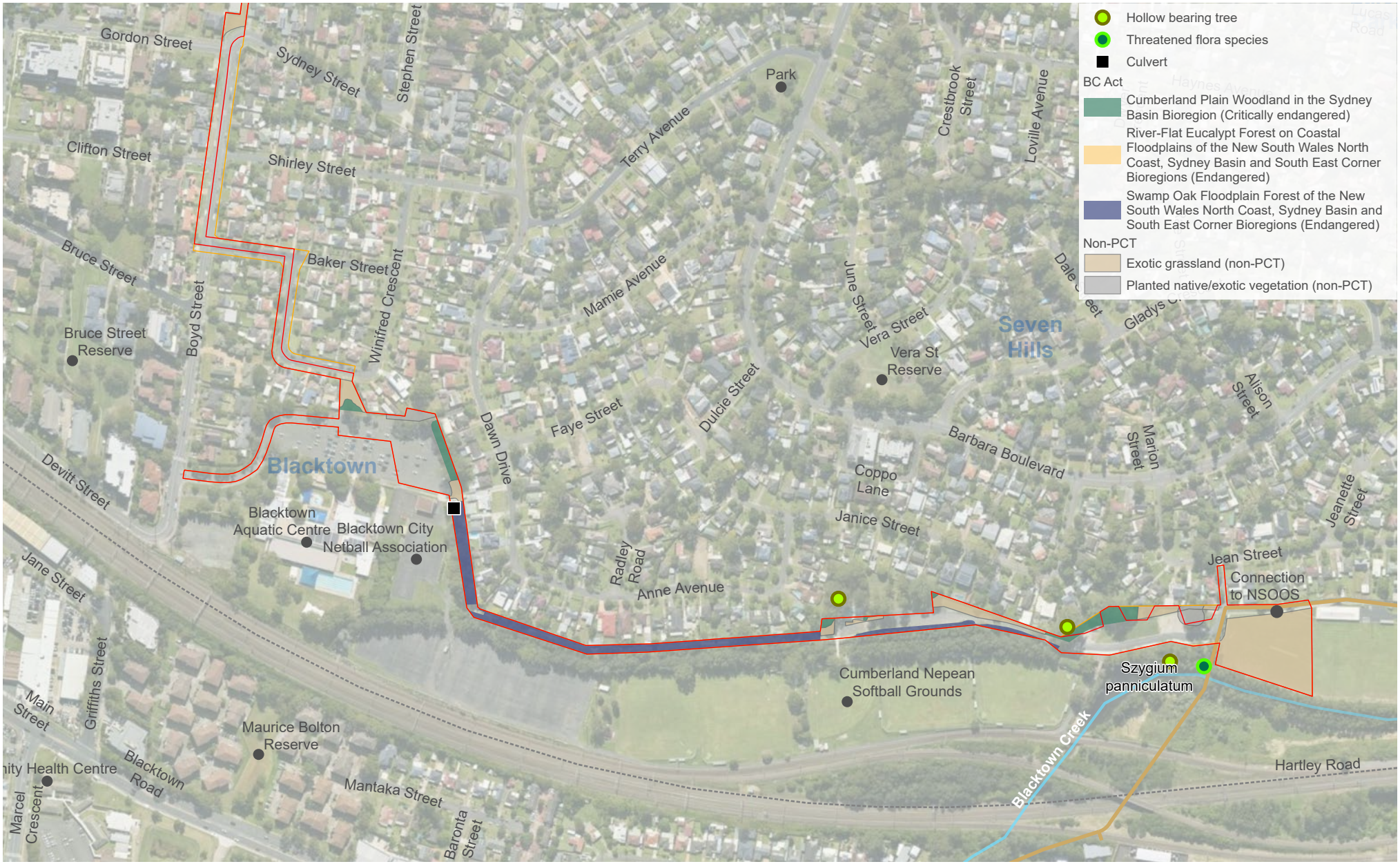


Figure 6-21g Ground-truthed vegetation, habitat features and observed threatened species in and near the impact area

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:5,000 @ A4
GDA2020 MGA Zone 56

6.9.3.5 Indirect impacts

Table 6-26 summarises likely indirect impacts to flora and fauna during construction.

Table 6-26 Indirect impacts from construction of the proposal

Impact description	Impact assessment
Edge effects on native vegetation	Vegetation clearing may create some new edges in PCT 4023, PCT 4025 and their associated TECs. These new edges could be degraded by weeds establishing and spreading, and enriched runoff from use of access tracks (e.g. the access track between Melrose Park and Falmouth Road). However, this risk is minor as the edge vegetation already contains weeds and is generally close to roads.
Invasion and spread of weeds, pathogen and disease	An increase in the movement of people, vehicles, machinery, vegetation waste and soil during construction may facilitate the introduction or spread of exotic grasses and other weeds. The impact area is unlikely to support Phytophthora, but it could enter the site through other sources, such as unclean equipment from infected areas.
Erosion, sedimentation and changes to hydrology	Direct impacts to Breakfast Creek and Blacktown Creek are unlikely. Indirect impacts may occur as vegetation removal near Breakfast Creek could expose soil and therefore create an erosion and sedimentation risk.

6.9.4 Potential impacts – operation

No additional biodiversity impacts are expected during operation. Since vegetation removal is required to install a new pipeline, not all the vegetation will be able to be reinstated where it is removed. When planted too close to pipelines, root systems of some trees can damage the pipelines. However, operational impacts will be minimised or mitigated by offsetting removed vegetation in specific locations agreed by landowners and other key stakeholders.

6.9.4.1 Sydney Water biodiversity offset requirements

Although formal offsets are not required under the BC Act, Sydney Water has an internal position to maintain or enhance biodiversity outcomes if projects have residual biodiversity impacts. Vegetation removed will be offset in accordance with Sydney Water's non-statutory offset guide as outlined in the mitigation measures below. Table 6-27 outlines Sydney Water's offset requirements for impacts to different types of biodiversity features.

Table 6-27 Offsetting options for vegetation

Residual loss of biodiversity values	Offset multiplier (Moderate Impact > 0.01 ha)
Threatened Ecological Communities	3
Non-threatened native vegetation (e.g. native remnant, riparian or planted native vegetation)	2
Tree Removal (Non-locally native or exotic tree)	1

Table 6-28 outlines the restoration requirements for the vegetation impacted in the impact area, based on the worst-case impact assessment. These areas will be re-calculated during construction once the actual impacts are known. Each restoration area is required to be like-for-like and must restore the same TEC that is being impacted. Mixed native and exotic vegetation are to be offset at a ratio of 1:1, once the number of these trees removed is confirmed.

Table 6-28 Restoration requirements based off the impact area

Vegetation type	Area of Impact (ha)	Required restoration (ha)
TEC		
Cumberland Plain Woodland in the Sydney Basin Bioregion (BC Act)	0.95	2.85
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act)	0.62	1.86
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (BC Act) River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria (EPBC Act)	0.39	1.17
PCT		
3975 – Southern Lower Floodplain Freshwater Wetland	0.01	0.02
Total	**1.97**	**5.90**

Offset obligations are proposed to be delivered through a combination of:

- replanting at locations identified by Blacktown City Council (or payment in kind for revegetation or restoration)
- restoration of PCTs in or near the impact area with weedy or absent understorey
- purchase and retirement of biodiversity credits from a registered Biobank or Biodiversity Stewardship site may be considered only when all other options are unavailable.

Offset options at Quakers Hill WRRF were considered. However, most non-operational areas are already managed under Sydney Water's Property Environmental Management Program so no suitable locations were available.

6.9.5 Mitigation measures

With the implementation of the mitigation measures in Table 6-29, biodiversity impacts can be adequately managed, and residual impacts are expected to be minor.

Mitigation measures in other sections of this REF (e.g. soils and contamination, surface water and aquatic ecology, groundwater) will also contribute to mitigating flora and fauna risks.

Table 6-29 Environmental mitigation measures — flora and fauna

Mitigation measures	Timing
Physically delineate areas of native vegetation that will not be removed and designate those areas as 'no-go zones'.	Pre-construction
Conduct pre-clearance surveys in all areas with identified Native Vegetation (all PCTs) as well as mixed native and exotic vegetation, which can provide potential habitat for fauna. Pre-clearance surveys should be conducted within 48 hours of clearing or trimming, by a suitably qualified ecologist. They will identify any breeding or nesting activities by native fauna and as far as practical no breeding sites will be disrupted. Should a nest tree be required to be cleared, the nest must be left until chicks naturally fledge. Pre-clearing survey will also target threatened species identified on site including: • Cumberland Plain Land Snail *(Meridolum corneovirens)* • Grey-headed flying-fox (*Pteropus poliocephalus*) • Magenta Lilly Pilly (*Syzygium paniculatum*).	Pre-construction
If any unexpected threatened species or ecological communities are identified during the pre-clearing surveys, these should be appropriately assessed through a supplementary impact assessment.	Pre-construction
During the pre-clearance surveys, any hollow-bearing trees not previously identified in or near the proposed Study Area will be marked by an ecologist so that they are retained and avoided by contractors.	Pre-construction
Where fauna species are identified in vegetation to be cleared, remove animals and relocate them to adjacent bushland before felling. If this is not possible, the tree will be sectionally dismantled or soft felled under the supervision of an ecologist or wildlife carer, before relocating the animal.	Pre-construction During construction
Toolbox talks should involve a print-out of the following threatened species: • *Acacia pubescens* (Downy Wattle) • *Grevillea juniperina subsp. juniperina* (Juniper-leaved Grevillea) • *Marsdenia viridiflora subsp. viridiflora* Penrith LGAs • *Persoonia hirsuta* (Hairy Geebung) • *Pimelea spicata* (Spiked Rice-flower) • *Syzygium paniculatum* (Magenta Lilly Pilly) • Cumberland Plain Land Snail (*Meridolum corneovirens*).	Pre-construction During construction
Adjust methodology (e.g. avoid area, hand excavate, implement exclusion fencing) to protect sensitive areas where possible (such as mature trees, known threatened species, populations or ecological communities).	Pre-construction During construction
Protect trees in accordance with the requirements of *Australian Standard 4970-2009 for the Protection of Trees on Development Sites*. Do not damage tree roots unless absolutely necessary, and engage a qualified arborist where roots > 50 mm are impacted within the Tree Protection Zone.	Pre-construction During construction

Mitigation measures	Timing
If any priority weeds are identified during the proposed works, remove and dispose of them at an appropriately licenced waste facility. The equipment used for removing them will be cleaned to minimise the likelihood of transferring and exotic plant materials.	During construction
Cover open trenches overnight to avoid fauna becoming trapped. Additionally, trenches should be checked each morning for possible trapped fauna.	During construction
Vegetation trimming or clearance cannot proceed without written authorisation from the Sydney Water Project Manager (in consultation with Environmental Representative).	During construction
Map and report native vegetation clearing greater than 0.01 ha in extent (and any associated rehabilitation) to the Sydney Water Environmental Representative. Track vegetation clearing as per SWEMS0015.26 Contractor Native Vegetation Clearing and Rehabilitation template.	During construction
Minimise vegetation clearance and disturbance, including impacts to standing dead trees and riparian zones. Identify opportunities to avoid and minimise such as trimming instead of full removal where possible.	During construction
If native fauna is encountered on site, stop work and allow the fauna to move away unharassed. Engage WIRES or a licenced ecologist if assistance is required to move fauna.	During construction
If any threatened species (flora or fauna) is discovered during the works, stop work immediately and notify the Sydney Water Project Manager. Work will only recommence once the impact on the species has been assessed and appropriate control measures implemented.	During construction
If any damage occurs to vegetation outside of the impact area, notify the Sydney Water Project Manager and Environmental Representative so that appropriate remediation strategies can be developed.	During construction
Construction should occur during standard daylight hours to avoid potential indirect impacts on nocturnal fauna such as owls, amphibians, and mammals. If construction is to occur at night, then standard light and noise mitigation measures should be applied to mitigate impacts to native fauna. Light mitigation measures are outlined in the *National Light Pollution Guidelines for Wildlife*.	During construction
Ensure vehicles, equipment, materials, and footwear are to be clean on entry (free of soil, mud and/or seeds) to minimise the risk of introduction or spread of *Phytophthora cinnamomi*.	During construction
Adopt the principles of the 'Arrive Clean – Leave Clean' guidelines to minimise the risk of introduction or spread of pathogens and weeds within the site or from off-site areas. These principles can be extended to invasive pest animal species including but not limited to red imported fire ants (*Solenopsis invicta*).	During construction
Offset any impacts from the proposal in accordance with the Sydney Water *Biodiversity Offset Guide*.	During operation
If replanting near Sydney Water pipelines refer to '*Which trees can damage wastewater pipes?'* link from Sydney Water website to help identify suitable species.	During operation

Mitigation measures	Timing
Use local provenance species for revegetation, in consultation with a suitably qualified bush regenerator.	During operation

6.10 Noise and vibration

Appendix K includes a noise and vibration impact assessment completed for the proposal. This section summarises key findings of that assessment.

6.10.1 Existing environment

6.10.1.1 Quakers Hill WRRF

Existing noise levels around Quakers Hill WRRF are influenced by traffic on the Westlink M7, local train lines and the existing WRRF. Most surrounding land is zoned as residential, with pockets of land zoned for public recreation, neighbourhood centre, local centre and education. Most noise sensitive receivers close to Quakers Hill WRRF are low-density residences. The closest noise sensitive receivers are residential receivers to the north and south-west, about 120 m from Quakers Hill WRRF.

6.10.1.2 Brine pipeline

The brine pipeline passes through the low-density residential suburbs of Marayong, Blacktown and Lalor Park. Other nearby land uses include public recreation, education and business parks. The distance to sensitive receivers varies along the brine pipeline impact assessment area. In some areas the impact assessment area extends up to the property boundary of residential receivers.

6.10.1.3 Construction criteria

Air-borne noise – background levels and relevant criteria

Figure 6-22 shows the 6 noise catchment areas (NCAs) identified for the proposal based on similar land use, background noise influences and sensitive receivers.

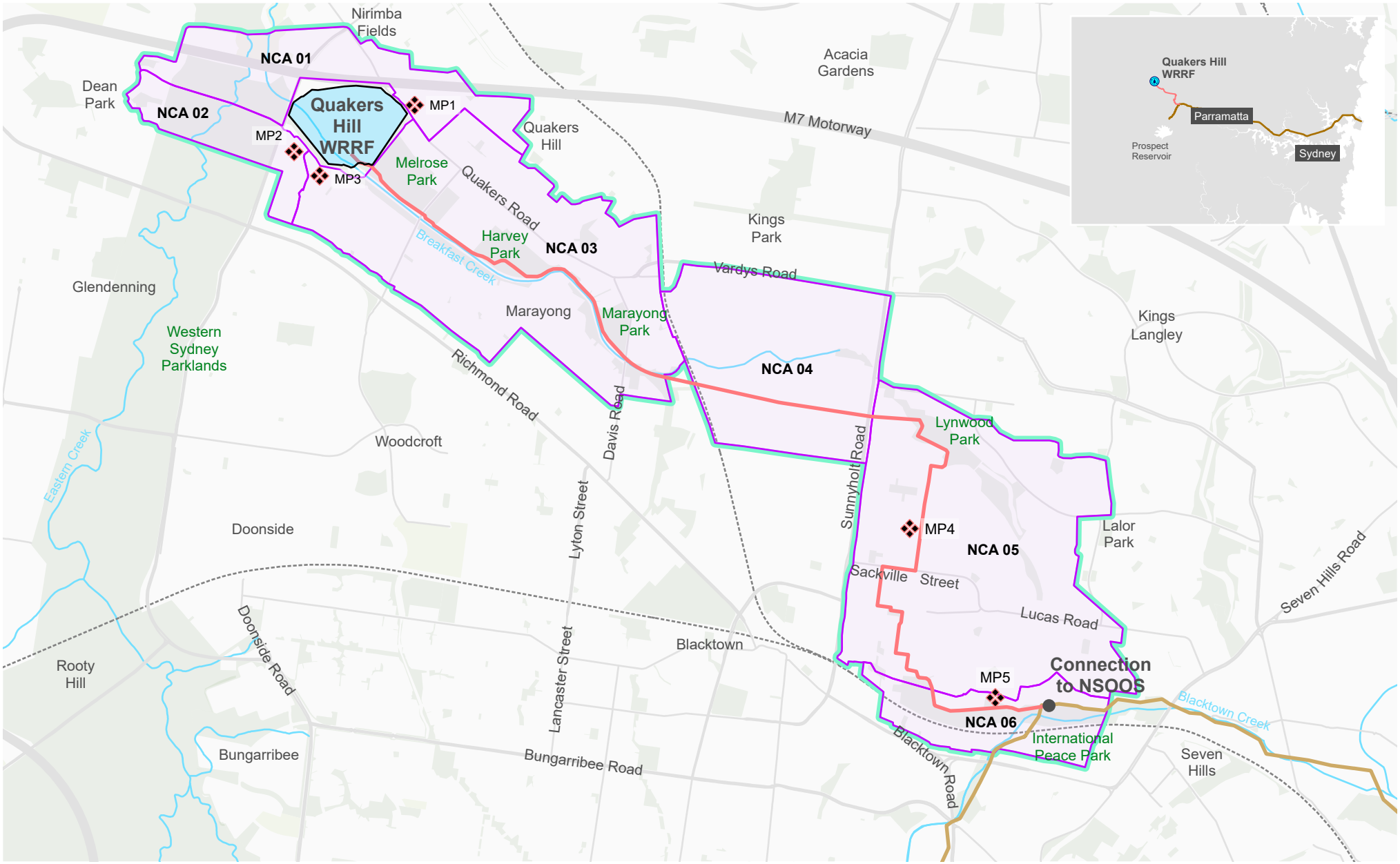
Unattended and attended noise monitoring was undertaken to characterise existing background noise levels (the rating background level (RBL)), including the placement of noise loggers at locations shown in Figure 6-22. This monitoring established the noise management levels (NMLs) for each NCA and quantified background noise levels at the nearest sensitive receivers. The NMLs for residential receivers were derived from the RBLs and both are presented in Table 6-30. NMLs for non-residential receivers were based on the *Interim Construction Noise Guideline* (ICNG) (DECC NSW 2009). One of the NCAs (NCA 04) does not have RBLs or NMLs as there are no sensitive receivers within the catchment. Out of hours works (OOHW) criteria are included because works outside of standard working hours are likely for drilling and pipe pull-through for the tunnelling sections of the brine pipeline.

Ground-borne noise - relevant criteria

Ground-borne noise is noise generated by vibration transmitted through the ground into a structure. Ground-borne noise may be experienced during tunnelling works. Ground-borne noise is usually not a significant

disturbance to building occupants during the day because higher ambient noise levels typically mask sounds from ground-borne noise. Objectives for internal noise levels for residential receivers in relation to ground-borne NMLs (GBNMLs) from DECC (2009) are:

- Evening (6 pm to 10 pm) – 40 dB(A).
- Night (10 pm to 7 am) – 35 dB(A).



Quakers Hill Water Resource Recovery Facility (WRRF)
Brine pipeline
NSOOS pipeline
Parks and open space
Logger locations
Noise catchment areas
Noise study area

Figure 6-22 NCAs and noise measurement

0 1 km

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024
Scale: 1:35,000 @ A4
GDA2020 MGA Zone 56

N

Table 6-30 Background noise levels (RBL) and construction NMLs for noise sensitive receivers

NCA	Highly noise affected	Standard hours $dBL_{Aeq(15min)}$		Outside standard hours dBL_{Aeq}						L_{AMax} Sleep disturbance screening level (L_{AMax} Awakening reaction screening level)
				Day (outside standard hours)		OOHW-1 Evening		OOHW – 2 Night		
		RBL	NML	RBL	NML	RBL	NML	RBL	NML	
Residential – 01	75	40	50	40	45	42	45	41	45	55 (65)
Residential – 02	75	39	49	39	44	43	44	45	44	54 (65)
Residential – 03	75	37	47	37	42	40	42	38	42	52 (65)
Residential – 05	75	38	48	38	43	38	43	35	40	52 (65)
Residential – 06	75	38	48	38	43	40	43	44	43	53 (65)
Commercial[1]	N/A	-	70	Non-residential receivers – NML applies when properties are in use						
Place of Worship[1]	N/A	-	45							
Educational facilities[1]	N/A	-	45							
Industrial[1]	N/A	-	75							
Active recreation[1]	N/A	-	65							
Passive recreation[1]	N/A	-	60							

1 – NMLs for these receivers apply in any NCA

Vibration - relevant criteria

The effect of vibration in buildings can be divided into 3 main categories:

- Human perception of vibration. This is when occupants or users of buildings are potentially disturbed by vibration.
- Effects on building contents. Some scientific equipment (such as microscopes or microelectronics) can require more stringent objectives than those applicable to human comfort. Where appropriate, these objectives should be sourced from the manufacturer or other published objectives. No receivers have been identified as containing any sensitive equipment. However, it is possible further consultation may identify receivers where this is relevant.
- Effects of vibration on structures. Vibration may cause damage ranging from cosmetic to major structural damage, where the integrity of the building or structure is affected. These criteria are typically well above the level of vibration people may consider intrusive.

A range of guidelines and standards specify vibration criteria and setback distances to manage annoying vibration and protect against cosmetic damage (including to sensitive building structures). These are outlined in Appendix K. Heritage items can be particularly vibration sensitive. There are 5 non-Aboriginal heritage items within 200 m of the brine pipeline impact assessment area. Section 6.8 provides more detail on these items, including the potential for vibration impacts.

6.10.1.4 Operational criteria

Operational project noise trigger levels (PNTLs) for the proposal shown in Table 6-31 were derived from the lower of the intrusive and amenity criteria following the EPA's 2017 Noise Policy for Industry (NPfI). Appendix K provides more detail about the intrusive and amenity criteria. The PNTLs apply to environmental noise emissions from operation of Quakers Hill WRRF after commissioning of the proposal. The brine pipeline is expected to generate negligible operational noise so is not assessed further. Sleep disturbance screening levels are also included in Table 6-31 and are based on the measured night-time RBL.

Table 6-31 Operational project noise trigger levels

Receiver	Period	Project noise trigger levels L_{Aeq}
NCA 01	Day	45
	Evening	45
	Night	43
NCA 02	Day	44
	Evening	44
	Night	43
NCA 03	Day	42

Receiver	Period	Project noise trigger levels L_{Aeq}
	Evening	42
	Night	42

6.10.2 Potential impacts – construction

The study area for the construction impact assessment includes the NCAs, which generally cover 500 m – 1 km from Quakers Hill WRRF and the brine pipeline as shown in Figure 6-22. Construction impacts are considered the worst-case based on the equipment likely to be used and assumptions that a range of noisy equipment will be operating at the same time.

6.10.2.1 Quakers Hill WRRF

Noise impacts

Estimated noise levels at the nearest sensitive receivers were predicted using SoundPLAN 9.1. The predicted noise levels at sensitive receivers were predicted based on 6 stages of construction:

- S1 – WRRF site establishment.
- S2 – secondary treatment upgrade.
- S3 – civil works.
- S4 – structure construction.
- S5 – mechanical and electrical installation.
- S6 – commissioning.

Both minimum and maximum noise levels are expected to exceed the standard hours NML shown in Table 6-30 for most stages. However, during all stages it has been predicted that noise levels will remain below the Highly Noise Affected recommended level (75 dB(A)). Table 6-32 outlines the maximum predicted noise level impacts at the most affected receivers during construction for residential and non-residential receivers. Site establishment is predicted to have the greatest noise impacts, and Figure 6-23 shows these predicted construction noise levels.

Appendix K includes the full suite of predicted construction noise contours for the above construction scenarios.

Table 6-32 Construction noise predictions at receivers

NCA / receiver type	NML standard hours	Maximum predicted noise level at most affected receivers during works, LAeq, 15 min (dB(A))					
		S1	S2	S3	S4	S5	S6
Residential receiver							
NCA 01	50	70	70	63	61	52	47
NCA 02	49	59	55	59	58	49	44
NCA 03	47	69	69	59	61	52	47
Non-residential receiver							
Commercial	-	81	81	59	57	48	43
Industrial	-	46	43	47	45	36	31
Passive recreational	-	62	62	61	62	53	48
Childcare	-	70	70	58	56	47	42

Construction traffic noise

While the overall traffic noise may be greater than the noise criteria for a local road, the contribution of the construction traffic to these noise levels remains below the 2 dB threshold identified in the ICNG (DECC NSW, 2009). Therefore, construction traffic noise impacts will be minimal.

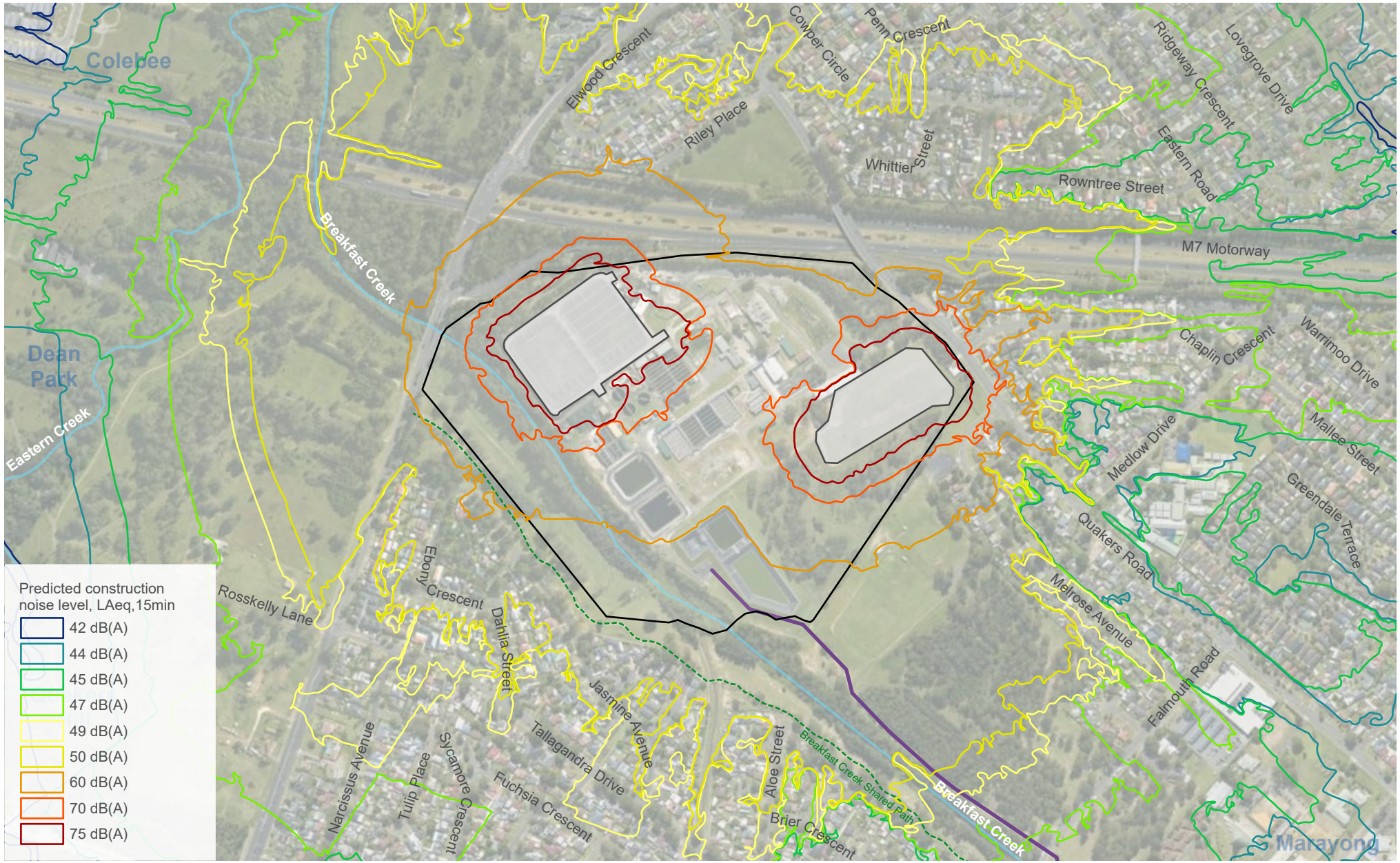


Figure 6-23 Predicted construction noise impact - site establishment

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:7,500 @ A4
GDA2020 MGA Zone 56

N

6.10.2.2 Brine pipeline

Noise impacts – pipeline construction

Noise predictions during construction were undertaken using an Excel-based noise estimator. Table 6-33 outlines the maximum potential noise level predicted at the nearest sensitive receivers in each NCA.

Sensitive receivers along the brine pipeline are predicted to experience noise levels above both the NMLs and the highly affected noise levels. In some locations, sensitive receivers are directly adjacent to the impact area. High noise emitting equipment is expected to be used, including excavator mounted hammers and rock breakers (117 dB(A)). However, as the pipeline works progress along the alignment, it is anticipated that the duration during which an individual receiver will experience the noise levels shown in Table 6-33 will be temporary as pipeline construction will progress at about 12 to 24 m per day.

During brine pipeline construction, earthworks and civil works are expected to have the highest noise levels, exceeding all NMLs and highly noise affected levels. Noise levels are expected to be between 107 – 113 dB(A).

Table 6-33 Predicted noise level at the nearest residential receivers during brine pipeline construction

NCA	NML dB(A)				Highly noise affected dB(A)	Predicted noise level at the nearest sensitive receiver, $L_{Aeq,\ 15\ min}$ dB(A)			
	SH	OOHW day	OOHW evening	OOHW night		OT_S1 –Earthworks and civil works	OT_S2 – Pipe installation	OT_S3 – Commissioning	OT_S4 – Landscaping and restoration
NCA 03	47	42	42	42	75	107	100	88	98
NCA 04[1]	-	-	-	-		-	-	-	-
NCA 05	48	43	41	40		113	106	94	104
NCA 06	48	43	43	43		113	106	94	104

Note 1: The pipeline in this NCA is proposed to be entirely constructed by horizontal direction drilling.

The noise impacts during construction for the brine pipeline are presented in Appendix D of Appendix K.

Noise impacts – compounds

The site compounds along the brine pipeline will have varying noise impacts. Due to the proximity of the nearest receivers and the use of equipment including loaders, bulldozers, drill rigs, excavator mounted hammers and rock breakers, the impacts will be:

- compounds C1, C2, C3, C5 are predicted to exceed all NMLs, however noise levels at the closest receiver will not exceed the highly noise affected levels

- compounds C4, C6 to C8, and C16 to C20 all exceed the NMLs and the highly noise affected levels at the nearest sensitive receiver
- compounds C9 to C11 and C13 are tunnelling compounds, and Table 6-34 outlines the noise impacts of these. All stages are predicted to exceed NMLs and most stages are predicted to exceed the highly noise affected levels, except for commissioning.

While noise impacts from construction compounds are generally limited in duration, it is acknowledged that some compounds will remain in place for extended periods, potentially several months. These locations may experience longer-term impacts compared to individual pipeline sections, which are typically subject to shorter construction durations as the location of the construction works moves.

Table 6-34 Predicted noise level at the nearest receiver to a tunnelling compound

Compound	NCA	NML dB(A)				Highly noise affected dB(A)	Predicted noise level at the nearest receiver, $L_{Aeq, 15min}$ dB(A) –				
		SH	OOHW day	OOHW evening	OOHW night		S1	S2	S3	S4	S5
C9	3	47	42	42	42	75	85	84	77	65	75
C10	4	-	-	-	-		47	46	40	27	47
C11	4	-	-	-	-		46	44	38	25	46
C13	3	47	42	42	42		89	87	81	68	78

Sleep disturbance

Construction will typically be during standard construction hours. However, tunnelling will potentially occur at any time of the day. Compound C9 and C13 are likely to have sleep disturbance impacts at the nearest sensitive receivers. Mitigation measures outlined in Table 6-37 should be implemented to manage the noise impacts.

Ground borne noise

Ground borne noise considerations apply to residential areas during evening and night-time hours and are not applicable to commercial properties. Ground borne noise levels are only relevant when they are both audible and exceed airborne noise levels from construction.

At night, residential receivers located within 50 m slant distance from the drilling and more than 100 m from the compound sites, may be at risk of sleep disturbance due to ground borne noise. Airborne noise is likely to exceed ground borne noise near tunnelling compound sites so receivers are likely to experience airborne noise rather than ground borne noise.

Construction traffic

Construction traffic associated with brine pipeline construction is highly unlikely to increase overall traffic noise by 2 dB. This is because most construction traffic will be on roads that carry significant traffic including M7 Motorway, Quakers Hill Parkway and Sunnyholt Road.

Vibration impacts

During construction, vibration-intensive equipment will be used that has the potential to cause impacts.

Where a receiver is located within the minimum working distance referenced in Appendix K, mitigation measures listed in Table 6-37 will be implemented to minimise vibration impacts to human comfort, cosmetic damage and heritage listed buildings.

6.10.3 Potential impacts – operation

The study area for assessing noise emissions from Quakers Hill WRRF during operations was about 500 m to the north, east and south of the site and 1 km to the nearest receivers to the west.

6.10.3.1 Quakers Hill WRRF

Table 6-35 outlines predicted noise levels at the upgraded Quakers Hill WRRF. The highest predicted noise levels under noise-enhancing conditions are up to 12-17 dB(A) higher than the nominal day PNTLs at the NCAs immediately near Quakers Hill WRRF. Within NCA 01, the loudest noise is predicted to be equipment within the AWTP area and the new blower room. At NCA 02, the AWTP and blower room are the primary contributors to noise levels, while at NCA 03, the dominant source is the brine transfer pumps located at the southern end of Quakers Hill WRRF site. These are all unmitigated noise impacts.

Table 6-35 Predicted operational noise impacts at residential receivers

NCA	Highest predicted noise level within NCA, $L_{Aeq, 15min}$ dB(A)		Project noise trigger levels, $L_{Aeq, 15min}$ dB(A)			Number of receivers over PNTL					
						Day		Evening		Night	
	Standard met condition	Noise-enhancing met. conditions	Day	Evening	Night	Standard met condition	Noise-enhancing met. conditions	Standard met condition	Noise-enhancing met. conditions	Standard met condition	Noise-enhancing met. conditions
NCA 01	54	57	45	45	43	62	119	62	119	102	152
NCA 02	55	57	44	44	43	54	62	54	62	58	65
NCA 03	56	59	42	42	42	118	167	118	167	118	167

Mitigated site noise levels

The operational noise assessment identified that noise levels from the proposal are likely to be greater than the PNTLs at NCA 01, NCA 02 and NCA 03 during all time periods. The following noise reduction measures were assessed to consider if PNTLs could be achieved:

- 3 mm steel acoustic enclosure for the major proposed pumps
- 25 mm acoustic lining on the new odour control unit stack
- selecting quiet equipment or acoustic louvers was assessed for the blower room.

Table 6-36 shows predicted noise levels with these mitigations applied.

Table 6-36 Predicted mitigated noise impacts at residential receivers

NCA	Highest predicted noise level within NCA, $L_{Aeq, 15min}$ dB(A)		Project noise trigger levels, $L_{Aeq, 15min}$ dB(A)			Number of receivers over PNTL					
						Day		Evening		Night	
	Standard met condition	Noise-enhancing met. conditions	Day	Evening	Night	Standard met condition	Noise-enhancing met. conditions	Standard met condition	Noise-enhancing met. conditions	Standard met condition	Noise-enhancing met. conditions
NCA 01	44	46	45	45	43	0	1	0	1	1	4
NCA 02	35	37	44	44	43	0	0	0	0	0	0
NCA 03	37	40	42	42	42	0	0	0	0	0	0

These mitigations (or similar equivalent mitigation) will reduce noise levels to below PNTLs in NCA 02 and NCA 03 during all times of day under both standard and meteorological conditions. In NCA 01, the noise impacts are greater than the day and evening PNTLs at a single receiver on Riley Place during noise enhancing conditions. This increases to 4 receivers experiencing noise greater than the night PNTLs. All receivers where levels above PNTLs are predicted are on the southern extent of Riley Place and Elwood Crescent.

These receivers were identified as experiencing noise greater than the PNTLs because of existing equipment. Due to the proximity of receivers to the M7 Motorway, it is highly likely that the background noise at these receivers is greater than the RBLs measured within the NCA, that were measured further back from the M7 Motorway. This would have a masking effect on the noise from Quakers Hill WRRF and would limit the actual impact from the works on these receivers.

6.10.3.2 Brine pipeline

The brine pipeline operation is not expected to generate any noise. Noise generated during operation will not exceed the noise criteria in the Noise Policy for Industry (EPA 2017).

6.10.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-37, impacts to noise and vibration can be adequately managed, and residual impacts are expected to be minor.

Table 6-37 Environmental mitigation measures — noise and vibration

Mitigation measures – noise	Timing
Continue to consult and coordinate with other major projects and utility providers that may be impacted during construction, or where cumulative impacts may occur	Pre-construction During construction
Works must comply with the *Interim Construction Noise Guideline* (DCCEEW 2009), including scheduling work and deliveries during standard daytime working hours of 7am to 6pm Monday to Friday and 8am to 1pm Saturday. No work to be scheduled on Sunday nights or public holidays. Any proposed work outside of these hours must be justified. The proposal will also be carried out in accordance with Sydney Water's Noise Management Procedure SWEMS0056. All reasonable and feasible noise mitigation measures should be justified, documented and implemented on-site to mitigate noise impacts.	During construction
Complete dilapidation and condition surveys on infrastructure and structures at risk from being damaged by vibration during construction, including heritage items.	Pre-construction During construction Post construction
Implement where feasible the following actions to manage noise from the HDD/tunnelling activities: • Select HDD equipment with the lowest possible noise emissions, and where available, use noise reduction features such as exhaust silencers and treated engine enclosures. • Identify and address any intrusive noise characteristics that may lead to complaints or penalties, with particular focus on the frequency and tonal qualities of HDD drive systems (e.g. low frequency noise and diesel engine tonality). • Install localised noise barriers around specific machinery, separate from broader noise control structures, where they can effectively reduce noise and are feasible given site conditions. • Implement efficient work practices to reduce the overall duration of HDD operations. • Provide advance notice to all potentially affected residents, informing them of planned works. Where possible, offer flexible scheduling options to minimise disruption to the local community. • Before starting tunnelling activities, revise noise modelling for the activities, including developing a more specific out of hours tunnelling scenario, to develop a more accurate understanding of OOHW noise impacts.	During construction

Mitigation measures – noise	Timing
• GBN levels can be significantly controlled by lowering the rotational speed where possible. • Consider opportunity to adopt HDD without vibration-assist. • Before starting tunnelling activities, where possible prepare the tunnelling compounds so the launch points are in the compound furthest from noise and vibration sensitive receivers.	
Address impacts from residual noise including the implementation of the following: • Appropriate notification to the community on the nature and duration of the works. • Negotiation for a community agreement for work scheduled outside the recommended standard hours. • For works to be conducted during night-time, the requirement for alternative accommodation or noise abatement measures should be evaluated in accordance with the number of nights where sleep disturbance is generated in any location. • If alternative accommodation is offered to provide respite from potential sleep disturbance, following consultation with affected individuals, but is declined, other feasible and reasonable mitigation measures must be explored. In such cases, some residual noise impacts may still occur despite all reasonable efforts to reduce them.	Pre-construction During construction
If works beyond standard daytime hours are needed (beyond those identified in this REF), the delivery contractor will: • justify the need for out of hours work (OOHW) and why it is not possible to carry out the works during standard daytime hours • consider potential noise impacts and implement the relevant standard daytime hours safeguards, follow Sydney Water's Noise Management Code of Behaviour (SWEMS0056.01) and document all reasonable and feasible management measures to be implemented • identify additional community notification requirements and outcomes of targeted community consultation • consult with residents that will be impacted by OOHW about measures to manage impacts in accordance with the ICNG, including considering alternative accommodation • seek approval from the Sydney Water Project Manager in consultation with the environment and community engagement representatives.	During construction
If night works are needed (beyond those identified in this REF), the delivery contractor will: • justify the need for night works • undertake noise and vibration impact assessments to determine the impacts associated with the work • consider potential noise impacts and implement the relevant standard daytime and out of hours safeguards and document consideration of all reasonable and feasible management measures • identify community notification requirements (i.e. for scheduled night work, not emergency works)	Pre-construction During construction

Mitigation measures – noise	Timing
• notify all potentially impacted residents and sensitive noise receivers not less than one week before starting night work • seek approval from the Sydney Water Project Manager in consultation with the environment and community engagement representatives.	
If works on Sundays or public holidays are required, the delivery contractor will: • justify why all other times are not feasible • consider potential noise impacts and implement relevant standard daytime, out of hours and night-time safeguards and other reasonable and feasible management measures • identify community notification requirements • seek approval from the Sydney Water Project Manager in consultation with the environment and community engagement representatives.	During construction
Select equipment to minimise noise emissions. For example: • Select equipment with lower noise emissions than alternative equipment. • Ensure equipment mufflers operate in a proper and efficient manner. • Use electric/hydraulic equipment where possible. • Use the minimum size and power requirement to complete a task.	Pre-construction During construction
Implement measures to reduce noise impacts including the following: • Develop and implement construction site layout plans as part of the CEMP. • Development of the plans should maximise the offset distance between noisy plant and adjacent sensitive receivers, including directing noise-emitting plant away from sensitive receivers. • Where possible, concentrate noisy activities at one location and move to another as quickly as possible. • Maximise the offset distance between the noisy plant and sensitive receivers. • Where possible, avoid the simultaneous operation of 2 or more noisy plants close to receivers. • Do not warm-up plant or machinery near residential dwellings before the nominated working hours.	Pre-construction During construction
Undertake in-situ vibration monitoring to confirm vibration levels and assess potential impacts where minimum vibration impact distances cannot be achieved. Where the monitoring identifies exceedances in the relevant criteria, or where impacts are identified, additional management measures will be identified and implemented to appropriately manage impacts Monitor compliance with the recommended vibration levels in DIN 4150-3 1999: Structural Vibration – Part 3; Effects of vibration on structures	Pre-construction During construction
Manage noise from reversing vehicles, including the following: • Implement and use non-tonal reversing beepers (or an equivalent mechanism) on all construction vehicles and mobile plant, where possible. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level. • Plan traffic flow, parking and loading/unloading areas to minimise reversing movements.	During construction

Mitigation measures – noise	Timing
Regularly train workers and contractors (such as at toolbox talks) to use equipment in ways to minimise noise, including the following: • Site managers to periodically check the site and nearby residences for noise problems so that solutions can be quickly applied. • Avoid the use of radios or stereos outdoors. • Avoid the overuse of public address systems. • Avoid shouting and minimise talking loudly and slamming vehicle doors. • Turn off all plant and equipment when not in use. • Maintain and monitor equipment to ensure proper and efficient operation. • Scheduling noisy activities around times of surrounding high background noise (local road traffic or when other noise sources are active).	During construction
Implement measures to address construction traffic noise, including the following: • Schedule construction traffic movements to avoid night periods and other sensitive times. • Revise vehicle routes and scheduling to reduce heavy vehicle traffic along roads predicted to experience construction traffic noise impacts. • Avoid the use of compression brakes. • Ensure vehicles are adequately silenced before leaving or accessing the proposal area.	During construction
Complete routine monitoring to evaluate construction noise levels and evaluate whether the mitigation measures in place are adequate or require revision	During construction
Undertake measures to manage vibration from construction activities, including the following: • Investigate opportunities for using alternatives to vibration generating equipment where vibration impacts have the potential to occur. • Use electric/hydraulic equipment where possible. • Use the minimum size and power requirement to complete a task. • Maximise the offset distance between the vibration-intensive plant and sensitive receivers. • Consider less vibration intensive methodologies where practicable and use only the necessary sized and powered equipment.	During construction
Implement physical noise mitigation for construction activities near sensitive receivers, including the following: • Construct temporary barriers or hoarding between noise-intensive works and receivers to decrease line-of-sight noise impacts. • Where practicable, install enclosures around noisy mobile and stationary equipment as necessary.	During construction

6.11 Air quality

Appendix L includes an odour and air quality impact assessment completed for the proposal. This section summarises key findings of that assessment.

6.11.1 Existing environment

6.11.1.1 Quakers Hill WRRF

The existing air quality environment around the proposal is described below in terms of local sources of air emissions, background air quality and local meteorology.

The nearest sensitive receivers are located about 120 m south of the proposal. The closest non-residential receiver is Quakers Hill Public School which is about 300 m east of the proposal. Figure 6-24 shows the nearest residential and non-residential receivers around Quakers Hill WRRF in every direction, with 'RR' and 'NR' labels respectively.

The existing odour environment at Quakers Hill WRRF was characterised by reviewing recent odour impact assessments of the site and Quakers Hill WRRF complaints register. A previous odour impact assessment identified the WRRF as a 'high risk odour plant, based on the 2-odour unit (OU) contours predicted to extend into residential areas'. An updated assessment (Stantec 2019) indicated the 2 OU was predicted to reach only the sensitive receivers to the north in worst-case scenarios, not the wider area as indicated by the ENSure, 2016 assessment.

Since 2010, 11 odour-related complaints have been recorded at Quakers Hill WRRF. The most recent complaints in 2023 and 2024 were from locations about 200 to 500 m west and south-west of the WRRF.

6.11.1.2 Brine pipeline

The closest sensitive receivers are at varying distances from the brine pipeline's impact assessment area. In some areas the impact assessment area extends up to the property boundary of residential receivers.

6.11.1.3 Other air emission sources

A search of the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW's) NPI database and the EPA's EPL register, identified 5 other existing nearby sources of air emissions within about 3 km of the proposal:

- VIP Seven Hills
- Snack Brands Australia Blacktown
- IXOM Kings Park
- Pacmetal Services
- VIP Seven Hills.

6.11.1.4 Background air quality and meteorology

Background air quality concentrations at the nearby Rouse Hill and Prospect DPHI air quality and meteorological stations were recorded as generally meeting the EPA's impact assessment criteria between

2020 and 2024. The 24-hour averaged PM_{10} and $PM_{2.5}$ concentrations occasionally exceeded the EPA impact assessment criteria, particularly during the 2020 bush fire season. There were no recorded exceedances of the 24-hour averaged criteria in 2024 (the most recent complete calendar year).

Meteorological conditions influence the direction and rate at which air emissions from a source would disperse. The prevailing local winds are predominantly from the north in autumn, winter and spring, and from the east north-east in summer.

6.11.2 Potential impacts – construction

During construction, dust is expected to be the primary air quality impact with potential to impact sensitive receivers. Dust will potentially be generated during construction, particularly from earthworks, demolition and open trenching. Without mitigation, there is a high potential for nuisance dust impacts along trenched sections of the brine pipeline and a low or negligible potential for other proposal components. The brine pipeline will be constructed progressively which means potential dust impacts at a single location will generally be limited and temporary.

Construction will also involve the use of equipment and machinery which will generate exhaust emissions but these will be minimal and unlikely to have any material or noticeable effect on air quality.

During construction, there will be additional construction traffic associated with Quakers Hill WRRF and brine pipeline works. It is expected that this additional traffic will be negligible compared to existing conditions and will not result in concentrations exceeding the applicable EPA impact assessment criteria.

Construction activities are not expected to generate odour. The only potential risk identified is if unexpected contaminated materials are exposed and generate odour. Works at Quakers Hill WRRF will be managed to avoid impacting existing odour controls.

With the implementation of the proposed mitigation measures, residual air quality from dust emissions will be negligible.

6.11.3 Potential impacts – operation

6.11.3.1 Quakers Hill WRRF

During operation, the main potential air quality related impact is any change to odours resulting from modifications to the existing infrastructure at Quakers Hill WRRF and new infrastructure to be constructed for the proposal. As outlined in section 3.3, the proposal includes odour control of new odour sources and this has been factored into the assessment. The odour sources identified included:

- existing sources such as the odour control unit, pumping station, inlet works, grit/screenings, and primary and secondary treatment processes
- new sources such as a new odour control unit and MBR.

Changes in operational odour at sensitive receivers around Quakers Hill WRRF from the proposal were quantitively assessed using air pollution dispersion modelling (CALPUFF version 7). The modelling considers the odour impacts from Quakers Hill WRRF in its entirety, not just the changes from the proposal. Modelling determined that the 99th percentile, 1-hour averaged ground-level odour concentrations from the upgraded Quakers Hill WRRF site will exceed the EPA's 2 OU impact assessment criterion at nearby

sensitive receivers within about 200 to 400 m of the WRRF. This is shown in Figure 6-24. The prior odour assessment of Quakers Hill WRRF in 2016 also predicted that the 2 OU contour will extend beyond the site boundary, so odour from existing operations already exceeds the criterion and this exceedance is not just attributable to the proposal.

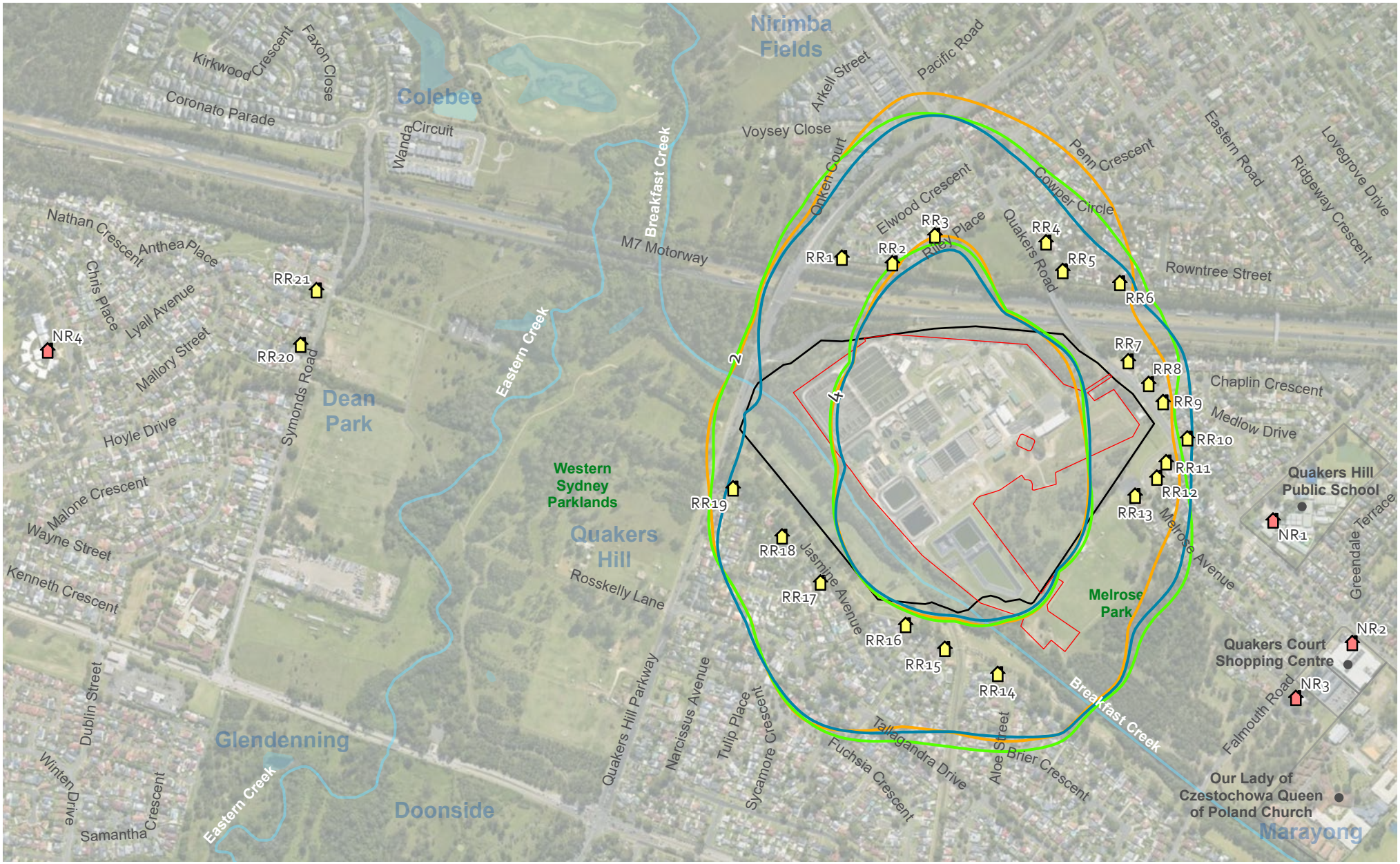
Sensitivity reviews were completed for key odour sources, to identify opportunities to reduce odour impacts. Given odour control is already proposed for key odour sources from the proposal, the main opportunity identified related to existing operations. This proposes to redirect emissions from the existing pump station vents via the new odour control unit. Modelling of this opportunity determined that the 99th percentile, 1-hour averaged 2 OU odour contour was still predicted to extend into the surrounding residential areas. However, its extent would reduce by around 90 to 130 m, particularly to the north and south. With this redirection of pump station emissions, it was estimated that odours from the upgraded plant would not materially differ from existing operations.

Figure 6-25 shows un-mitigated odour contours and mitigated odour contours (with the above redirection of pump station vents) for Quakers Hill WRRF. The green and blue lines represent the 2 OU contour around Quakers Hill WRRF following the WRRF upgrade without and with mitigation respectively. ‘2014’ in the legend refers to the meteorological year applied in the model.

The opportunity to redirect emissions from the existing pump station vents to the new odour control unit is not part of the proposal scope as it relates to existing WRRF components. However, Sydney Water is separately investigating an operational project to redirect these emissions to the existing or new odour control unit.

6.11.3.2 Brine pipeline

Operation of the brine pipeline will have negligible air quality impacts as there are no sources of dust generation or odour.



Quakers Hill WRRF

WRRF impact area

Residential receiver

Non-residential receiver

Ground level odour concentration (odour units)

2013 meteorology

2014 meteorology

2015 meteorology

Figure 6-24 99th percentile odour results, upgraded Quakers Hill WRRF

0 200 m

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024

Scale: 1:10,000 @ A4
GDA2020 MGA Zone 56

N

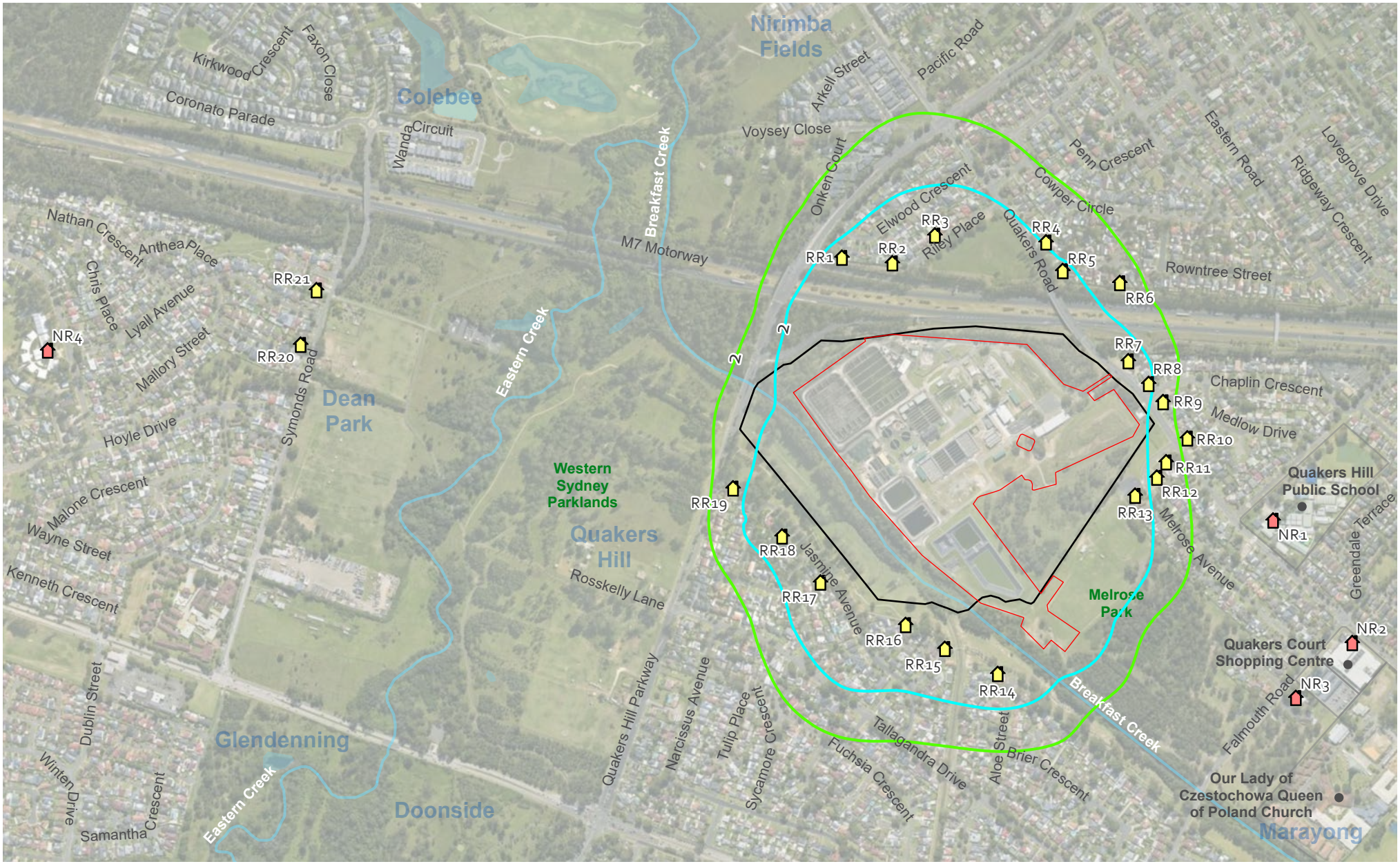


Figure 6-25 Comparison of mitigated results (redirection of pump station emission vents to OCU) and unmitigated results (using 2014 meteorology)

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2024
Scale: 1:10,000 @ A4
GDA2020 MGA Zone 56

6.11.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-38, impacts to air quality can be adequately managed, and residual impacts are expected to be low.

Mitigation measures in other sections of this REF (e.g. soils and contamination) will also contribute to mitigating air quality risks.

Table 6-38 Environmental mitigation measures — air quality

Mitigation measures	Timing
As part of the proposal's CEMP, develop an air quality management plan (AQMP) and implement measures to minimise air quality impacts during construction, with the objective of no unacceptable adverse changes in air quality at surrounding sensitive receptors. The AQMP must: • identify the main sources of dust and airborne pollutants, and the location of sensitive land uses • set out how when and by whom the proposal will control the emission of dust, exhaust emissions, fumes, odour and other pollution into the atmosphere during construction in accordance with relevant statutes, policies and guidelines • outline processes for reviewing and updating the plan and implemented controls in response to proposal changes, changes to conditions, monitoring results or enquiries/complaints.	Pre-construction
Maintain equipment in good working order, comply with the POEO Clean Air Regulation, have appropriate exhaust pollution controls, and meet Australian Standards for exhaust emissions.	During construction
Switch off vehicles/machinery when not in use.	During construction
Implement measures to prevent offsite dust impacts, including the following: • Water exposed areas (using non-potable water source where possible such as water from excavation pits). • Cover exposed areas with tarpaulins or geotextile fabric. • Modify or cease work in windy conditions. • Modify site layout (place stockpiles away from sensitive receivers). • Vegetate exposed areas using appropriate seeding.	During construction
Cover all transported waste.	During construction
No burning of trimmed and cleared vegetation	During construction
Implement appropriate site speed limits along any unsealed access routes	During construction
Apply odour suppressing agents to materials as necessary to minimise related impacts should any contaminated or hazardous materials be uncovered during the works	During construction

6.12 Traffic and access

Appendix M includes a traffic and transport assessment completed for the proposal. This section summarises key findings of that assessment.

6.12.1 Existing environment

The study area for the traffic and transport impact assessment includes the roads that provide access between the construction sites and the nearest main road. It also includes associated transport facilities (e.g. parking, active transport, heavy vehicle and public transport networks). It spans across Quakers Hill, Marayong, Blacktown and Lalor Park. Figure 6-26 shows the study area and key road classifications. Traffic counts were undertaken to understand current traffic demands, conditions and travel patterns. All other existing traffic conditions were qualitatively assessed.

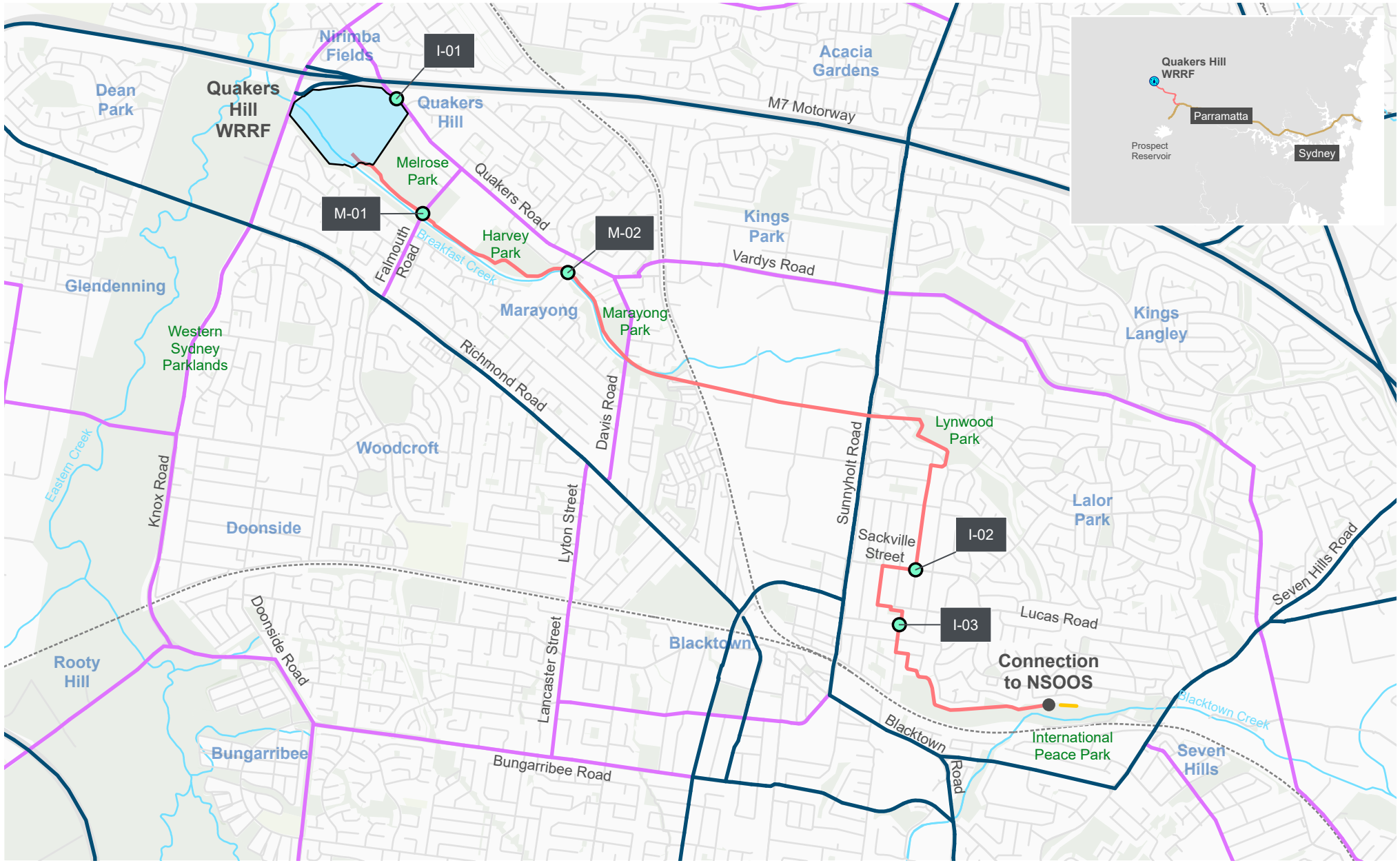


Figure 6-26 Key roads and survey locations

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:35,000 @ A4
GDA2020 MGA Zone 56

6.12.1.1 Traffic counts

Traffic counts were undertaken in locations where lane closures may affect nearby roundabouts, signalised intersections, sight lines or bus stops. Traffic counts were also undertaken at the entrance to Quakers Hill WRRF given the high number of construction vehicles that will access this site.

Midblock traffic counts were undertaken at Falmouth Road and Breakfast Road in Marayong. Intersection counts were undertaken at:

- Quakers Road/Quakers Hill WRRF Site Access, Quakers Hill
- Sackville Street/Mort Street, Blacktown
- Gordon Street/Sydney Street/ Boyd Street, Blacktown.

These counts identified morning peaks between 8 and 9 am and afternoon peaks varying between 3 and 6 pm depending on the location. The highest total daily volumes were recorded on a Wednesday at the mid-block count locations. However, the hourly volumes during peak periods were generally consistent across weekdays.

6.12.1.2 Speed limits

Where construction impacts are proposed in roads along the brine pipeline alignment, the posted speed limits are generally 50 km/h, with several posted as 60 km/h including Quakers Road and Quakers Hill Parkway. There are also school zones on Sunnyholt Road, Sackville Street and Wheeler Street.

6.12.1.3 Active transport

There are footpaths and pedestrian crossings throughout the study area, along with several established walking and cycling routes. The Great West Walk is a 140 km walking route from Parramatta to Katoomba. The brine pipeline alignment, west of Davis Road will largely be along Breakfast Creek, which has an adjacent shared use path that forms part of the Great West Walk. The path along Breakfast Creek also connects to the shared use path within the Western Sydney Parklands, designated on-road cycling facilities on local roads within Marayong (e.g. Noel Street) and the shared use path on Richmond Road. A shared use path is provided along Sunnyholt Road in the north-south direction and along Devitt Street and Blacktown Creek (forms part of the Great West Walk) in the east-west direction.

The parking lane along Sackville Street and Wheeler Street is also available for cycling generally in the east-west direction.

The following locations are expected to experience high pedestrian activity around the brine pipeline impact assessment area:

- Skate park in Harvey Park, south of Benalla Crescent, Quakers Hill
- Breakfast Road, north of St Andrew The Apostle Catholic School, Marayong
- Lynwood Park in Blacktown.

6.12.1.4 Public transport

Sixteen bus services were identified as operating within the study area. These typically run between 5 am and 10 pm on weekdays and 8 am and 8 pm on weekends. Bus frequency varies between services, but they typically operate with 30-minute gaps on weekdays and 1-hour gaps on weekends. There is one night service bus that operates between 1 am and 5:30 am.

6.12.1.5 Heavy vehicles

During construction, restricted access vehicles (RAV) will likely be required. RAVs are vehicles exceeding the General Access Vehicle limit of 19 m long and 2.5 m wide (i.e. a semi-trailer dimension). This includes B-Double vehicles up to 26 m long. Within the impact assessment area there are existing RAV routes to accommodate heavy vehicle movements.

Within the study area, RAVs are permitted to travel on the Westlink M7 Motorway, Richmond Road, Knox Road, Sunnyholt Road, Fourth Avenue, Third Avenue, Blacktown Road, Wall Park Avenue and Prospect Highway.

6.12.1.6 Crash data

Crash data analysis was undertaken for the road network within about 150 m of the proposed site compounds and brine pipeline impact assessment area as these roads will be impacted most by the proposed construction works. Crash data between 2019 and 2023 was analysed. Overall, 67 crashes were reported including a fatality, 27 injury crashes and 39 tow-away crashes. The fatality crash reported occurred on Quakers Road east of Arnott Road, which was a mid-block crash involving vehicle losing control.

6.12.2 Potential impacts – construction

Construction related traffic impacts will be generated by light and heavy vehicles used by construction personnel accessing the impact assessment area including Quakers Hill WRRF, various entry points along the brine pipeline, site compounds and laydown areas as shown in Figure 3-2. Heavy vehicles will also access site compounds for deliveries and to collect waste. The brine pipeline will be in open space areas where possible to minimise traffic impacts on local roads. Table 6-39 outlines the estimated peak traffic movements for light and heavy vehicles during construction.

Table 6-39 Indicative construction traffic generated by the proposal

Location	Likely route	Estimated peak daily movements	
		Light vehicles	Heavy vehicles
Quakers Hill WRRF	Quakers Road	100	78
Brine pipeline	Western section: M7 Motorway, Quakers Hill Parkway and Quakers Road Central section: M7 Motorway, Sunnyholt Road and Vardys Road	50	8

Location	Likely route	Estimated peak daily movements	
		Light vehicles	Heavy vehicles
	Eastern section: M7 Motorway and Sunnyholt Road		

Light vehicle trips for construction workers will mostly occur outside peak traffic times. However, for a conservative assessment, these were assumed to happen during peak hours. Heavy vehicle movements will be evenly spread throughout the workday, with a few trips expected during peak hours.

6.12.2.1 Quakers Hill WRRF

Construction at Quakers Hill WRRF will not require any road closures. It will not have any impacts on property access, public transport, active transport or road capacity. Construction traffic and parking impacts are assessed below.

Construction traffic

Quakers Hill WRRF site is expected to generate the largest number of traffic movements during construction. Access will be via the existing WRRF access point on Quakers Road. From there, vehicles can connect to Quakers Hill Parkway then access the M7 Motorway or continue southbound to connect to Richmond Road and Doonside Road.

Intersection modelling at the Quakers Road and Quakers Hill WRRF access road intersection shows it currently operates satisfactorily, achieving level of service (LoS) C or better during weekday morning and afternoon peak hours. Modelling shows that with the addition of the proposal's construction traffic, the intersection will experience some minor additional delays but will continue to operate satisfactorily with LoS D or better.

Parking

Car parking will be provided for construction workers within Quakers Hill WRRF. Existing parking areas will be designated for worker use, and additional parking on greenfield areas within the WRRF could be made available if necessary. During peak periods, overflow parking at Blacktown City Council's Melrose Avenue carpark could provide 27 extra spaces if needed.

6.12.2.2 Brine pipeline

Brine pipeline construction will occur throughout the entire construction phase, with work likely to be staggered across different sections of the proposal alignment. Appendix M provides a detailed assessment of traffic impacts along 12 different sections of the brine pipeline. These impacts are summarised below.

Construction traffic

As shown in Table 6-39, a smaller volume of construction traffic will be generated for the brine pipeline compared with Quakers Hill WRRF. Construction routes will primarily be along Quakers Road and connecting streets between Quakers Hill Parkway and Sunnyholt Road. East-west roads like Dunstable Road and Sackville Street connect site compounds and work sites to Sunnyholt Road, while north-south roads will be impacted by the pipeline alignment or used for access.

Road capacity

The proposed open trenching will require temporary lane closures, with traffic control in place to manage traffic movements. Open trenching typically progresses at about 12 to 24 m per day under standard conditions, which means lane closures will be short-term. Road closures will be partial and a contra-flow arrangement will be implemented to allow 2-way traffic to alternate under traffic control. Alternatively, if a suitable detour route is available, lane closures will be implemented with access restrictions for general traffic, only allowing residents. Sydney Water will consult with the relevant road authority about lane closures and obtain relevant approvals. Table 6-40 outlines the closures expected during construction.

Table 6-40 Road closures

Road name / location	Closure description
Falmouth Road	Lane closure while trenching across road. To maintain traffic flow, a contra-flow arrangement will be implemented, allowing northbound and southbound traffic to move alternately under traffic control.
Breakfast Road	Lane closure while trenching across road.
Gate Road	Lane closure for HDD/tunnelling compounds. Two-way access to properties to be maintained to address issues raised during consultation with businesses in this area.
Venn Avenue	Lane closure while trenching across road
Stephen Street	Lane closure while trenching across road
Dunstable Road	Lane closure while trenching across road
Mort Street	Lane closure while trenching across road
Cambridge Street	Lane closure while trenching across road
Sackville Street	Lane closure while trenching across road
Sarsfield Street	Lane closure while trenching across road
Cardiff Street	Lane closure while trenching across road
Gordon Street and Sydney Street intersection	Full closure of intersection while trenching along road. Given availability of potential detours, the closure is expected to have minor impacts.
Boyd Street	Lane closure while trenching across road
Baker Street	Lane closure while trenching across road
Winifred Crescent	Lane closure while trenching across road

Traffic modelling was completed for 3 locations, including Falmouth Road, Breakfast Road and Sackville Street. Modelling was only completed for these 3 locations due to the existing traffic demand, available road width and construction methodology. All other roads impacted by the proposal, are expected to have minimal impacts and can be managed in accordance with the mitigation measures outlined in Table 6-41.

The traffic modelling results indicate the following:

- Falmouth Road - open trenching across Falmouth Road during the weekday AM and PM peak hours will result in significant delays and queuing. The queues would potentially disrupt traffic in the area. LoS will be F, with queue lengths likely to extend beyond 490 metres.
- Breakfast Road - traffic will be satisfactorily managed during AM and PM peak hours during open trenching on Breakfast Road, achieving a LoS C or better. Southbound queues may extend to 124 m and could potentially impact the signalised intersection at Quakers Road and Breakfast Road, as well as school drop offs at St Andrew's the Apostle Catholic School.
- Sackville Street - traffic will be satisfactorily managed during AM and PM peak hours during open trenching on Sackville Street, achieving a LoS C. However, both eastbound and westbound queues on Sackville Street are projected to extend beyond the nearby roundabout intersections at Sackville Street/Stephen Street and Sackville Street/Harold Street, which is located about 85 m from Mort Street. This may interfere with traffic operations at these intersections as well as the surrounding road network.

Property access

As construction of the brine pipeline progresses, open trenching will be required across some driveways. This includes residential properties and businesses. Although it is preferred that access be constantly maintained to all properties, there may be brief periods where driveway access will be unavailable.

During open trenching, impacts to property access will be experienced by some properties on Dunstable Road, Mort Street, Cambridge Street, Sackville Street, Sarsfield Street, Cardiff Street, Boyd Street, Baker Street and Winifred Crescent in Blacktown. The mitigation measures in Table 6-41 describe how Sydney Water will consult with residents about property access arrangements before construction. Residents along the brine pipeline may also experience reduced accessibility due to lane closures where the pipeline needs to be trenched across or along a road corridor.

Parking

Construction vehicles for the brine pipeline will park on local roads near work areas, with additional off-street parking at compounds where possible. Parking on local streets will reduce on-street parking availability and increase demand. The open trenching sections on local streets will impact on-street parking on both sides of the road to maintain 2-way traffic flow. The number of kerbside parking spaces impacted by open trenching will vary daily. Where trenching is across a road, parking spaces will likely be reduced by about 4 spaces.

Overall, the impact to on-street parking is minor, as the works are temporary and most of the alignment runs along residential streets with ample unrestricted parking and low demand.

The site compounds will have the following parking impacts:

- Site compound C1, C2, C3, C4 to C6 is expected to provide construction vehicle parking. However parking around C1 within Melrose Park and on street parking on Falmouth Road for C2 and C3 is likely to be required.
- Around compound C7 and C8, on street parking for construction vehicles is likely on Breakfast Road. Breakfast Road provides unrestricted kerbside parking along its length. As there are low occupancy levels on-street parking of construction vehicles is not expected to result in any significant impacts.
- Around compound C9 and C10, construction vehicles are likely to use on street parking along Gate Road and Bessemer Street. There is a high demand for on-street parking on Gate Road and Bessemer Street. Impacts to on-street parking are likely to be moderate.
- Compound C13 will temporarily remove about 60 parking spaces in Lynwood Park car park, that provides about 135 parking spaces. The removal of car parking spaces is likely to have a moderate impact to the community during sporting events. Alternative construction parking is likely required during sporting events.
- Partial occupation of the Blacktown Aquatic Centre car park is proposed to allow for a site compound (C9). Up to 50% of the car park will be temporarily occupied during construction.
- Existing car parking spaces at International Peace Park will be maintained, however its access may experience minor interruptions during work with compound C20 proposed to be set up nearby.

Public transport

Six bus routes will be potentially impacted by the proposal on Sackville Street, Sydney Street, Gordon Street, Stephen Street and Davis Road. Bus routes 705, 711, 752, 753 and N71 will be maintained with traffic control where required and no detours are expected. Bus route 743 may be temporarily impacted by road closures on Sackville Street, Sydney Street, Gordon Street and Stephen Street. Buses will be detoured, and customers will need to use alternative existing bus stops outside the lane closures and temporary bus stops may be installed.

Where bus detours or temporary bus stops are required, the measures outlined in Table 6-41 will be implemented to minimise impacts to bus operators and customers.

Active transport

The impacts on active transport are anticipated to be minor and temporary in nature. Mitigation measures such as temporary diversions will be needed on footpaths near construction sites to provide pedestrians safe access around the work area.

Existing on-road cycling facilities including dedicated bicycle lanes, bicycle lanes shared with parking lanes, and quietway/mixed traffic areas will also require traffic control to ensure safe movement around the construction site. This may include introducing a speed limit reduction around the proposal and ensuring existing road pavements are suitable for cyclists.

The proposal is likely to temporarily impact the following shared paths:

- The refuge on Falmouth Road and Breakfast Creek will likely be temporarily closed during construction as the proposal will go through it.

- The shared path in Harvey Park north of Breakfast Creek will likely be temporarily closed as the pipeline follows the shared path alignment.
- The shared path along the northern side of Breakfast Creek will likely be closed to ensure no interaction between the public and work area.
- Shared paths in Marayong Park north of Breakfast Creek will likely be closed during construction to ensure no interaction between the public and construction.
- Full closure of the shared path at the International Peace Park is likely required to separate people walking and cycling from construction.

Emergency access

A minimum 3 m wide emergency access is generally required at all times by road authorities during any type of road closures. The contractor is expected to comply with this access requirement by road authorities. With priority always given to emergency access, the impacts on emergency access are anticipated to be negligible.

6.12.3 Potential impacts – operation

6.12.3.1 Quakers Hill WRRF

There will be 4 additional workers at Quakers Hill WRRF during operation and some additional movements for deliveries and maintenance. These will generate minor additional trips and are considered negligible in terms of road network operation. There will be no impact on parking, property access, public transport or active transport during operation.

6.12.3.2 Brine pipeline

Following completion of the brine pipeline, the road network and associated capacity will be reinstated to pre-construction condition. This means there will be no impact to the road network capacity, parking, property access, public transport or active transport.

6.12.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-41, impacts to traffic and access can be adequately managed, and residual impacts are expected to be low.

Table 6-41 Environmental mitigation measures — traffic and access

Mitigation measures	Timing
Refer to section 5.6 of Appendix M for additional specific issues to be considered in developing the plans and consultation approaches required by the mitigation measures below.	Detailed design Pre-construction
Develop a Construction Traffic Management Plan (CTMP) and associated Traffic Guidance Scheme (TGS) in consultation with the relevant road authorities, to be implemented by licensed traffic management contractors. Obtain necessary road occupancy licences and road related work approvals before starting relevant works (including site access and access tracks).	Pre-construction

Mitigation measures	Timing
The CTMP will detail the implementation plan proposed for the construction works and enable a consultation process with stakeholders and road authorities to mitigate and plan response strategies for any residual risks. The CTMP will include: • confirmation of construction routes associated with construction compounds through the preparation of Vehicle Movement Plan (VMP) • details of activities of adjoining land uses and awareness of public safety measures (e.g. school zones and high pedestrian activity areas) to provide guidance to drivers of construction vehicles travelling to and from proposal locations. • measures to maintain access to local roads and properties • site specific traffic control measures (including signage) to manage and regulate traffic movement • measures to maintain pedestrian and cyclist access • requirements and methods to consult and inform the local community of impacts on the local road network • relevant approvals for any potential works in the road corridor and access by restricted access vehicles required for the proposal • access to construction sites including entry and exit locations and measures to prevent construction vehicles from queuing on public roads • a response plan for any construction traffic incident • consideration of other nearby developments under construction to minimise cumulative impacts.	
Consult with Blacktown City Council, affected residents and businesses before construction works to ensure the work area can be set up for construction and concerns from residents are addressed beforehand. This includes consulting with council about impacts on its existing parking areas such as Melrose Park, International Peace Park, Blacktown Aquatic Centre and Lynwood Park.	Pre-construction
Obtain prior approval from Transport for NSW (TfNSW) for any works in public roads within 30 m of traffic signals.	Pre-construction
Obtain prior approval from TfNSW for tunnelling works within the rail line corridor.	Pre-construction
Consult with the relevant road authority to manage potential impacts on pedestrian traffic, signposting, parking meters, line marking, and parking. Additionally, confirm whether traffic control measures or pavement restoration will be required	Pre-construction During construction
Where road closures are likely to result in a significant traffic impact (e.g. short-term full road closure and long-term temporary lane/road closures), consult with potentially affected stakeholders (e.g. landowners, emergency services, transport services) and relevant approval(s) obtained from the relevant roads authority. Where feasible, plan temporary road closures to occur outside of the traffic peak periods to minimise impacts to the road network.	Pre-construction During construction
Clearly identify in the CTMP any specific road segments that should be avoided by construction vehicles. Communicate these restrictions to all construction personnel and delivery drivers before starting works. Inform construction workers and delivery drivers about areas with a history of crashes, especially along designated construction vehicle routes.	Pre-construction During construction

Mitigation measures	Timing
Identify any impacts to bus routes and bus stops in the CTMP including how they will be managed with the operator (including Busways) and communicated to customers.	Pre-construction During construction
Develop and implement an appropriate journey management policy incorporating considerations such as driver behaviour, road safety and fatigue management.	During construction
Provide off-street parking in Quakers Hill WRRF. Where it is possible, provide off-street parking spaces in larger site compounds along the pipeline alignment to minimise the impact to the surrounding streets. Where it is not possible, park construction vehicles on-street surrounding the work area.	During construction
To mitigate impacts to temporary closures of shared paths: • Consider carrying out works will be carried out at night-time to minimise impacts of the temporary closure of the refuge. • Identify alternative walking and cycling routes during temporary closures, to maintain connections for school students and residents between Falmouth Road and Breakfast Road and Breakfast Road and Davis Road. • Consult with local bicycle groups where available. Pedestrian and bicycle paths around construction will be considered in the preparation of CTMP and TGS.	During construction
Maintain a minimum 3 m wide emergency access at all times. Notify local emergency services of traffic changes as required by road authorities.	During construction

6.13 Waste and hazardous materials

Appendix N includes a waste management impact assessment completed for the proposal. This section summarises key findings of that assessment.

6.13.1 Existing environment

Sydney Water's corporate objectives include to be a resource recovery business with an increasing portfolio of circular economy products and services. This includes reducing waste through recycling, reuse, and encouraging our suppliers to minimise waste.

The proposal is located close to the main waste management facilities servicing the Sydney metropolitan area. There are 16 waste management facilities licensed to handle waste within 10 km of the proposal for all types of waste streams being generated. The closest waste facilities are Cleanaway Industries, Marsden Park Landfill and Glendenning liquid waste facility.

6.13.1.1 Quakers Hill WRRF

The proposal plans to reuse 2 existing stockpiles at Quakers Hill WRRF to minimise the need for importing spoil and re-use what would otherwise be considered waste. These stockpiles were discussed in section 6.2.1 and are:

- a stockpile of about 10,000 m^3 north of the car park. It contains asbestos and if it were to be disposed off-site it would be classified as special waste (asbestos).
- stockpile QHSP01 of about 36,000 m^3 in the north-eastern part of the site, adjacent to the PRW Discovery Centre. As asbestos was recorded in one of the samples analysed from this stockpile it would be classified as general solid waste (non-putrescible) plus special waste (asbestos) if it were to be disposed off-site.

Other waste relevant at Quakers Hill WRRF is the infrastructure contained in the decommissioned IDALs. These include 2 lined earthen walls ponds (80 m by 117 m) with aeration pipework, associated walkways, external walls covered with concrete mattress, internal walls covered with polyethylene liner, drainage pipes and sub soil layers. As discussed in section 6.2.1.2, there is potential for the waste from demolition of the IDALs to be contaminated from wastewater leakage. Whether this has occurred can only be determined during demolition. Testing of the IDAL demolition waste would therefore be required to determine its waste classification.

6.13.1.2 Brine pipeline

As discussed in section 6.2.1.2, asbestos was detected in fill sampled near the brine pipeline within Billy Goat Hill Reserve. Further investigations are needed to assess the presence and spatial distribution of asbestos along the brine pipeline at Billy Goat Hill Reserve. Asbestos containing material excavated from this area during trenching of the brine pipeline would require off-site disposal and has been assigned a preliminary waste classification of general solid waste (non-putrescible) including special waste (asbestos).

Based on the results of the soil samples taken elsewhere along the brine pipeline, material excavated during trenching of the pipeline and the HDD launch and retrieval pits would be suitable for reuse within the construction extents (e.g. backfilling of the trench and pits).

6.13.2 Potential impacts – construction

6.13.2.1 Quakers Hill WRRF

Table 6-42 outlines the waste classifications and estimated quantities of waste generated during construction of the proposal that would require off-site disposal. It excludes materials that would be reused on site such as the existing stockpiles at the WRRF that are proposed to be used to backfill the IDALs, and excavated material that is suitable for backfilling of the trench and HDD launch and retrieval pits for the brine pipeline.

Table 6-42 Construction waste classification and estimated quantities

Waste classification or Resource Recovery Order	Waste stream	Waste description	Location	Estimated quantity
Special waste	Tyres	Used construction vehicles and plant tyres	AWTP Secondary treatment plant upgrade site C1, C19, C20 – Main	2.3 t
	Fill material contaminated with asbestos	Fill material excavated during trenching of the brine pipeline through Billy Goat Hill Reserve	Billy Goat Hill Reserve. Further investigations are needed to assess the presence and spatial distribution of asbestos within and around the reserve.	A quantity can only be estimated once the spatial distribution of asbestos contamination is known
Liquid waste	Sediment-laden water and/or oily water	Water and groundwater encountered in: • open trenches • excavations • sediment basins.	AWTP site Secondary treatment plant upgrade site Brine pipeline – Open trench areas All compounds with temporary water quality treatment basins	260 kL
	Septic waste	Wastewater collected in ablution blocks in construction compounds	AWTP site Secondary treatment plant upgrade site All construction compounds	1,738 ML
Hazardous waste	IDAL demolition – linear, concrete drainage and soil	The material under the IDALs, including the liner, concrete drainage and soil, has the potential to be contaminated if the IDALs have leaked. Testing for contamination and to determine a waste classification can only occur during the demolition works. The classification of this waste is therefore unknown, but for the purposes of this table a	IDAL site	12,000 m^3

Waste classification or Resource Recovery Order	Waste stream	Waste description	Location	Estimated quantity
		hazardous waste classification has been assumed.		
	Excavated material at the site of the secondary treatment plant upgrade works	As discussed in section 6.2.1.2, the WRRF has known soil contamination. A hazardous waste classification is assumed but would need to be confirmed with sampling and analysis.	Secondary treatment plant upgrade site	3,900 m^3
	Electrical infrastructure waste	Waste generated during electrical fitout	AWTP site Secondary treatment plant upgrade site	195 kg
	Used batteries	Lead-acid batteries from construction vehicles and plant, rechargeable nickel-cadmium and lithium-ion batteries from portable handheld power tools	AWTP site Secondary treatment plant upgrade site Compounds C1, C19, C20 – Main	58 kg
	Used containers that previously held DG Class 1, 3, 4, 5 or 8	Waste containers mainly from the fitout of the AWTP and upgraded secondary treatment plant	AWTP site Secondary treatment plant upgrade site Compounds C1, C19, C20 – Main	97.5 m^3
	Waste oil	Waste oil mostly from construction vehicle, plant and equipment servicing	AWTP site Secondary treatment plant upgrade site Compounds C1, C19, C20 – Main	5,050 L
General waste (putrescible)	Food waste	Food waste generated in crib rooms	AWTP site Secondary treatment plant upgrade site All construction compounds	11,583 kg
	Metal waste	Metal waste generated during demolition of the IDALs from aerial piping,	IDAL site	575 t

Waste classification or Resource Recovery Order	Waste stream	Waste description	Location	Estimated quantity
General waste (non-putrescible)		walkways and buried pipes. Metal waste generated during construction of the AWTP and secondary treatment plant upgrade including waste from rebar, steel tanks and structural steel.	AWTP site Secondary treatment plant upgrade site C1, C19, C20 – Main	
	Piping (polyethelene)	Waste brine pipeline	C1, C19, C20 – Main	6.8 t
	Wood	Wood waste primarily from formwork	AWTP and secondary treatment plant upgrade work sites	38 t
	Site office waste	Waste generated in work site offices	AWTP site Secondary treatment plant upgrade site C1, C19, C20 – Main	5,792 kg
The excavated natural material order 2014	ENM	Surplus soil from trenching of the brine pipeline	Brine pipeline – open trench sections	1,800 m^3
The treated drilling mud order 2014	Treated (dewatered) drilling mud)	Dewatered drilling mud from the HDD works for the brine pipeline	HDD/tunnelling compounds C9, C10, C11, C13	990 m^3
The excavated public road material order 2014	Asphalt and roadbed metals	Excavated road pavement where trenching of the brine pipeline occurs in road pavements, and at the retrieval pit in Gate Road for the HDD sections of the pipeline	Brine pipeline – open trench sections, and C10 and C11	1,400 m^3
The mulch order 2016	Vegetation	Vegetation clearing and trimming for the brine pipeline	Brine pipelines – open trench areas	23,850 m^3

Most waste generated during construction is considered to have a negligible impact and can be managed in accordance with Table 6-44. Wastes with potential for a high impact without appropriate mitigation are asbestos at the existing asbestos stockpile at Quakers Hill WRRF and in Billy Goat Hill Reserve. These have potential to risk human health and safety from exposure to asbestos from inappropriate management

and handling. It also has potential to pollute soil, groundwater, surface water if handled and managed poorly. Any asbestos containing material excavated along the brine pipeline (including at Billy Goat Hill Reserve) would require off-site disposal at a suitably licenced waste facility and will need to be tracked using the EPA's WasteLocate online tracking system.

6.13.3 Potential impacts – operation

Table 6-43 outlines the waste expected to be generated by the proposal during operation. Waste will only be generated from Quakers Hill WRRF, with no wastes expected from the brine pipeline.

Table 6-43 Operational waste classification and estimated quantities

Waste classification	Waste stream	Waste description	Estimated quantity per year
Liquid waste	Brine	Brine is a byproduct of the reverse osmosis treatment process and is a concentrated solution of salts and contaminants	2,555 ML
	Waste treatment chemicals	Wastage of non-hazardous chemicals in the chemical dosing building, AWTP and upgraded secondary treatment plant	820 L
	Waste oils, greases and solvents	Used oil, oily water, and waste degreasers, solvents and general cleaning and washdown chemicals from the switch room, brine pump station, clean water workshop and other locations in the AWTP and upgraded secondary treatment plant	200 L
	Wastewater	Wastewater generated by the additional staff employed at Quakers Hill WRRF because of the proposal	50 kL
Hazardous waste	Wastage of hazardous process chemicals	Wastage of hazardous chemicals in the chemical dosing building, bioreactor, membrane bioreactor, reverse osmosis and ultrafiltration units	5.5 kL
	Unwashed containers that previously contained DG Class 1, 3, 4, 5 or 8	Unwashed containers that previously held fuel, paint and non-process chemicals	5 m^3
General waste (putrescible)	Screenings	Additional process waste generated at the preliminary treatment works due to the increased capacity of Quakers Hill WRRF	237 t
	Grit	Additional process waste generated at the preliminary treatment works due to	116 t

Waste classification	Waste stream	Waste description	Estimated quantity per year
		the increased capacity of Quakers Hill WRRF	
	Food waste	Food waste generated by the additional staff employed at Quakers Hill WRRF because of the proposal	335 t
General waste (non-putrescible)	Water treatment chemicals) non-hazardous)	Wastage of non-hazardous chemicals in the chemical dosing building and AWTP pH correction and stabilisation standpipe	600 kg
	Office waste	Office waste generated by the additional staff employed at Quakers Hill WRRF because of the proposal	165 kg

6.13.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-44, waste and hazardous materials impacts can be adequately managed, and residual impacts are expected to be low.

Mitigation measures in other sections of this REF (e.g. soils and contamination, groundwater) will also contribute to mitigating waste and hazardous materials risks.

Table 6-44 Environmental mitigation measures — waste and hazardous materials

Mitigation measures	Timing
Develop and implement a Waste Management Plan as part of the proposal's CEMP to appropriately manage and classify any materials including soils, construction/demolition wastes and associated stockpiles. The plan will include: • expected waste types and their location • opportunities to minimise the generation of spoil • targets for different waste streams with disposal being the least preferred approach, including diverting of spoil from landfill (e.g. through offsite reuse), recycling rates for construction and demolition waste and reuse of stormwater for construction activities (where practical to do so) • classification of all waste generated by the proposal in accordance with the EPA waste classification guidelines • site-specific measures (in accordance with the compound locations) for waste segregation, storage, stockpile management, handling, collection and transport according to their waste classification, including for liquid wastes • instructions on clear signage to be provided at construction compounds to encourage correct recycling and reduce contamination • measures to ensure safe storage and transport of waste materials and avoid or minimise any risk of waste or contaminated materials creating dust or other impacts to the community or surrounding sensitive environments	Pre-construction During construction

Mitigation measures	Timing
• regular monitoring and auditing to assess the performance of waste management activities against the determined targets including visual monitoring of materials during excavation and measures to be undertaken to prevent co-mingling / cross-contamination of waste / resource types • training and awareness for all construction personnel • a record keeping system on site so that waste tracking systems can be maintained. This should include the use of the EPA's online waste tracking system where required • delineation of waste /resource types including identification of likely vertical and lateral extents (where warranted) • ex-situ waste and resource recovery classification program, including timing relative to proposal / excavation phases as well as proposed hold points • roles and responsibilities in relation to waste stockpile and material management and a waste monitoring program • proposed onsite reuse locations and reuse methodology (if applicable) • proposed offsite reuse, offsite recycling and / or offsite disposal locations / facilities • legislative compliance requirements.	
Develop and implement a procedure for managing special waste in accordance with legislative and policy requirements. This should include the following as a minimum: • Identify lawful offsite storage and disposal options for all special waste. • If fibro or other asbestos containing material is identified, restrict access and follow Sydney Water's Asbestos Management – Minor Works procedure, Document Number 746607 and SafeWork NSW requirements. Contact Sydney Water Project Manager (who will consult with Contamination and Hazardous Materials team propertyenvironmental@sydneywater.com.au). Ensure appropriate containment methods are in place including, as a minimum, wrapping asbestos sheets and wetting down soil contaminated with asbestos containing material. Ensure transportation of asbestos waste by appropriately qualified personnel.	Pre-construction During construction
Prepare a Drilling Fluid Management Plan for tunnelled (HDD) construction, including measures to: • contain and monitor drilling fluids at entry/exit points • identify and manage frac-outs • reuse and/or dispose of drilling fluids (checking waste classification) • dewater drilling mud and satisfy the testing requirements of The Treated Drilling Mud Order 2014 (EPA, 2014c).	Pre-construction During construction
Manage waste in accordance with relevant legislation and maintain records to show compliance e.g. waste register, transport and disposal records. Record and submit SWEMS0015.27 Contractor Waste Report.	During construction

Mitigation measures	Timing
Provide adequate bins for general waste, hazardous waste and recyclable materials.	During construction
Minimise stockpile size and ensure delineation between different stockpiled materials.	During construction
Minimise the generation of waste and sort waste streams to maximise reuse/recycling in accordance with the legislative requirements	During construction
Prevent litter escaping, including by covering skip bins.	During construction
Manage liquid waste as follows: • Seek approval and discharge criteria from the relevant Sydney Water Network Area Manager before discharge of water to the wastewater system. Otherwise tanker by a licensed waste contractor and dispose off-site to an appropriately licensed waste facility. • Store effluent and greywater from the ablutions at each construction compound in a securely sealed system and transport offsite for disposal by an appropriately licensed contractor. • Store construction runoff from Quakers Hill WRRF in sediment basins or other sediment and erosion control measures detailed in section 6.3. • Contain waste oil in fully sealed containers.	During construction
Store, manage and dispose of hazardous wastes in accordance with legislative and policy requirements, including disposal by a licensed contractor and at a lawful waste facility.	During construction
Investigate opportunities to divert food waste from landfill. This could include the provision of site waste facilities such as bins to separate food waste at source.	During construction
Manage waste and excess ENM spoil in accordance with the NSW EPA Resource Recovery Orders and Exemptions (if applicable) and / or Waste Classification Guidelines. Where materials are not suitable or cannot be reused onsite or offsite, recycle where appropriate. Recycle soils at a licensed soil recycling facility or dispose at an appropriately licensed landfill facility. Dispose excess vegetation (non-weed) that cannot be used for site stabilisation at an appropriate green waste disposal facility	During construction
Ensure that the release and disposal of pipe commissioning water (for brine pipeline testing and commissioning) is undertaken in accordance with the POEO Act and that there are no uncontrolled releases to the environment which may cause scour or localised flooding.	During operation

6.14 Landscape and visual amenity

Appendix O includes a landscape character and visual impact assessment (LVIA) completed for the proposal. This section summarises key findings of that assessment.

6.14.1 Existing environment

6.14.1.1 Landscape context

Regional landscape features of the area include national parks (including part of the Blue Mountains), waterways such as Eastern Creek, and significant open spaces such as the Western Sydney Parklands. These natural features offer residents and visitors a range of recreational activities and scenic landscapes.

Figure 6-27 shows the study area for the LVIA which includes a buffer of 250 m around the impact assessment area to include all areas potentially affected by the proposal. Figure 6-27 shows typical features of the 3 landscape character units (LCUs) in the study area:

- LCU1 – low density residential
- LCU2 – parklands
- LCU3 – industrial.

The LVIA assesses construction and operational impacts on these LCUs.

The proposal will be potentially visible to a range of nearby receivers, including residential properties, users of public spaces and people travelling along roads and rail lines. Figure 6-27 shows 14 viewpoints selected to assess visual amenity impacts on these receivers during construction and operation.

6.14.1.2 Quakers Hill WRRF

The WRRF is surrounded by the Westlink M7 motorway to the north, Melrose Park to the south-east and Breakfast Creek to the south-west, with residential properties nearby. Melrose Park comprises open space, sports fields, and running and walking trails.

The ground level within Quakers Hill WRRF is generally flat. WRRF visibility is limited from nearby receptors given surrounding topography, vegetation, and structures such as fences. The WRRF is predominantly within LCU 3.

6.14.1.3 Brine pipeline

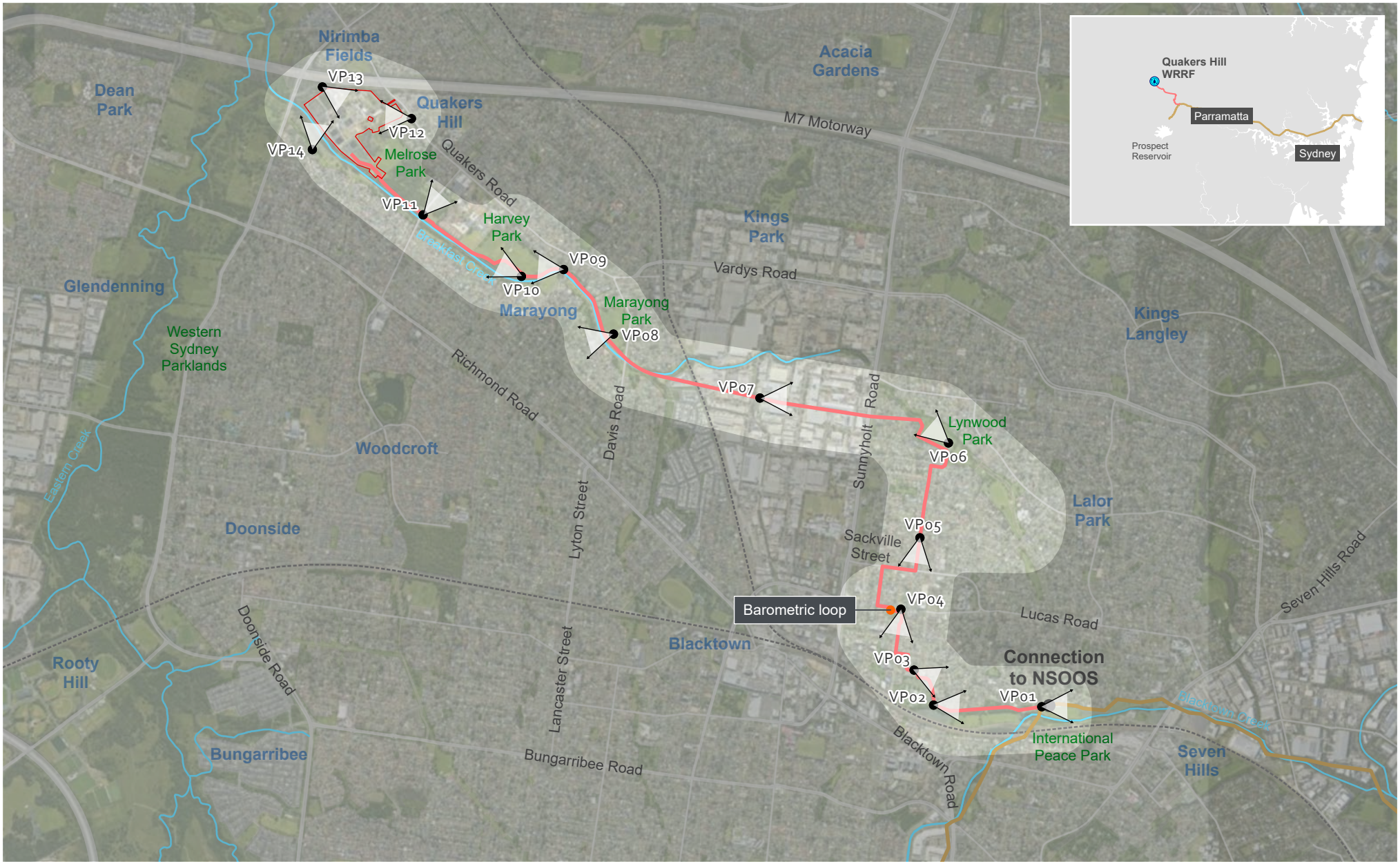
The brine pipeline will be installed within public spaces and roads, including major arterial routes such as Richmond Road and Sunnyholt Road. Other landscape features along the brine pipeline alignment include Breakfast Creek, parks and playing fields, and the Kings Park industrial estate.

A shared path generally follows the alignment of Breakfast Creek from Quakers Hill WRRF to Marayong Park, within the LVIA study area. Harvey Park and Marayong Park provide open spaces with public playing fields and provide a buffer between the northern bank of Breakfast Creek and the nearest residential properties in those areas. The Kings Park industrial estate is a large, industrial precinct with a range of commercial and warehouse operations such as storage facilities and other support services.

The elevation across the brine pipeline alignment generally rises to the east until a high point of about reduced level (RL) 75 m around Billy Goat Hill Reserve. Elevation then generally falls until the pipeline connects to the NSOOS in International Peace Park, Seven Hills. The distance between the lowest points and highest points (about 4 km) results in subtle level changes across the LVIA study area.

As detailed in section 6.9, vegetation along the brine pipeline is generally concentrated around waterways (Breakfast Creek) and within public parks. The remainder of the brine pipeline is characterised by suburban streetscape trees and grass, parks and residential gardens, and cleared industrial and commercial landscapes.

The brine pipeline impact assessment area is in all 3 LCUs.



WRRF impact area
Brine pipeline
NSOOS pipeline
Barometric loop
REF viewpoints

Figure 6-27 Viewpoint locations within the study area

0 1 km

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:35,000 @ A4
GDA2020 MGA Zone 56

N

LCU1 – low density residential

LCU2 – parklands

LCU3 – industrial

Figure 6-28 Photographs of typical features of the 3 LCUs (Source: Appendix O)

6.14.2 Potential impacts – construction

Potential impacts on landscape character and visual amenity have been identified by combining impact magnitude and sensitivity of the receiver, using the impact rating matrix in Table 6-45. Impact magnitude generally refers to the size, scale, severity and duration of changes associated with a project. Sensitivity is the value attributed to the landscape of a visual receptor and how sensitive it is to change.

Table 6-45 Landscape character and visual impact rating matrix for construction and operation

		Magnitude			
		High	Moderate	Low	Negligible
Sensitivity	High	High	High-Moderate	Moderate	Negligible
	Moderate	High-Moderate	Moderate	Moderate-Low	Negligible
	Low	Moderate	Moderate-Low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Impacts to visual amenity rated moderate or higher during construction will be limited to one viewpoint at Quakers Hill WRRF (viewpoint 12) and 4 viewpoints along the brine pipeline alignment (viewpoints 1, 3, 4 and 5), as discussed in the following subsections.

6.14.2.1 Quakers Hill WRRF

Construction at Quakers Hill WRRF will be within the context of other existing large-scale infrastructure and confined to LCU3 (industrial). Temporary discernible changes within the WRRF site will occur due to construction equipment and activities. However, this LCU has low sensitivity to such changes as it is already highly modified and heavily industrial. Although the edges of Quakers Hill WRRF extend into LCU2, potential impacts on landscape character at that location are associated with brine pipeline construction. As a result, the potential impacts to landscape character from works at Quakers Hill WRRF will be low.

Three publicly accessible viewpoints were selected to represent private and public receivers with potential views of Quakers Hill WRRF:

- Viewpoint 12 – the intersection of Melrose Avenue and Quakers Road. This viewpoint represents pedestrian and single-storey private residential views across grassland towards Quakers Hill WRRF. A stockpile that currently provides screening from this viewpoint is proposed to be removed during construction. Views from private residential dwellings, which are considered highly sensitive, will therefore change over the construction program such that the construction site and parts of the WRRF will become visible. As a result, the overall construction-phase visual impact at this location will be moderate.

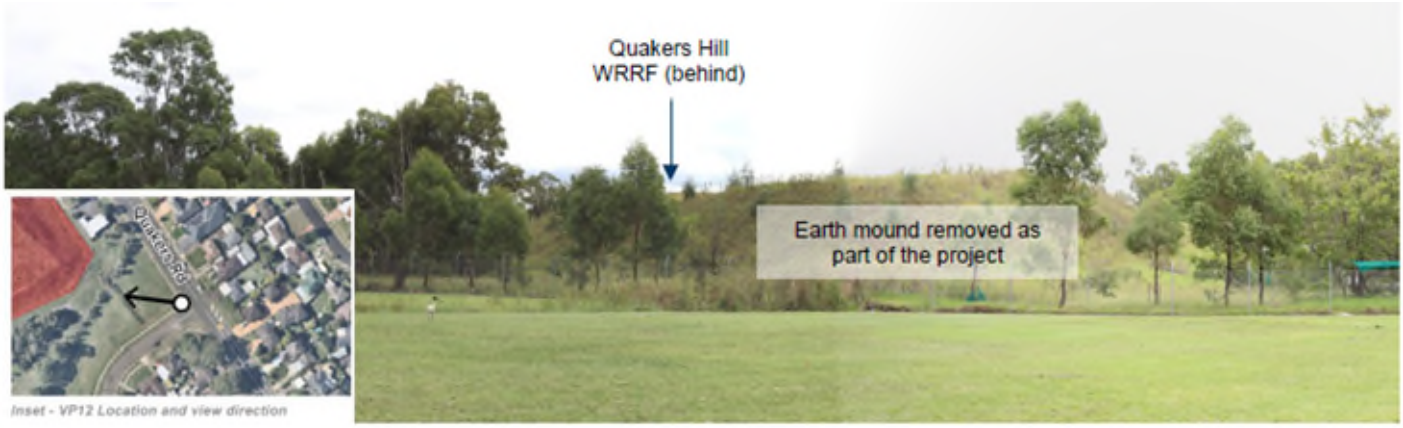


Figure 6-29 Location of, and view looking west from, viewpoint 12

- Viewpoint 13 – on the M7 Cycleway. This viewpoint represents public views looking south towards Quakers Hill WRRF. Interspersed trees and an existing solid fence completely obscure views of Quakers Hill WRRF. This, and the short-term, transient viewing times of cyclists using the cycleway, mean the overall construction-phase visual impact at this location will be negligible.

Figure 6-30 Location of, and view looking east from, viewpoint 13

- Viewpoint 14 – on Jasmine Avenue. This viewpoint represents public views looking north towards Quakers Hill WRRF from parkland and open space. Dense vegetation along the banks of Breakfast Creek obscure views of Quakers Hill WRRF behind. This, and the short-term viewing times of visual receivers accessing the park on the path, mean the overall construction-phase visual impact at this location will be negligible.

Figure 6-31 Location of, and view looking north-east from, viewpoint 14

Out-of-hours site lighting may be required for some construction activities.

6.14.2.2 Brine pipeline

Open trenching will require heavy construction machinery and temporary stockpiling of spoil along most of the brine pipeline alignment through areas mapped as LCU1 and LCU2. These LCUs are both moderately sensitive receivers, so there will be moderate impacts to these LCUs during construction. While the pipeline interacts with an area of LCU3 mapped at Kings Park Industrial Estate, most of the pipeline here will be installed using a tunnelled construction technique. Despite this and the LCU's low sensitivity rating, moderate impacts on LCU3 are expected from the excavation of HDD intermediate pits on Gate Road.

Eleven publicly accessible viewpoints were selected to represent private and public receivers with potential views of the brine pipeline. Visual amenity at 7 of these viewpoints was assessed as having moderate or lower impact during construction. The following 4 viewpoints were assessed to experience visual impacts rated at least moderate-high during construction:

- Viewpoint 1 – looking east from a point on a shared path near Jean Street. This viewpoint represents temporary views of people using the path and permanent views of nearby 2-storey residential properties (high sensitivity). A main construction compound occupying the full width of International Peace Park at this location for 6-12 months, temporarily affecting the views from the nearby residences. This will generate an overall moderate to high impact.

Figure 6-32 Location of, and view east from, viewpoint 1

- Viewpoint 3 – a public view south-east of Winifred Crescent representing views of nearby private residential properties (high sensitivity) and pedestrians. The open space adjacent to properties will be occupied by a temporary construction compound and views from nearby residences and pedestrians will change discernibly due to the presence of construction machinery and vehicles, fencing and trench excavations. The overall construction-phase visual impact at this location will be high.

Figure 6-33 Location of, and view east from, viewpoint 3

- Viewpoint 4 – looking south-west from Billy Goat Hill Reserve adjacent to Cardiff Street, representing views of pedestrians accessing the park and nearby residential properties (high sensitivity). A construction compound here will occupy a large area of the reserve. Up to about half of Cardiff Street, the

associated verge and a corner of Billy Goat Hill Reserve will experience a high level of visual amenity impact during construction for between 6 to 12 months.

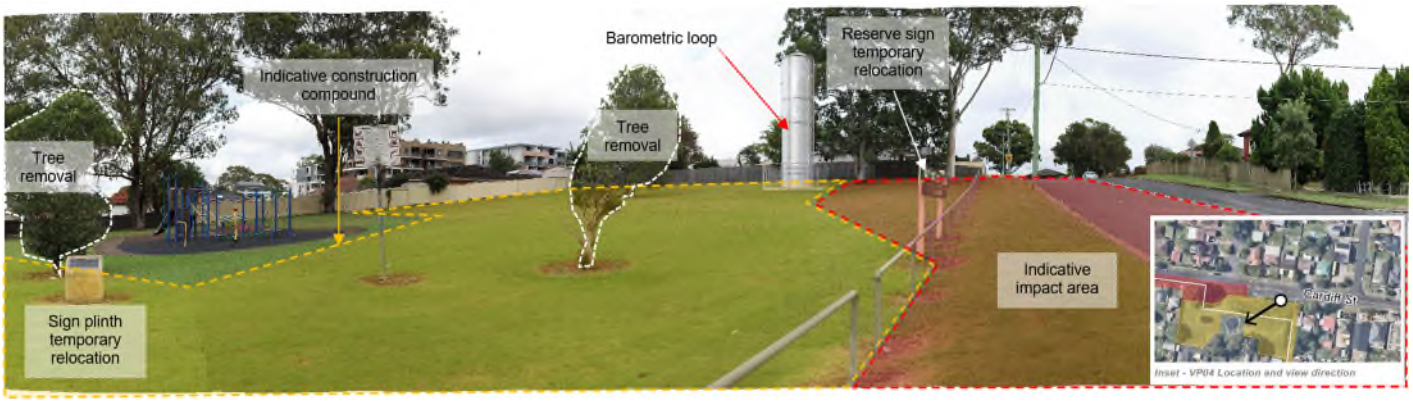


Figure 6-34 Location of, and view west from, viewpoint 4

- Viewpoint 5 – view south from Mort Street about 100 m north of Sackville Street, representing views of nearby residential properties (high sensitivity) and pedestrians. Half the street could be impacted as open trenching progresses along the alignment at about 12-24 m per shift. This will require partial road closures. Given the proximity to high sensitivity receivers, the overall construction-phase visual impact at this location will be high.

Figure 6-35 Location of, and view south, from viewpoint 5

Out-of-hours site lighting may be required for some construction activities.

6.14.3 Potential impacts – operation

6.14.3.1 Quakers Hill WRRF

The proposal infrastructure at Quakers Hill WRRF will look and operate in a manner consistent with existing infrastructure and the industrial character of LCU3. This means the impact of proposal operation on the landscape character of LCU3 will be negligible.

Impacts to views of Quakers Hill WRRF from the north (viewpoint 13 on the M7 Cycleway) and south (viewpoint 14 on Jasmine Avenue) will be negligible, given existing screening of the site will be retained. Views of the WRRF site from the east (viewpoint 12 on Melrose Avenue) will be moderately impacted due to removal of a stockpile and associated vegetation that currently provide screening of the site from this angle during construction. Elements of the WRRF may become visible to nearby residents.

Night lighting will likely be required at Quakers Hill WRRF for the operation of new infrastructure such as security, night-time maintenance or for emergencies. This will be similar to existing lighting on the site.

6.14.3.2 Brine pipeline

The brine pipeline will largely be installed below ground except for the barometric loop. Therefore, in most locations there will be no impact on landscape character during operation. There will be low-moderate impacts on the landscape character of LCU1 (low density residential) and LCU2 (parklands) associated with above-ground infrastructure, particularly the barometric loop at Billy Goat Hill Reserve. The other above-ground infrastructure includes valves and maintenance holes. These will be at or near the ground surface so will have minimal impacts on landscape character.

The main viewpoint along the brine pipeline to experience visual impacts during operation of the proposal is viewpoint 4, due to views of the barometric loop, as illustrated in Figure 6-36. The barometric loop represents a new, tall and visually incongruous vertical structure within public land at Billy Goat Hill Reserve. As a result, the impact on views is rated high.

Figure 6-36 Artist's impression of barometric loop at Billy Goat Hill Reserve

All other viewpoints along the length of the brine pipeline alignment will experience negligible or low impacts during operation, once excavations are backfilled and restored and site compounds demobilised. Viewpoints 2 and 11 are assessed to have low impacts during operation due to limited vegetation removal and/or pruning. There is no requirement for night-time lighting along the brine pipeline alignment during operation.

6.14.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-46, impacts to landscape character and visual amenity can be managed. Following mitigation, impacts to landscape character are rated no greater than moderate.

Mitigation measures proposed in other chapters (such as heritage, soils and contamination, and ecology) also help to mitigate visual impacts.

Table 6-46 Environmental mitigation measures — landscape and visual

Mitigation measures	Timing
The CEMP should record the locations where adverse construction visual impacts have been identified for mitigation and any associated measures that must be put in place to address these impacts.	Pre-construction
Consider the installation of temporary screening measures, and/or alternative solutions, around construction sites and compounds to minimise the visual impacts on sensitive receivers. Temporary screens should be considered near viewpoints 1 through 12 (inclusive).	During construction
Develop and implement a Restoration Plan for construction sites requiring restoration. The aim of this plan is to restore work sites to pre-existing condition or better. The plan should include: • removing all equipment and materials from the site • repairing/replacing pavements with new • replacing street trees, vegetation and turf removed during construction wherever possible or considering other opportunities to reduce impacts on landscape character and visual amenity of streets • restoration items from other mitigation measures tables in the REF.	During construction During operation
Visually integrate the barometric loop into the open reserve at Billy Goat Hill Reserve. Engage with the community to understand their preference(s) for a community led solution. Potential treatments to mitigate visual impacts may include: • implementing screen planting including trees along the road corridor or adjacent the barometric loop • using a light-coloured non-reflective finish • considering the use of public art as part of the barometric loop design to improve visual amenity and interest.	During construction
Design proposed lighting in accordance with Australian Standards AS/NZS 4282:2019 Control of the Obtrusive Effects of Outdoor Lighting, and any recommendations from other environmental assessments, for example an ecological assessment.	During construction During operation
Specific lighting measures could incorporate the following principles: • Only use lighting for areas when required. • Switch off lighting when not required. • Keep lights close to the ground and / or directed downwards.	During construction During operation

Mitigation measures	Timing
• Use the lowest intensity required for the job. • Ensure lights are not directed at reflective surfaces. • Use non-reflective dark-coloured surfaces to reduce reflection of lighting. • Use light shield fittings to avoid light spill. • Direct light away from residential properties, if possible.	
Consult with Natural Assets and Heritage team to determine if any further screening planting is needed (beyond what is planned in the existing Property Environmental Management Plan program) to provide long-term screening of views towards Quakers Hill WRRF from residential properties on Melrose Avenue.	Detailed design During construction During operation

6.15 Social

6.15.1 Existing environment

The proposal is entirely within the Blacktown LGA. This LGA is the largest in Greater Sydney, with about 426,000 residents and covering about 247 km^2. The impact assessment area has interconnected green space links (e.g. Great West Walk, Breakfast Creek shared path) and is well connected to major transport links (e.g. M7 Motorway, T1 Western rail line). The area is highly urbanised with pockets of industrial and recreational land use.

Community responses to urbanisation and industrialisation have been mixed. For example, high-rise development is considered by some as an efficient use of space, while others have criticised the impacts to community character and local infrastructure. Some larger infrastructure projects have faced opposition due to factors including traffic and parking, air quality and public health.

Surveys by Blacktown City Council and Sydney Water indicate that the community is concerned about perceived overdevelopment and its flow-on effects. However, they appreciate quietness, accessibility to local places and Greater Sydney, availability of community amenities, and green space.

Demographics of the Blacktown LGA and implications for the proposal are briefly discussed below:

- Consistently higher rates of residents 14 years and below compared to NSW. The relatively large number of school-aged children means impacts on routes to and from local schools should be considered.
- Communities with overlapping vulnerabilities (e.g. people who need assistance, lower income households, unemployment) may feel more vulnerable or susceptible to impacts from the proposal.
- Largest urban Aboriginal and/or Torres Strait Islander population in Australia. The proposal is on the traditional lands of the Dharug people, who have lived in the area for 50,000 years, which pre-colonisation reflected semi-nomadic tribes of about 50 people. Water and its wider ecological role are important to Dharug culture and identity. This context is useful given potential heritage and ecology impacts.

6.15.2 Potential impacts – construction

6.15.2.1 Amenity impacts

Construction amenity impacts from the proposal will be temporary and are typical of a large-scale linear infrastructure project. These include noise, dust, increased traffic and traffic delays, presence of construction workers, access to local shops and services, and impacts to recreation. Sections 6.10, 6.11, 6.12 and 6.14 provide further discussion of these impacts. Longer-term amenity impacts may reduce health and wellbeing (e.g. distress, sleep loss), particularly for those residents that may be more vulnerable or sensitive (e.g. people who live near the impact area and are less able to leave the house than others). Some avenues to de-stress or to escape these impacts, such as accessing green space, may be restricted, resulting in cumulative and compounding effects.

During construction, there will be no disruption to existing water supply or wastewater services.

Lynwood Park and Marayong Park will both be occupied by the HDD launch pits for one to 6 months. Smaller temporary compounds will be in place for 4 to 8 weeks. Along with these static sites, open trenching and pipe stringing (for about a kilometre in each direction from the launch pit) will be visible. Construction will reduce the amount of recreational space available to the public and temporarily reduce or remove parking in some areas. Sydney Water will work with Blacktown City Council and other stakeholders such as schools and sporting associations to schedule work to minimise these impacts.

Temporary closures of shared paths and footpaths will require detours or traffic control to be installed. These short-term impacts will have a noticeable impact to local pedestrians and cyclists. Temporary closures near schools will expose children to a higher risk of traffic accidents, particularly if they are active while the school is open. Traffic delays may also encourage unsafe driving behaviours. Relevant mitigation measures to address this are outlined in section 6.12.4.

Multiple stakeholders suggested Sydney Water identify locations to restore and enhance local green space. This would benefit health and wellbeing outcomes for residents and improve sense of place. Sydney Water will work with Blacktown City Council and other stakeholders on this initiative once a delivery contractor is engaged. This suggestion ties in with our offset requirements discussed in section 6.9.4 and 6.9.5.

6.15.3 Potential impacts – operation

Once operational, the proposal will have social benefits by providing a more reliable wastewater service to accommodate population growth and new housing in the area. It will also improve the quality of treated water releases into Breakfast Creek and benefit waterway health downstream of Quakers Hill WRRF.

Once construction of the proposal is complete and impact areas restored, negligible social impacts are expected during operation. For example:

- roads, footpaths and parkland will be reinstated
- all traffic control including lane closures and footpath detours will be removed
- additional operational vehicle movements will be negligible compared to existing movements
- vegetation replanting or restoration will improve amenity and vegetation quality in selected locations, and when near waterways may improve aquatic ecology and waterway health

- odours from the upgraded WRRF will not significantly change from existing operation
- the pipeline is largely underground
- the new infrastructure at the WRRF is unlikely to be visible from most viewpoints during operation. Some buildings in the WRRF may be visible to residents near the south-east of the WRRF (e.g. Melrose Avenue near Quakers Road) once the stockpile within the WRRF is removed.

The main operational impacts include:

- a minor increase in operational noise at the WRRF, mostly from new assets like the AWTP, blower room, and brine transfer pumps. Section 6.10 includes mitigation measures for operational noise
- installing a 12 m high barometric loop in Billy Goat Hill Reserve, which is visible to surrounding properties. This fenced off area will no longer be accessible for recreation or other activities.

No specific concerns were raised about the barometric loop location or size during doorknocking of properties surrounding Billy Goat Hill Reserve. Blacktown City Council suggested alternative locations, but these did not meet hydraulic requirements, would be on private property, or would require a structure taller than 12 m. There was general support from Blacktown City Council and residents for painting the loop once it is built or considering opportunities for incorporating public art to reduce visual amenity impacts.

6.15.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-47, social impacts can be adequately managed, and residual impacts are expected to be low.

Mitigation measures in other sections of this REF (e.g. air quality, noise and vibration, traffic and access, landscape and visual amenity) will also contribute to mitigating social risks.

Table 6-47 Environmental mitigation measures — social

Mitigation measures	Timing
Establish a pre-construction agreement with Blacktown City Council to determine expected construction, work activities and restoration timing. Pre-construction agreements should also be made with any residents or services where property disturbance is anticipated and/or restoration will be required.	Pre-construction
Engage with Blacktown City Council on strategies to most effectively restore and enhance existing greenspaces likely to be disturbed during construction. Consider landscaping, installation and maintenance requirements, council strategic planning initiatives and tailoring measures to meet community use and need. Document this in the Restoration Plan.	Pre-construction During construction
Develop detailed community and stakeholder engagement measures for each proposal phase, accessible via multilanguage services. Provide consistent and up-to-date information such as website updates and letterbox drops.	Pre-construction During construction
Undertake works in accordance with Sydney Water Communications policies and requirements including: • Notify impacted residents and businesses. • Erect signs to inform the public on nature of work.	Pre-construction During construction

Mitigation measures	Timing
• Treat community enquiries appropriately.	
Implement the CEMP outlined in Chapter 4.	During construction
Establish a clear line of communication for enquiries during construction activities, with key community liaisons identified. The CSEP could outline how the community liaison will communicate with residents who have self-identified as vulnerable and who are known to Sydney Water.	During construction
Coordinate pipeline construction and compound use in Harvey Park for its less busy season (generally mid-December to early February).	During construction

6.16 Hazards and risks

Appendix P includes a preliminary hazard analysis completed for the proposal. This section summarises key findings of that assessment. It also discusses the proposal's bush fire risks.

6.16.1 Existing environment

6.16.1.1 Bush fire

Although there are green corridors and bushland in the vicinity of the proposal, in general the landscape is highly built up and lacking large areas of contiguous woodland or forest that could provide large fire runs and allow significant fires to develop.

Dangerous fire weather typically occurs in NSW in spring to mid-summer, following a dry winter and spring. Dangerous fire weather is becoming more frequent and intense, a trend which is projected to continue over the coming decades with climate change (AdaptNSW 2025). Bush fire is a recognised climate-influenced hazard in Sydney Water's Climate Change Adaptation position (Sydney Water 2024).

Bush fire prone land mapping of the proposal is provided in Figure 6-37, which shows that the closest bush fire prone land to Quakers Hill WRRF is more than 1.3 km to the north-west in Colebee. However, the Western Sydney Parklands corridor is adjacent to Quakers Hill WRRF, and while some areas of the parklands are maintained as low-threat vegetation there are considerable areas of remnant woodland and forest.

Vegetation at Quakers Hill WRRF close to buildings and infrastructure is mown and largely kept free of vegetation debris, reducing the fuel hazard. However, the nearby vegetation in the Breakfast Creek riparian zone along the western boundary of the site is not similarly managed. While this vegetation is not mapped as being bush fire-prone, it does not meet any of the criteria for classification as low- threat vegetation. This means it presents a risk to Quakers Hill WRRF.

The brine pipeline will be underground in a highly developed landscape, and its alignment does not cross or come near bush fire-prone land or other significant vegetation hazards. It is therefore unlikely to be exposed to bush fire, so has been excluded from this assessment.

6.16.1.2 Hazards

Quakers Hill WRRF is an existing WRRF operated by Sydney Water and already stores chemicals and dangerous goods used for wastewater treatment. Chemicals and classified dangerous goods are stored in appropriate structures within the Quakers Hill WRRF site to comply with Australian standards. Chemicals are generally stored close to the treatment process unit associated with their use, with incompatible chemicals stored separately.

The main chemicals currently stored and used at Quakers Hill WRRF include:

- ferrous chloride
- alum
- hypochlorite
- bisulphite
- liquid and powder polymer.

Smaller volumes of hydrochloric acid (HCL) are also kept on site for use. Some of these chemicals are used in the existing secondary wastewater treatment process (Activated Granular Sludge) to coagulate organic matter for removal through mechanical processes. Others are used for purposes such as:

- managing biofouling of treatment process unit equipment
- correcting pH and balancing water chemistry
- removing chlorine and chloramines used in disinfection and cleaning.

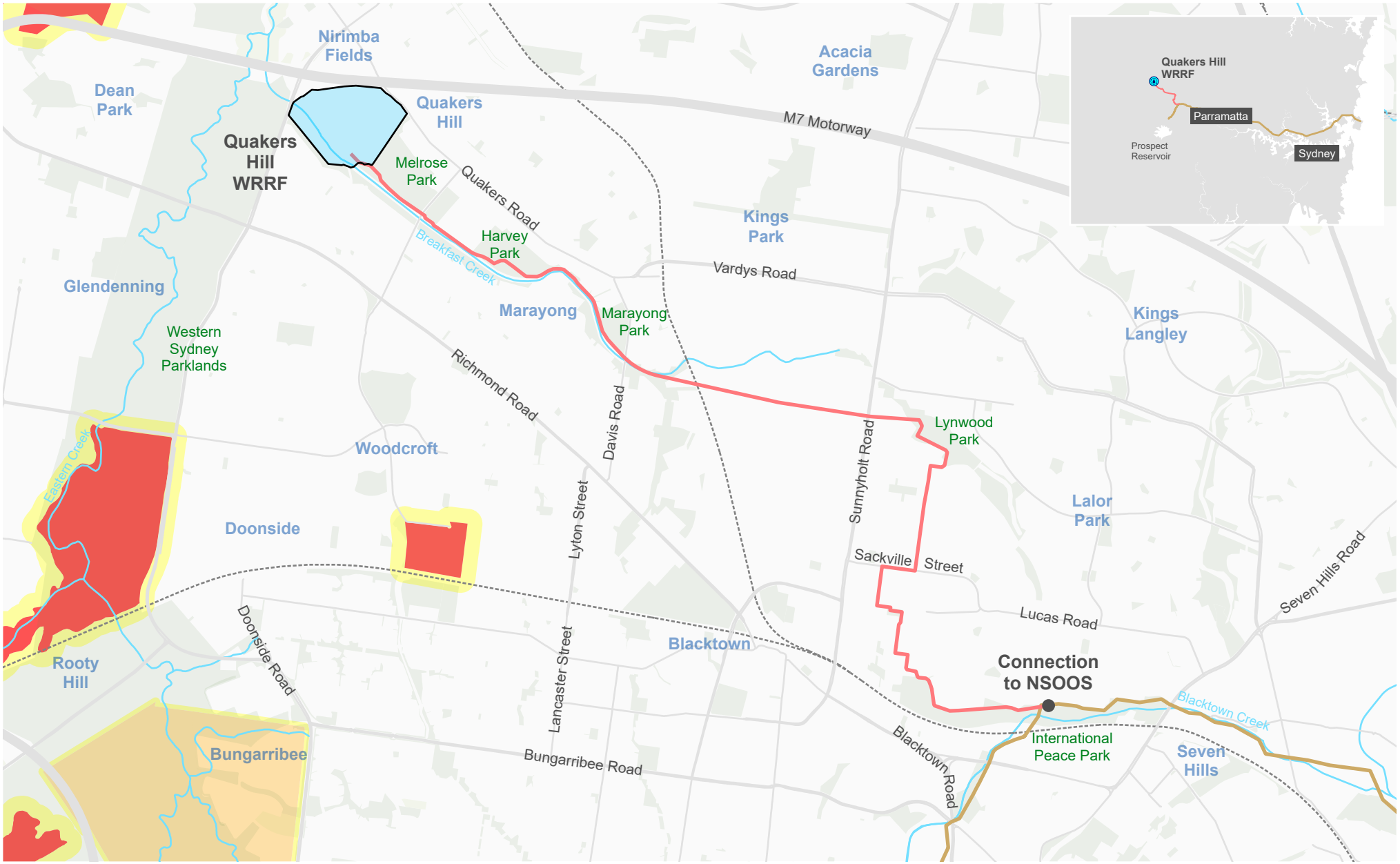


Figure 6-37 Bush fire prone land in the vicinity of the proposal

Data sources: State of NSW (Spatial Services), NSW Department of Planning and Environment
Basemap: MetroMap 2025
Scale: 1:35,000 @ A4
GDA2020 MGA Zone 56

6.16.2 Potential impacts – construction

6.16.2.1 Bush fire

Given Quakers Hill WRRF is adjacent to a vegetation hazard, people working here during a bush fire event may be at heightened risk.

Construction activities also pose additional bush fire risks, by introducing new potential sources of ignition and stationing more people than usual in areas exposed to bush fire hazard.

Construction activities may introduce the following elements which may ignite or intensify a fire:

- spark-producing hot works (welding, grinding etc.)
- vehicle movement through long grass
- storage of fuel or other combustible material on-site.

Construction activities on days of elevated fire danger, including Total Fire Ban (TOBAN) days, carry a risk of igniting a fire that escapes control. Mitigation measures to minimise bush fire risks are included in Table 6-48.

6.16.2.2 Hazards

Chemicals that will be used or stored at the proposal site during the construction phase will be identified during detailed design. However, it is expected that construction will only require small quantities of dangerous goods at volumes below the general and transportation screening thresholds of Applying SEPP 33. This means that a preliminary hazard analysis is not required for the construction phase of the proposal.

6.16.3 Potential impacts – operation

6.16.3.1 Bush fire

The WRRF assets have low levels of vulnerability to fire (e.g. concrete tanks filled with water), making the risk acceptable with few additional measures. However, the transformer bank is in a particularly exposed position and is highly vulnerable to fire. Detailed design will consider whether fire protection measures (e.g. shielding) is appropriate for this asset.

Several of the buildings feature ventilation for operational purposes. This should be assessed for compliance with ember protection, including whether operational measures, such as shutting off the ventilation systems in case of a bush fire, will adequately control the risk.

Most of the proposed structures will be built on a concrete hardstand, with sealed roads between them. All buildings will be concrete and steel with no external combustible components that could carry a fire. The site is already serviced by road and reticulated water. These factors largely mitigate the bush fire risk to the site and its operations.

6.16.3.2 Hazards

The assessment of the proposal was carried out in accordance with *Applying SEPP 33: Hazardous and Offensive Development Application Guidelines* (Department of Planning 2011a) (Applying SEPP 33) and

focused on the works at Quakers Hill WRRF. This is because there are no relevant hazards or risks associated with the brine pipeline. The assessment included:

- risk screening
- hazard identification
- preliminary hazard analysis.

Risk screening

The classes and quantities of all dangerous goods to be transported to or used, stored or produced at the proposal site were assessed against the general screening threshold quantities in Applying SEPP 33. This informed a decision about whether the proposal is potentially hazardous and would require a preliminary hazard analysis. The quantity and nature of discharges from the proposal and the significance of the offence likely to be caused was also assessed to determine whether the proposal would be potentially offensive.

Eleven dangerous goods would be stored at Quakers Hill WRRF for the proposal. Ten of these are class 8 (corrosive substances) and one is class 2.2 (non-flammable, non-toxic gases). Corrosive substances are categorised into 3 packing groups, with packing groups I, II and III presenting a high, medium and low level of danger respectively. Four of the class 8 dangerous goods proposed to be stored at Quakers Hill WRRF are packing group II and the other 6 are packing group III.

Chemicals to be stored for the proposal were grouped by their dangerous goods class and packing group and the estimated storage quantities compared to the Applying SEPP 33 general screening threshold quantities. Storage quantities for most chemicals were estimated based on storing enough for 28 days of average daily usage. This identified that the quantity of class 8 dangerous goods proposed to be stored will exceed the thresholds for both packing groups II and III. Based on these exceedances a preliminary hazard analysis of Quakers Hill WRRF is required.

A comparison was also made to the Applying SEPP 33 transportation screening threshold for class 8 dangerous goods. Transport movements were estimated at 14 deliveries annually for each of the 10 class 8 dangerous goods proposed to be stored at Quakers Hill WRRF, based on storing enough for 28 days of average daily use of each substance. This will result in a total of 140 deliveries annually, which is below the transportation screening threshold for class 8 dangerous goods of more than 500 vehicle movements per year.

The proposal will release emissions during its construction and operation, so is considered a potentially offensive industry. These emissions were analysed by reviewing the noise and vibration and air quality assessments of the proposal in Appendices K and L respectively. The review concluded that if the management and mitigation measures proposed in each of these assessments are implemented and any applicable EPL requirements are adhered to, the proposal would not be an offensive industry.

Hazard identification

A desktop assessment was carried out to identify possible events at the proposal site that could lead to an off-site incident. The assessment considered the potential causes of these incidents and the operational and organisational safeguards that could prevent the incidents from occurring or mitigate the impact. This process identified possible events at Quakers Hill WRRF that could result in significant off-site impacts.

Five hazard scenarios were identified that have potential to cause offsite impacts, of which one was assessed as having a low risk rating and the other 4 a medium risk rating. The scenarios with medium risk ratings were:

- interaction between incompatible chemicals
- release of firewater into the environment
- release of brine into the environment
- release of treated water into the environment.

Preliminary hazard analysis

The risk screening determined that the proposal is potentially hazardous but has a low potential for causing harm off-site. Applying SEPP 33 requires a Level 1 preliminary hazard analysis of projects with this characterisation. The Level 1 analysis comprised a qualitative assessment of the 4 events from the hazard identification with a medium risk of causing significant off-site impacts.

The preliminary hazard analysis assessed these hazard scenarios as outlined below.

Interaction between incompatible chemicals

The most credible causes of failure leading to the interaction of incompatible dangerous goods include corrosion and leaks from chemical storage tanks. These interactions may lead to the formation of new substances which are corrosive, flammable, or toxic. This risk is also relevant to chemicals which are not classified as dangerous goods.

To prevent the mixing of incompatible chemicals they will be stored at least 5 m away from each other, in separately bunded areas, and in accordance with *AS 3780 – The Storage and handling of corrosive substances*. The detailed design of the chemical storage area will consider different connection types/sizes to make it impossible to connect and mix incompatible chemicals during unloading and normal operation. With the implementation of these measures the residual risk of this hazard will be reduced so far as is reasonably practicable, and off-site impacts are expected to be negligible. No off-site fatality risk was identified.

Release of firewater into the environment

After a fire, firewater may be released into the environment if not controlled. The stormwater design is ongoing, with a first flush system to capture the first 10 mm rainfall runoff. To mitigate this hazard, the stormwater system will be designed to contain firewater until it is tested and deemed safe for release. This risk will be minimised as much as possible through detailed design and meeting design criteria.

Release of brine into the environment

Quakers Hill AWTP will produce brine as a by-product of the reverse osmosis (RO) treatment process. The brine will be pumped offsite by the brine transfer pump station for disposal. There is a possibility that a leak in the brine pipeline could result in release of brine into the environment and cause human injury as a potential skin irritant.

Release of treated water into the environment

High-quality treated water from the WRRF is released into Breakfast Creek. If a leak occurs in the pipeline before the release point, the treated water may enter the environment. The water quality is expected to be high enough quality to cause negligible environmental contamination. However, ground erosion and runoff of soil or dirt into waterways may occur, depending on the volume and rate of release. No human impact is anticipated from such a release.

Conclusion of the preliminary hazard analysis

The preliminary hazard analysis demonstrates that the proposal can be designed, constructed, and operated in a manner that will meet the relevant regulations, standards and policies and minimise hazardous impact to the public. The outcomes and recommendations of the analysis will be considered in the detailed design of the proposal. The preliminary hazard analysis determined that the proposal is not a hazardous industry.

6.16.4 Mitigation measures

With the implementation of the mitigation measures in Table 6-48, impacts to hazards and risk can be adequately managed, and residual impacts are expected to be minor.

Table 6-48 Environmental mitigation measures — hazards and risks

Mitigation measures	Timing
Design and construct proposal assets to align with the relevant prescriptions and performance outcomes from AS3959 for the calculated bush fire attack level.	Detailed design During construction
Maintain vegetation on site in a low fuel hazard condition during the fire danger period (grass <100 mm in length, removal of vegetation debris).	During construction During operation
Maintain access around the property for emergency responders.	During construction During operation
Maintain water sources for fire attack.	During construction During operation
Maintain bush fire awareness – Fires Near Me app/website, warnings on local radio, watch for smoke. Evacuate site if safe to do so when a Watch and Act or Emergency Warning is issued for the local area.	During construction During operation
Follow site Emergency Management Plan. If trapped on site during a bush fire event, shelter in a non-combustible structure towards the centre of the property.	During construction During operation
A Total Fire Ban Exemption is required for all non-essential work in TOBAN periods. Staff and contractors should use the Sydney Water Total Fire Ban Exemption Framework to determine exemption permissibility and approval pathway.	During construction During operation
Hot works only to occur within cleared areas and with appropriate ignition suppression equipment to hand.	During construction During operation

Mitigation measures	Timing
During the fire danger period, flammable materials to be stored in areas kept clear of vegetation. Move fuel and any other hazardous materials to areas >100 m from forest or woodland vegetation on days of Extreme FDR or above.	During construction During operation
No vehicles to drive through or park in long grass during the fire danger period.	During construction During operation
All chemicals brought onsite must be stored in accordance with relevant Australian Standards, with appropriate labelling, separation where necessary, and disposal procedures that comply with Australian Standards.	Detailed design During construction During operation
Maintain up-to-date SDSs for all chemicals stored onsite, accessible to site personnel. Ensure emergency services have access to the complete SDS register.	During construction During operation
Implement comprehensive safe work procedures for all chemical handling, including transfer, storage, spill prevention, and cleanup requirements. Provide emergency spill kits and appropriate Personal Protective Equipment (PPE).	During construction During operation
Store all DGs and chemicals in compliance with AS3780, ensuring incompatible materials are properly separated, with appropriate bunding and separation distances.	Detailed design During construction During operation
Install and maintain alarmed leak detection systems in locations where there is potential for chemical interactions.	Detailed design During construction During operation

6.17 Sustainability

Sydney Water considers sustainability as balancing the needs of future generations by achieving a better life for customers today. This includes managing for the long-term by caring for Country, supporting social equity and community well-being, providing high economic value and affordable services for generations to come.

The proposal and its identified initiatives and commitments align with Sydney Water's key objectives and sustainability policy areas. Best practice guidelines such as version 2.1 of the Infrastructure Sustainability (IS) rating scheme supported the assessment approach.

6.17.1 Policy framework

Sydney Water has an overarching strategy to deliver on our vision of 'creating a better life with world class water services'. This strategy has a range of supporting sustainability and resilience policies and guidelines, briefly discussed in Table 6-49.

Table 6-49 Sydney Water sustainability and resilience policies and strategies

Document	Relevance
Sustainability Policy	Outlines our commitment to achieving positive economic, social and environmental outcomes for current and future generations.
Environmental Policy	Outlines our commitment to protect the environment by adhering to ecologically sustainable development principles.
Resilience Policy	Outlines our commitment to ensure the reliability and sustainability of our services in the context of climate variability, population growth and urbanisation. The policy emphasises proactive risk management, infrastructure adaptability and integrated water cycle management.
Climate Change Adaptation Position Statement	Outlines our commitment to proactively address climate-related challenges to ensure the resilience and reliability of our services.
Climate Change Adaptation Guidebook	Structured approach to assess and manage climate risk across all operations. Emphasises integrating climate considerations in the decision-making processes, and integrating adaptation and resilience into the value chain.
Carbon Zero Plan	Outlines our commitment to achieve net zero carbon emissions across Sydney Water operations by 2030 and across the supply chain by 2040.
Net Zero Carbon Directional Statement	Embeds carbon-related policy changes into Sydney Water's processes for infrastructure projects.
Design Guideline – Best Practice Energy Efficiency	Framework for integrating energy efficiency into design and operation of water and wastewater infrastructure.
Innovate Reconciliation Plan 2024-26	Commitment to reconciliation with First Nations people.
Aboriginal Procurement Participation Plan	Outlines our commitment to enhancing economic opportunities for First Nations communities through procurement activities.

Sydney Water has also developed 8 mandatory sustainability priority areas to be embedded into proposal requirements. This is so that sustainability objectives and targets can be achieved throughout a project lifecycle. The integrated sustainability initiatives and proposed mitigation measures support these priority areas. These priority areas are:

- leadership and governance (innovative, high-performing team with behaviours contributing to sustainability and improved environmental outcomes)
- sustainable procurement (sustainable and socially responsible supply chain)
- carbon and energy (best practice energy efficiency; contribute to Sydney Water's net zero targets)

- materials and resource efficiency (support a circular economy through responsible resource management; reduce waste creation)
- water (water efficiency; minimising potable water use)
- climate adaptation and resilience (systems approach to climate risks)
- environmental protection (protect, restore and enhance natural assets)
- social sustainability (operate in a socially responsible way with stakeholders to achieve positive social outcomes).

6.17.2 Sustainability in design

While all 8 of the above priority areas are relevant, Table 6-50 summarises how the 3 highest priority areas have been integrated into concept design. These initiatives will evolve throughout proposal design, as part of the proposal's Sustainability Strategy and Sustainability Management Plan.

Table 6-50 Sustainability initiatives integrated into concept design

Priority area	Sustainability requirement	Sustainability initiative/ opportunity
Materials and resource efficiency	Prioritise recycled content and low carbon options from key materials e.g. concrete, aggregates, steel	Concrete reinforcement alternatives – low carbon concrete e.g. supplementary cementitious materials mix
		Steel alternatives e.g. e-mesh, recycled plastic fibre reinforcement
		Recycled plastic for temporary bollards and safety barriers
	Reuse or repurpose existing infrastructure	Reuse in situ or recycled materials for bedding/backfill
		Reuse stockpile within the WRRF to partially backfill the IDALs
Environmental protection	Avoid, minimise and mitigate impacts to ecological features and values; no net loss of ecological value	Ecologically sensitive construction methods (e.g. modifications to construction methodology to avoid high value ecological features)
Carbon and energy	Reduce use and embodied impacts (Scope 3 emissions) of treatment chemicals and materials compared to reference design	Reduce embodied carbon in pavement and concrete
	Substitute 50% of whole-of-life non-renewable energy use with renewables	Integrate solar panels on to building roofs greater than 100 m^2
		Stage delivery of treatment trains to minimise space and increase future capacity (some equipment sized for future upgrades)

Priority area	Sustainability requirement	Sustainability initiative/ opportunity
	Implement increased energy efficiency measures	Integrate future new assets within existing WRRF (e.g. use currently unused areas or facilities for new assets)
		Use rear-cooled variable speed drives to reduce heating, ventilation and air conditioning load on switch room
		Explore redundancies for renewable or alternative energies such as batteries. Consider separating power supplies to enhance redundancy if power is lost
		Explore low energy systems and energy efficiency opportunities

6.17.3 Climate change risk assessment

A climate change risk assessment was undertaken for construction and operation to understand the climate risks most relevant to the proposal. The baseline assessment was done under the moderate Representative Concentration Pathway (RCP) 4.5 with potential increased impacts assessed using RCP 8.5. RCPs describe possible climate futures based on the quantity of greenhouse gases (GHG) emitted. RCP 4.5 reflects moderate emissions and RCP 8.5 reflects high emissions. Two different time horizons were assessed – 2030 (for short-term assets) and 2070 (for long-term assets).

6.17.3.1 Climate projections

The study area for the proposal is projected to experience hotter temperatures, more frequent extreme temperatures, heavier rainfall during extreme events, increased drought and more hazardous fire weather. Table 6-51 provides more detail about the aspects of greatest risk to the proposal.

Table 6-51 Summary of climate change projections

Aspect	Current	What would change	2030 scenario (RCP 4.5)	2030 scenario (RCP 8.5)	2070 scenario (RCP 4.5)	2070 scenario (RCP 8.5)
Temperature	Warm temperate climate	Rising temperature	1.0°C increase	1.1°C increase	1.7°C increase	2.7°C increase
Heatwaves (above 35°C)	11 days	More days of heatwave	14 days	18 days	Over 3 weeks	Over 4 weeks
Rainfall	Evenly distributed through the year with small peak in summer	Amount of rain during 1% AEP 24-hour extreme events	10% increase (275 mm)	10% increase (277 mm)	20% increase (302 mm)	37% increase (328 mm)

6.17.3.2 Construction and operational risks

Table 6-52 summarises the proposal's construction and operational climate change risks. Modelled climate change patterns are predicted to cause some damage to assets and infrastructure, which could lead to construction delays and increased operational risks. Climate adaptation measures can be implemented to build resilience to changes that may impact the performance, operating life and/or use of an infrastructure system. Table 6-54 includes some of these adaptation measures.

Pipelines have a low level of exposure to climate risks. Design measures such as high-strength, durable pipeline materials and concrete casing provide resilience. Installing pipelines underground also reduces their exposure to climate hazards such as heat and rain.

Table 6-52 Construction risks from climate change scenarios

Climate change hazard	Construction risk	Operational risk
Rainfall and flooding	Current high rainfall during summer months may become more intense and increase the risk of stormwater runoff, sediments mobilising, and follow-on impacts to downstream waterways and ecosystems.	Most critical assets are located above known flood levels, but some of the assets on the western edge of the site may be vulnerable to overland flow. Flooding can cause soil instability and impact site assets.
Extreme storms and wind	Increased risk of high winds, hail, flash flooding and lightning damaging construction equipment or delaying construction	Winds and storms may damage roof structures or the barometric loop. Wind may also carry debris into the damaged barometric loop and cause blockages.
Heat and humidity	Increased risk of heat-related illness and heat exhaustion for construction workers	Extreme heat may impact function of compressor or blowers. Electrical or mechanical assets may have an increased risk of failure from overheating. This may cause a reduced quality of treatment, leading to poorer water quality, and higher operational costs from more repairs. Power outages could stop the WRRF operating. Cumulative effects of more severe weather may increase the risk of getting more power outages.
Bush fire	Heat, poor visibility from smoke and respiratory issues from poor air quality. New potential sources of ignition. More people than usual in areas exposed to bush fire. Some compounds are in areas exposed to bush fire hazard.	New buildings will be made of concrete and steel with no combustible components on the outside. Bush fires may contribute to more frequent power outages. Above-ground sections of pipeline will be more susceptible to fire than underground sections. However, the pipeline will be constructed with concrete and steel. Neither material is considered vulnerable to fire.

6.17.4 Greenhouse gas assessment

A greenhouse gas (GHG) estimating tool was used to estimate the GHG emissions during construction and operation of the proposal. The tool assessed the following emissions:

- Scope 1 emissions – these are direct emissions because of our activities (e.g. use of fuel to power plant and equipment during construction).
- Scope 2 emissions – these are indirect emissions released outside the facility boundary to produce the electricity used by the facility (e.g. the electricity used to supply the WRRF)
- Scope 3 emissions – these are indirect emissions not included in Scope 2 across our full supply chain (e.g. purchasing chemicals, performing maintenance activities, transporting materials).

Table 6-53 outlines the predicted GHG emissions during construction and operation to 2050. Table 6-54 includes some mitigation measures to reduce GHG emissions.

Table 6-53 Predicted GHG emissions to 2050

Phase	Source	Scope 1 emissions (tonnes CO_2 equivalent)	Scope 2 emissions (tonnes CO_2 equivalent)	Scope 3 emissions (tonnes CO_2 equivalent)	Total emissions (tonnes CO_2 equivalent)
Construction	Embodied in construction materials	0	0	16,312	16,312
	Waste treatment of construction materials	0	0	287	287
	Transport construction materials and waste	0	0	251	251
	Fuel consumption	4,071	0	0	4,071
	Total emissions during construction	**4,071**	**0**	**16,851**	**20,922**
Operation	Fugitive emissions	49,141	0	0	49,141
	Grid electricity use	0	4,209	0	4,209
	Embodied in chemicals	0	0	2,781	2,781
	Transport biosolids, residuals and chemicals	0	0	6	6
	Total emissions during operation	**49,141**	**4,209**	**2,787**	**56,137**
	Total				**77,059**

6.17.5 Mitigation measures

The mitigation measures in Table 6-54 have been designed to:

- ensure sustainability considerations are incorporated throughout the proposal's life cycle
- ensure opportunities to reduce greenhouse gas emissions are pursued
- effectively manage climate change risks.

Mitigation measures in other sections of this REF (e.g. operational noise, visual, ecology, waste, bush fire and flooding) will also support sustainability initiatives.

Table 6-54 Environmental mitigation measures — sustainability

Mitigation measures	Timing
Establish a Sustainability Management Plan during detailed design to guide sustainable outcomes during detailed design, construction and operation. This plan should include: • demonstrating leadership and sustainability commitments • setting reasonable targets that align with Sydney Water objectives • establishing roles, responsibilities and requirements for embedding sustainability throughout detailed design and construction • documenting the process for identifying, assessing and implementing sustainability initiatives and opportunities • outlining the process for assessing, monitoring and reviewing sustainability performance, as well as requirements to measure performance aligned to a silver IS rating (if the proposal is registered later) -e.g. monitoring asset performance after extreme weather events • outlining documentation and reporting requirements to demonstrate how sustainability is embedded in design, construction and operation.	Detailed design Pre-construction During construction Operation
Maintain Sustainability Opportunities Register as a live document and progressively update it as the proposal progresses.	Detailed design Pre-construction During construction
Explore opportunities during detailed design to maximise local reuse of non-potable water (e.g. council using recycled water for watering parks).	Detailed design
Consider backup power options such as local standby generator for inlet pumping station SP1174 and/or supplementing dual-feed power supply with backup generators.	Detailed design
Select equipment that can withstand the increase in maximum ambient temperature from climate change.	Detailed design
Consider diverting stormwater detention at the WRRF from rainfall capture area to reduce stormwater runoff.	Detailed design
Design the treatment plant to reduce heat accumulation (e.g. light-coloured building materials for roofing and pavement).	Detailed design

Mitigation measures	Timing
Provide air-conditioning and evaporative cooling system in switch room and equipment room.	Detailed design
Consider installing and using on-site renewable plant or equipment during construction e.g. generators.	Detailed design
Consider using alternative fuels e.g. biodiesel blends or battery powered equipment.	Detailed design
Consider increasing capacity of the on-site solar setup to offset electricity purchased from the grid.	Detailed design
Consider where reduction in material quantities can be made while maintaining design performance.	Detailed design
Consider where materials can be substituted for lower embodied carbon alternatives.	Detailed design
Optimise polymer dosage to reduce waste and indirect emissions.	Detailed design
Align equipment and process selection to Sydney Water's *Design Guideline – Best Practice Energy Efficiency*. This includes nominating compliant blowers and motors and using variable speed drives to control the compressed air output.	Detailed design
Reduce operational electricity demand by including LED lighting, high efficiency appliances, and low carbon heating or cooling solutions.	Detailed design During operation
Procure energy efficient centrifuges and pumps.	Pre-construction

6.18 Cumulative and future trends

6.18.1 Potential environmental impacts

Specialist reports did not identify any cumulative impacts with other nearby projects within the Blacktown LGA from the Major Projects Planning Portal. Cumulative construction and operation impacts are expected to be low or negligible.

Blacktown City Council adopts a capital works program every year that involves maintenance and upgrade of a range of council assets. Sydney Water will consult council about how to coordinate activities where locations and timeframes overlap.

Quakers Hill WRRF is an operational site that requires regular maintenance and minor equipment upgrades. It is likely that some of these activities may be needed while the proposal is being built. Regular engagement with the operational team will minimise cumulative impacts and allow the WRRF to continue to operate.

The proposal has considered future trends and is unlikely to further exacerbate them. Sections 6.16 and 6.17 consider impacts from events such as bushfires, coastal hazards, flooding, extreme heat and extreme storm events related to climate change. GHG emissions are not expected to be significant. Sustainability

initiatives related to materials and resource efficiency and carbon and energy reductions have already incorporated into the design. Construction and operational risks can be managed through design and mitigation measures, which include initiatives related to energy efficiency and resilient power supply.

Although the proposal is likely to be impacted by more extreme weather patterns during operation, the impacts can be managed through the design and mitigation measures in sections 6.6, 6.16 and 6.17.

6.18.2 Mitigation measures

With the implementation of the mitigation measures below, cumulative impacts can be adequately managed, and residual impacts are expected to be minor.

Table 6-55 Environmental mitigation measures — cumulative and future trends

Mitigation measures	Timing
Continue engagement with Quakers Hill WRRF operational team on scope of work and scheduling.	Detailed design Pre-construction During construction
Liaise with Blacktown City Council on their capital works program and coordinate with any council projects proposed within the impact area.	Pre-construction During construction

6.19 General environmental management

Table 6-56 outlines general environmental management measures that apply to the proposal, in addition to the specific measures included throughout this chapter.

Table 6-56 Environmental mitigation measures — general environmental management

Mitigation measures	Timing
Prepare a Construction Environmental Management Plan (CEMP) addressing the requirements of this environmental assessment (including any toolbox talks). The CEMP should specify licence, approval and notification requirements. Before starting work, all project staff and contractors will be inducted in the CEMP. The CEMP must be readily available on site and include a site plan which shows: • go/no go areas (e.g. sensitive vegetation, contaminated areas) professionally surveyed. Mark the boundary with highly visible non-ground-disturbing and 'environmental protection zone' signs and boundaries of the impact area including locations of lay-down and storage areas for materials and equipment • location of environmental controls (such as erosion and sediment controls, fences or other measures to protect vegetation or fauna, spill kits) • location and full extent of any vegetation disturbance. Delineate approved impact area before construction.	Pre-construction

Mitigation measures	Timing
The CEMP is to include all sub-plans identified in other mitigation measures.	
Prepare an Incident Management Plan (IMP) outlining actions and responsibilities for: • prediction/onset of heavy rain or strong winds during works • spills • unexpected finds (e.g. heritage and contamination) • other potential incidents relevant to the scope of works (e.g. changes to water quality). All site personnel must be inducted into the IMP.	Pre-construction
Sydney Water's Project Manager (after consultation with the environmental and community representatives and affected landowners) can approve temporary ancillary construction facilities (such as compounds and access tracks), without additional environmental assessment or approval if the facilities: • limit proximity to sensitive receivers • do not disrupt property access • have no impact to known items of non-Aboriginal and Aboriginal heritage • are outside high risk areas for Aboriginal heritage • use existing cleared areas and existing access tracks • have no impacts to remnant native vegetation or key habitat features • have no disturbance to waterways • do not require additional safeguards beyond those included in the EIA • do not disturb contaminated land or acid sulfate soils • will be rehabilitated at the end of construction. The delivery contractor must demonstrate in writing how the proposed ancillary facilities meet these principles. Any facilities that do not meet these principles will require additional environmental impact assessment. The agreed location of these facilities must be shown on the CEMP site plan and appropriate environmental controls installed.	Pre-construction During construction
Should the proposal or methodology change from the EIA, no further environmental assessment is required provided the change: • remains within the impact assessment area and has no net additional environmental impact or • is outside the impact assessment area but: ○ reduces impacts to biodiversity, heritage or human amenity or ○ avoids engineering (for example, geological, topographical) constraints and ○ after consultation with any potentially affected landowners and relevant agencies	Pre-construction During construction

Mitigation measures	Timing
The delivery contractor must demonstrate in writing how the changes meet these requirements, for approval by Sydney Water's Project Manager in consultation with the environmental and community representatives.	
The delivery contractor should consider pre-mobilisation and post-demobilisation soil sampling on compound sites to confirm no residual impacts, due to the potential for residual contamination across the impact area.	Pre-construction During operation
Complaints to be managed in accordance with Sydney Water's Complaints Procedure and relevant Community Engagement Plan.	During construction
Assign single person with accountability for coordinating communication and information flow across contractors and consultants and provide the contact details of this person in the CEMP.	During construction
Incorporate relevant operational mitigation measures into Quakers Hill WRRF standard operating procedures.	During operation

7. Conclusion

Sydney Water has prepared this REF to assess the potential environmental impacts of the Quakers Hill WRRF Advanced Treatment Upgrade. The proposal is required to accommodate forecast growth in the Quakers Hill WRRF catchment and to meet more stringent water quality requirements in the WRRF's EPL.

The main potential construction environmental impacts are removal of native vegetation and amenity impacts (e.g. noise, dust, additional traffic movements and access restrictions in public open spaces). We will implement a range of mitigation measures to manage these impacts, as part of a Construction Environmental Management Plan.

During operation, environmental impacts are expected to be minimal. New infrastructure at Quakers Hill WRRF will be of similar scale to existing assets with potential impacts such as noise and odour being similar to current conditions. The brine pipeline will be underground, with the main above ground structure being a barometric loop at Billy Goat Hill Reserve in Blacktown.

Given the nature, scale and extent of impacts and implementation of the mitigation measures outlined in this REF, the proposal is unlikely to have a significant impact on the environment. Therefore, an environmental impact statement is not required under Division 5.1 of the EP&A Act.

The REF considers how the proposal aligns with the principles of ESD. The proposal will have an environmental benefit by improving the quality of treated water released to Breakfast Creek. The proposal will not result in the degradation of the quality of the environment and will not pose a risk to the safety of the environment.

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Appendix A – Section 171 checklist

Section 171 checklist	REF finding
Any environmental impact on a community	There will be short-term impacts on the community from vegetation removal, noise, visibility of construction activities and access changes. Construction noise generated from the brine pipeline will extend for a longer duration compared to the WRRF upgrade construction. However, all reasonable and feasible measures will be implemented to reduce noise impacts on the local community. There will be environmental improvements by providing a reliable wastewater service to service the growing local community. Moderate permanent visual impacts to residents surrounding Billy Goat Hill Reserve are expected, associated with the installation of a barometric loop.
Any transformation of a locality	The proposed work will not result in the transformation of a locality. The locality will be temporarily impacted during the construction period. Impacted land outside Quakers Hill WRRF will be restored to its original condition, except where the barometric loop and small-scale surface infrastructure (such as valves, maintenance holes) is located.
Any environmental impact on the ecosystems of the locality	There will be vegetation clearing associated with construction of the proposal, with about 1.97 ha of native vegetation communities impacted. However, an impact assessment demonstrates the impact is not significant. Impacts will not increase fragmentation or put local populations or habitats at risk of extinction. Revegetation up to a 3:1 ratio will be completed in accordance with Sydney Water's *Biodiversity Offset Guideline*. The proposal will improve treatment processes to maintain and improve waterway health and associated ecosystems.
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality	Temporary construction impacts will seek to avoid vegetated areas and minimise impacts to recreational tracks. Rehabilitation and revegetation will take place following vegetation removal in areas that cannot be avoided. Moderate permanent visual impacts to residents surrounding Billy Goat Hill Reserve are expected, associated with the introduction of a barometric loop.
Any effect upon a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or any other special value for present or future generations	The proposal is in areas with widespread ground disturbance. Five Aboriginal heritage sites overlap with the impact assessment area. However, all are either destroyed or have no potential for archaeological deposits. Therefore, the proposal will not impact any Aboriginal heritage. There will be no direct impacts to significant fabric of any non-Aboriginal heritage items. Two non-Aboriginal heritage items may experience indirect impacts from vibration.
Any impact on the habitat of any protected animals (within the meaning of the *Biodiversity Conservation Act 2016*)	Actual and potential habitat (vegetation communities) will be removed during construction. However, no specific habitat features (e.g. hollow-bearing trees or culverts) will be removed or impacted. Revegetation or restoration will aim to improve habitat quality in targeted locations.
Any endangering of any species of animal or plant or other form of life,	A biodiversity assessment has assessed the impacts on a range of threatened species and ecological communities and concluded the proposal will not endanger any species.

Section 171 checklist	REF finding
whether living on land, in water or in the air	
Any long-term effects on the environment	The proposal is expected to provide a long-term benefit by providing improved wastewater treatment processes and maintaining the health of local waterways.
Any degradation of the quality of the environment	The proposal requires native vegetation removal. The impacted vegetation is mostly degraded (for example, plant communities with canopy only with the understorey weedy or absent). Odour modelling conducted for the proposal confirms that there will be no net reduction in odour performance and it is estimated that odours from the upgraded plant will not materially differ from existing operations. The proposal will improve the quality of treated water releases. The reduction in nutrient loads will result in water quality improvements including lower risk of algal blooms, better ecosystem health and long-term sustainability. The lower pollutant loads will support healthy fish and macroinvertebrate populations and improve overall biodiversity. While the volume of treated water releases will reduce slightly compared to existing, sediment in the creek channel will continue to move, with long term siltation of the channel unlikely.
Any risk to the safety of the environment	Construction of the proposal will result in a temporary increase of traffic movements along nearby roads. The proposal will also result in temporary impacts to pedestrians and car parking around brine pipeline construction locations. Consultation, signage and provision of alternative routes will mitigate this potential safety risk to the environment. There is potential for temporary, minor, localised flooding incidents and emergencies during construction, particularly within Quakers Hill WRRF and at construction compounds within the vicinity of Breakfast Creek and Blacktown Creek in areas with a 5% AEP. Once operational, the proposal will have only minor impacts on mainstream and overland flooding, flow velocity and flood extent and duration. Overall, the proposal represents only a minor change in flood-related hazards. There is potential for offsite hazards to arise during operation associated with incompatible chemical interactions and leaks of firewater, brine and / or treated water. The risk of such hazards occurring will be mitigated through designing to relevant industry standards and adhering to standard operating procedures.
Any reduction in the range of beneficial uses of the environment	The proposal will improve wastewater treatment processes to enable servicing and compliance with EPL requirements and generally improve waterway system health. No reduction in the range of beneficial uses of the environment (e.g. natural resources, community resources, existing land use) is anticipated.
Any pollution of the environment	The proposal has been designed to meet the EPA's Hawkesbury Nepean nutrient framework and our EPL requirements. Overall, the upgrades will improve the quality of treated water released to the environment. Environmental mitigation measures will mitigate the potential for the proposal to pollute the environment during construction.

Section 171 checklist	REF finding
Any environmental problems associated with the disposal of waste	The disposal of waste will be conducted in accordance with the environmental safeguards, including EPA waste classifications, and no environmental problems associated with the disposal of waste are expected. The proposal provides an opportunity to avoid waste by beneficially reusing stockpiled fill material, and burying asbestos-contaminated spoil, leftover from previously completed Sydney Water projects.
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply	The proposal will not increase demand on resources, that are, or are likely to become, in short supply.
Any cumulative environmental effect with other existing or likely future activities	The proposal would have negligible to minor cumulative environmental effects with other existing or likely future activities. These include maintenance and upgrade works within Quakers Hill WRRF and Blacktown City Council routine maintenance and upgrade works program. The extent of any cumulative environmental effect would be limited to the Quakers Hill WRRF site and the area immediately surrounding the brine pipeline.
Any impact on coastal processes and coastal hazards, including those under projected climate change conditions	The proposal is not near the coast and will not have any impact on coastal processes or hazards. Coastal processes and coastal hazards will not have any impact on the proposal.
Any applicable local strategic planning statements, regional strategic plans or district strategic plans made under the EP&A Act, Division 3.1	The proposal is to service growth and the applicable strategic planning statements or plans have been considered in the system planning and options selection process (see sections 2.2.3.1 and 5.2).
Any other relevant environmental factors	The proposal has been assessed against the factors listed above, and there are no other relevant environmental factors to consider.

Appendix B – Section 171A checklist

Section 171A of the EP&A Regulation imposes additional requirements on a determining authority to take into account certain matters under Part 6.2 of State Environmental Planning Policy (Biodiversity and Conservation) 2021 (BCSEPP) for a proposal in a 'regulated catchment'. The regulated catchments are defined under the BCSEPP, and include the:

- Sydney Drinking Water Catchment
- Sydney Harbour Catchment
- Georges River Catchment
- Hawkesbury-Nepean Catchment.

As the proposal is within the Hawkesbury-Nepean catchment, the requirements of Section 171(A) are applicable guidelines for the proposal and are considered in the table below.

Section 171A checklist (Development in regulated catchments)	REF finding
BCSEPP – Section 6.6(1) - Water quality and quantity In deciding whether to grant development consent to development on land in a regulated catchment, the consent authority must consider the following:	
(a) whether the development will have a neutral or beneficial effect on the quality of water entering a waterway	Mitigation measures included in Table 6-3 and Table 6-12 will be implemented during construction to ensure the proposal has a neutral impact on water quality in Breakfast Creek and Eastern Creek. Treated water releases during operation of the proposal will be of better quality than current releases from Quakers Hill WRRF, reducing overall nutrient loading in the Hawkesbury-Nepean Sackville 2 subzone.
(b) whether the development will have an adverse impact on water flow in a natural waterbody	The proposal will have minor adverse impacts on water flows within Breakfast Creek and Eastern Creek, due to reduced release volumes associated with brine production during advanced treatment. Change in flows and associated impacts will occur gradually in line with growth in the catchment. The anticipated changes in flows of Breakfast Creek and Eastern Creek are not expected to modify or adversely affect water flows within the catchment during construction or operation.
(c) whether the development will increase the amount of stormwater run-off from a site	Increase in impervious area will increase stormwater runoff from Quakers Hill WRRF, leading to increased annual average pollutant loads to Breakfast Creek (total suspended solids, total phosphorus and total nitrogen). With the implementation of mitigation measures, increases in pollutant loads can be reduced so that they do not exceed those for existing conditions.
(d) whether the development will incorporate on-site stormwater retention, infiltration or reuse	Section 6.3 outlines the stormwater management proposed during construction and operation. For Quakers Hill WRRF, this will be refined during detailed design. However, it will likely include sediment basins during construction and considerations such as expanding the existing first flush system during operation.

Section 171A checklist (Development in regulated catchments)	REF finding
	The brine pipeline will be laid underground and will therefore not impact stormwater. Provision for on-site stormwater retention, infiltration or reuse along the brine pipeline alignment is not required.
(e) the impact of the development on the level and quality of the water table	Overall, the proposal is anticipated to require about 0.13ML of short-term dewatering throughout construction, with drawdown limited to within about 6 m of excavations. The implementation of mitigation measures in Table 6-14 are expected to adequately manage impacts to groundwater and residual impacts are expected to be minor. The fine screen feed pump wet well foundations may be subject to ongoing seepage throughout operation of the proposal. The magnitude and extent of drawdown will be similar to construction and not impact groundwater users or groundwater dependent ecosystems
(f) the cumulative environmental impact of the development on the regulated catchment	The proposal is required to meet increasing wastewater service demand in the Quakers Hill wastewater catchment. Potential impacts from the proposal are expected to be limited and localised. The proposal also has a benefit to the Hawkesbury-Nepean catchment by improving the quality of treated water releases into Breakfast Creek. With the implementation of the environmental mitigation measures in Section 6, the potential for cumulative impacts between the proposal and other projects within the catchment is low.
(g) whether the development makes adequate provision to protect the quality and quantity of ground water.	As detailed above, impacts to the level and quality of the groundwater are expected to be minor.
BCSEPP – Section 6.6(2) - Water quality and quantity Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied the development ensures:	
(a) the effect on the quality of water entering a natural waterbody will be as close as possible to neutral or beneficial	A key driver for the project is to improve the quality of treated water releases from Quakers Hill WRRF into Breakfast Creek. Appropriate mitigation measures are included in Table 6-12 to ensure that the proposal will have a neutral or beneficial effect on the water quality of the catchment.
(b) the impact on water flow in a natural waterbody will be minimised	The proposal will not significantly modify or adversely affect water flows within the catchment during either construction or operation.
BCSEPP – Section 6.7(1) - Aquatic Ecology In deciding whether to grant development consent to development on land in a regulated catchment, the consent authority must consider the following:	
(a) whether the development will have a direct, indirect or cumulative adverse impact on terrestrial, aquatic or migratory animals or vegetation	The proposal requires trimming and removal of vegetation within the impact area. No work is required in watercourses or waterbodies, so aquatic vegetation will not be impacted.

Section 171A checklist (Development in regulated catchments)	REF finding
	Direct, indirect or cumulative adverse impacts to terrestrial, aquatic or migratory animals or vegetation of the locality will not be significant. Vegetation removal will be offset.
(b) whether the development involves the clearing of riparian vegetation and, if so, whether the development will require: (i) a controlled activity approval under the *Water Management Act 2000*, or (ii) a permit under the *Fisheries Management Act 1994*	Clearing is required in the riparian zone. These impacts will be offset in accordance with the Sydney Water Biodiversity Offset Guideline. Sydney Water is exempt from the need to obtain a controlled activity approval under the *Water Management Act 2000*. A permit under the FM Act is not required for the proposal.
(a) Whether the development will minimise or avoid: (i) the erosion of land abutting a natural waterbody, or (ii) the sedimentation of a natural waterbody	Mitigation measures to minimise the potential for erosion and sedimentation impacts to adjacent waterways are included in Table 6-3 and Table 6-12.
(b) whether the development will have an adverse impact on wetlands that are not in the coastal wetlands and littoral rainforests area	There are no wetlands in proximity to the proposal.
(c) whether the development includes adequate safeguards and rehabilitation measures to protect aquatic ecology	Mitigation measures to protect aquatic ecology are included in Table 6-12. These are considered adequate to protect aquatic ecology.
(d) if the development site adjoins a natural waterbody, whether additional measures are required to ensure a neutral or beneficial effect on the water quality of the waterbody	Appropriate mitigation measures are included in Table 6-3 and Table 6-12 to ensure that the proposal will have a neutral or beneficial effect on water quality.
BCSEPP – Section 6.7(2) - Aquatic Ecology Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied of the following:	
(a) the direct, indirect or cumulative adverse impact on terrestrial, aquatic or migratory animals or vegetation will be kept to the minimum necessary for the carrying out of the development	Appropriate mitigation measures are included in Table 6-12, Table 6-29 and Table 6-55 to ensure that the cumulative impacts of the proposal on terrestrial, aquatic or migratory animals or vegetation are limited to the minimum extent necessary.
(b) the development will not have a direct, indirect or cumulative adverse impact on aquatic reserves	There are no aquatic reserves near to the proposal.

Section 171A checklist (Development in regulated catchments)	REF finding
(c) if a controlled activity approval under the *Water Management Act 2000* or a permit under the *Fisheries Management Act 1994* is required in relation to the clearing of riparian vegetation—the approval or permit has been obtained	Sydney Water is exempt from the need to obtain a controlled activity approval under the *Water Management Act 2000*. A permit under the FM Act is not required for the proposal.
(d) the erosion of land abutting a natural waterbody or the sedimentation of a natural waterbody will be minimised	Mitigation measures to minimise the potential for erosion and sedimentation impacts to areas adjacent to waterways are included in Table 6-3 and Table 6-12.
(e) the adverse impact on wetlands that are not in the coastal wetlands and littoral rainforests area will be minimised	There are no wetlands in proximity to the proposal.
BCSEPP – Section 6.8(1) – Flooding	
(a) In deciding whether to grant development consent to development on land in a regulated catchment, the consent authority must consider the likely impact of the development on periodic flooding that benefits wetlands and other riverine ecosystems	The proposal has the potential to impact flood behaviour by re-distributing flood flows during construction. Given the extent and magnitude of change, this is not expected to impact wetlands or any other riverine ecosystem. As the brine pipeline will be below ground, it will have no impacts on flooding.
BCSEPP – Section 6.8(2) – Flooding Development consent must not be granted to development on flood liable land in a regulated catchment unless the consent authority is satisfied the development will not:	
(a) if there is a flood, result in a release of pollutants that may have an adverse impact on the water quality of a natural waterbody, or	Mitigation measures to minimise the potential for erosion and sedimentation impacts to areas adjacent to waterways are included in Table 6-3.
(b) have an adverse impact on the natural recession of floodwaters into wetlands and other riverine ecosystems	The proposal will alter the existing contours of the land and introduce new structures within the Quakers Hill WRRF which will affect the overland flow behaviour of floodwaters. Given the extent and magnitude of change, this is not expected to impact wetlands or other riverine ecosystems. As the brine pipeline will be below ground, the risk of adverse impacts from future flood events that benefits riverine ecosystems during operation of the proposal is negligible.
BCSEPP – Section 6.9(1) - Recreation and public access In deciding whether to grant development consent to development on land in a regulated catchment, the consent authority must consider:	
(a) the likely impact of the development on recreational land uses in the regulated catchment	The proposal will be managed to ensure that access to recreational land is maintained where possible. However, during construction access will be restricted to some recreational land (e.g. at the working front of the brine pipeline and in construction compounds).

Section 171A checklist (Development in regulated catchments)	REF finding
	Once the proposal is built, the only ongoing impact to recreational land is a small area in Billy Goat Hill Reserve in Blacktown that will house a barometric loop. Potential impacts on recreational land will be managed with the mitigation measures in Table 6-41 and Table 6-47.
(b) whether the development will maintain or improve public access to and around foreshores without adverse impact on natural waterbodies, watercourses, wetlands or riparian vegetation	Not applicable
BCSEPP – Section 6.9(2) - Recreation and public access Development consent must not be granted to development on land in a regulated catchment unless the consent authority is satisfied of the following:	
(a) the development will maintain or improve public access to and from natural waterbodies for recreational purposes, including fishing, swimming and boating, without adverse impact on natural waterbodies, watercourses, wetlands or riparian vegetation	Not applicable
(b) new or existing points of public access between natural waterbodies and the site of the development will be stable and safe	Not applicable
(c) if land forming part of the foreshore of a natural waterbody will be made available for public access as a result of the development but is not in public ownership—public access to and use of the land will be safeguarded	Not applicable

Appendix C – Consideration of TISEPP consultation

TISEPP section	Yes	No
Section 2.10, council related infrastructure or services – consultation with council		
Will the work:		
Potentially have a substantial impact on stormwater management services provided by council?		✓
Be likely to generate traffic that will strain the capacity of the road system in the LGA?		✓
Connect to, and have a substantial impact on, the capacity of a council owned sewerage system?		✓
Connect to, and use a substantial volume of water from a council owned water supply system?		✓
Require temporary structures on, or enclose, a public space under council's control that will disrupt pedestrian or vehicular traffic that is not minor or inconsequential?	✓	
Excavate a road, or a footpath adjacent to a road, for which the council is the roads authority, that is not minor or inconsequential?	✓	
Section 2.11, local heritage – consultation with council		
Is the work likely to affect the heritage significance of a local heritage item, or of a heritage conservation area (not also a State heritage item) more than a minor or inconsequential amount?		✓
Section 2.12, flood liable land – consultation with council		
Will the work be on flood liable land (land that is susceptible to flooding by the probable maximum flood event) and will works alter flood patterns other than to a minor extent?		✓
Section 2.13, flood liable land – consultation with State Emergency Services		
Will the work be on flood liable land (land that is susceptible to flooding by the probable maximum flood event) and undertaken under a relevant provision*, but not the carrying out of minor alterations or additions to, or the demolition of, a building, emergency works or routine maintenance? * (e) Div.14 (Public admin buildings), (g) Div.16 (Research/ monitoring stations), (i) Div.20 (Stormwater systems)?		✓
Section 2.14, development with impacts on certain land within the coastal zone– council consultation		
Is the work on land mapped as coastal vulnerability area and inconsistent with a certified coastal management program?		✓
Section 2.15, consultation with public authorities other than councils		
Will the proposal be on land adjacent to land reserved under the *National Parks and Wildlife Act 1974* or land acquired under Part 11 of that Act*? If so, consult with DPE (NPWS).*		✓
Will the proposal be on land in Zone C1 National Parks and Nature Reserves or on a land use zone that is equivalent to that zone? *If so, consult with DPE (NPWS).*		✓
Will the proposal include a fixed or floating structure in or over navigable waters? *If so, consult*		✓

TISEPP section	Yes	No
TfNSW.		
Will the proposal be on land in a mine subsidence district within the meaning of the *Coal Mine Subsidence Compensation Act 2017*? *If so, consult with Subsidence Advisory NSW.*		✓
Will the proposal be on land in a Western City operational area specified in *the Western Parkland City Authority Act 2018,* Schedule 2 and have a capital investment value of $30 million or more? *If so, consult the Western Parkland City Authority*.		✓
Will the proposal clear native vegetation on land that is not subject land (ie non-certified land)? *If so, notify DPE at least 21 days prior to work commencing. (Requirement under s3.24 Chapter 3 Sydney Region Growth Centres - of the SEPP (Precincts – Central River City) 2021).*		✓

Appendix D – Surface Water Quality and Aquatic Ecology Assessment

See standalone document

Appendix E – Hydrology and Geomorphology Impact Assessment

See standalone document

Appendix F – Groundwater Assessment

See standalone document

Appendix G – Flooding Impact Assessment

See standalone document

Appendix H – Aboriginal Heritage Due Diligence Assessment

See standalone document

Appendix I – Statement of Heritage Impact

See standalone document

Appendix J – Biodiversity Assessment Report

See standalone document

Appendix K – Noise and Vibration Impact Assessment

See standalone document

Appendix L – Odour and Air Quality Impact Assessment Report

See standalone document

Appendix M – Traffic and Transport Impact Assessment

See standalone document

Appendix N – Waste Management Impact Assessment

See standalone document

Appendix O – Landscape and Visual Impact Assessment

See standalone document

Appendix P – Preliminary Hazards Analysis

See standalone document