BoorYul-Bah-Bilya
Mandoon Bilya (Helena River)

Baseline Surface Water and Sediment Sampling 2024-2025

Bibbul Ngarma Aboriginal Association Incorporated

A collaboration with the Local Health Authorities Analytical Committee, Shire of Mundaring, City of Kalamunda, City of Swan and Evergreen Consultancy WA

June 2026

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Details

This document was prepared by Francesca Flynn of Bibbul Ngarma Aboriginal Association Incorporated (BNAA) and Evergreen Consultancy WA Pty Ltd (Evergreen) with input from the wider BNAA team including Walter McGuire OAM and Callum Haines. Input was also sought from key stakeholders including:

- City of Kalamunda (Cameron Chisholm)
- City of Swan (Nathan Russell and Neil Harries)
- Shire of Mundaring (Shekofeh Elhani)
- Local Health Authorities Analytical Committee (LHAAC) (Ryan Janes)
- Department of Biodiversity Conservation and Attractions (DBCA) (Suzanne Thompson and Michelle VanCompernolle)
- Department of Water and Environmental Regulation (DWER) (Tim Storer and Dom Heald)
- Water Corporation (Clairly Lance and Michelle Phoenix)
- Eurofins ARL Pty Ltd (Natalie Hill)
- Senversa Pty Ltd (Katie Richardson)

Document Use

Information sharing and community education is an integral part of the BoorYul-Bah-Bilya program and is strongly encouraged for all non-sensitive data. Making information available to the community will allow BNAA to deliver the greatest possible value and help to unlock opportunities for future use, deliver more informed outcomes and reduce duplication of data collection.

Disclaimer

Summary

This report presents the findings of surface water and sediment sampling undertaken in the Mandoon Bilya (Helena River) catchment in September 2024 and 2025 by Bibbul Ngarma Aboriginal Association (BNAA). The objective was to improve understanding of the river's health and establish a multi-year baseline to support future work. The work is part of BNAA's BoorYul-Bah-Bilya (BBB) program.

The sampling was enabled through collaborative funding from local governments (Shire of Mundaring, City of Kalamunda and City of Swan) that was facilitated by the Local Health Authorities Analytical Committee (LHAAC), a statutory WA State Government entity under the *Health (Miscellaneous Provisions) Act 1911*.

This report also includes a summary of environmental DNA (eDNA) sampling undertaken in October 2025 with support from Lotterywest and Edith Cowan University. While the full eDNA results will be reported separately, key findings are included to provide a more comprehensive picture of river health.

Water and Sediment Quality

Water and sediment quality in the Mandoon catchment is shaped by natural geology, land-use pressures, and altered water flows caused by major water supply dams. Overall, the results are broadly consistent with findings from previous studies.

Salinity was low at most sites, with freshwater conditions recorded everywhere except Salty Pool. This site consistently had marginally brackish conditions due to its position downstream of Wundabiniring Brook, which is impacted by rising salinity due to historical land clearing in the upper catchment.

Dissolved oxygen levels were low across most of the catchment, reflecting the reduced water flows and limited natural aeration associated with the large water-supply dams.

Conductivity was elevated at all sites in the lower catchment, where urban land use and stormwater inputs contribute additional ions and sediment load, and also at Salty Pool in the upper catchment, where historical land clearing has resulted in rising salinity. Dissolved solids were elevated in the river's lower reaches where reduced flows limit sediment flushing and land clearing, bank erosion and urban runoff supply fine suspended material.

Nutrients (nitrogen and phosphorus) were elevated in both water and sediment throughout the catchment, reflecting a combination of natural attenuation processes and land-use influences. Of particular concern were the high nitrogen and nitrate levels in Piesse Brook, which suggest inputs from surrounding horticultural land in Pickering Brook and Bickley Valley, as well as elevated ammonia in the lower catchment at Whiteman Rd and Helena Roe, which indicate localised inputs and urban runoff.

Metals were also elevated in water and sediment, largely reflecting the catchment's natural geology, with iron and aluminium most abundant, followed by copper, manganese, vanadium and zinc. Some results suggest human influence, including elevated cadmium, mercury and uranium at Whiteman Rd which may relate to the former Bellevue Waste Facility or Midland Railway Workshops.

Major ions were elevated at Salty Pool, including chloride, fluoride, magnesium and sodium. Calcium and/or fluoride were also elevated in the lower catchment, suggesting potential human influence, while elevated fluoride at Beraking Yarra indicates a natural source in the river's headwaters.

Microbes and faecal bacteria were present across the catchment, as expected in most aquatic ecosystems. Elevated *E. coli* and *Enterococci* were recorded at all sites, while thermophilic *Naegleria* species and *Naegleria fowleri* were not detected at any site.

Per- and polyfluoroalkyl substances (PFAS) were detected throughout the catchment's surface water, consistent with levels observed across the Swan Canning system. Sediment detections were limited to the lower catchment only. PFOS was the most frequently detected PFAS compound, possibly due to its lower laboratory detection limit. PFAS contamination was highest in the lower catchment, including the most PFAS compounds detected and the greatest concentrations.

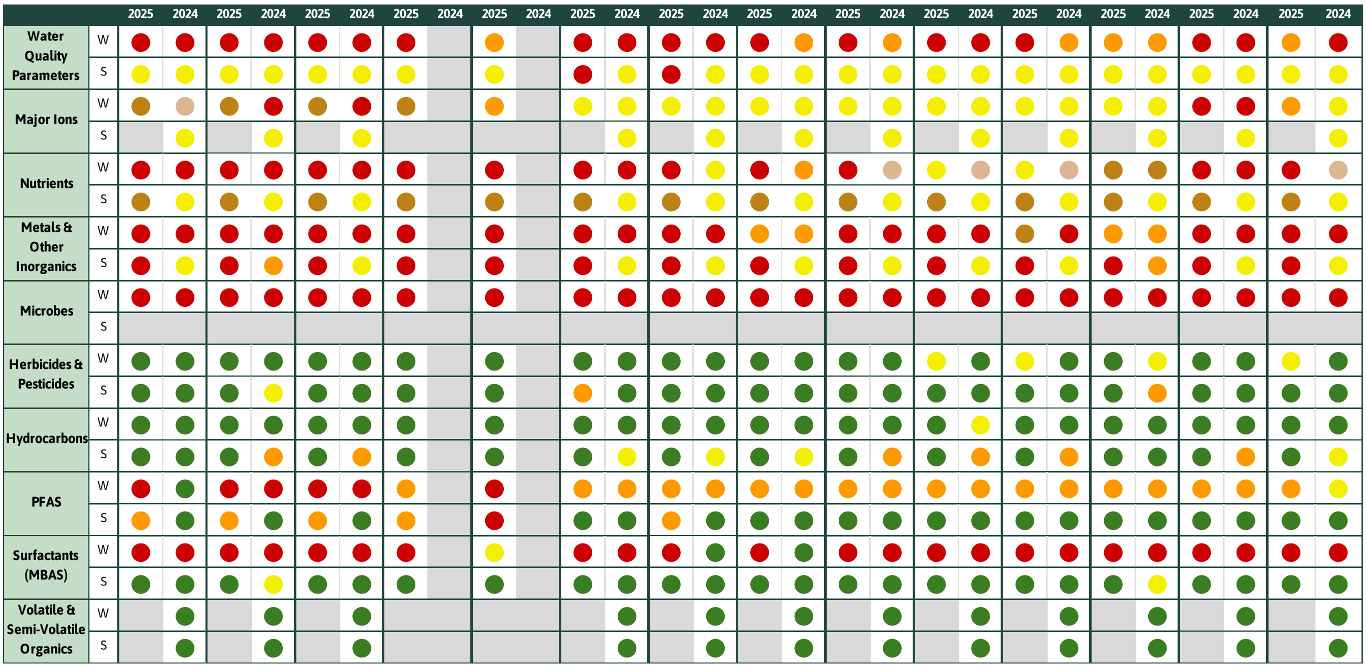
Anionic surfactants were also widespread in water, indicating the presence of foaming agents. The highest levels were at Salty Pool, where salinity and chloride may have influenced the results, although their extensive presence suggests at least some natural sources, such as saponins from local soap bush plants.

Hydrocarbons were rarely detected in water, with low levels of volatile hydrocarbons appearing at a single site in the middle catchment in 2024. Semi-volatile hydrocarbons were found in sediment across the catchment, including naphthalene at two lower catchment sites, although these only occurred as total concentrations. Leachable hydrocarbons were not detected in sediment, indicating that hydrocarbons are bound to the solid phase. It is unclear if the hydrocarbons are naturally occurring. BTEX and other PAH were not detected at any site.

Herbicides and pesticides were also uncommon. Dieldrin was detected at low concentrations in water at four sites, while low levels of bifenthrin, dieldrin, DDE and DDT were found in sediment at three sites.

Volatile and semi-volatile organic compounds were not reported at any site.

There were widespread exceedances of the default guideline values (DGVs) in water and sediment, indicating potential risks to freshwater ecosystems, human health and primary industries. Exceedances are summarised below.



- Exceeds human health and primary industries and/or freshwater ecosystem DGVs
- Exceeds freshwater ecosystem DGVs
- Exceeds freshwater ecosystem and primary industries DGVs
- Exceeds primary industries DGVs
- Detected below DGVs or no DGVs exist
- Not detected

W = Water sample
S = Sediment sample

Potential Risks to Freshwater Ecosystems

Risks may exist due to elevated PFOS, nutrients and metals, together with low dissolved oxygen and high conductivity at most sites. Additional risks may also arise from elevated fluoride at around half the sites, slightly acidic conditions at three sites, and pesticides at one site in the lower catchment.

Most elevated metals reflect naturally occurring aluminium, copper, iron, vanadium and zinc, suggesting local aquatic organisms may already be adapted to higher background concentrations. Other metals were elevated in leachable sediment only, and several solid-phase sediment exceedances were not reflected in water or leachate, indicating limited bioavailability.

Some DGVs were applied as screening criteria due to a lack of more suitable values, meaning catchment-specific guidelines would improve ecological risk interpretation. Although no guidelines exist for microbes in freshwater ecosystems, *E. coli* concentrations at all sites exceeded on-site wastewater disposal criteria for the Mandoon catchment.

Potential Risks to Human Health

Risks to drinking water are considered to be low. PFOS exceeded drinking water guidelines in the lower catchment only, downstream of the two water supply dams, where water is not used for drinking. Metals exceedances occurred in leachable sediment only, indicating that the metals are mostly bound to solids, and are not present in dissolved concentrations at levels of concern. Drinking water sourced from the catchment's water supply dams is treated to remove microbes and neutralise acidity before distribution.

However, risks may exist for non-potable water uses, such as domestic irrigation and private abstractions, due to elevated microbes and dissolved metals (aluminium and iron) at all sites, high turbidity at most sites, and PFOS in the lower catchment. Elevated biochemical oxygen demand and slightly acidic conditions at several sites may also contribute to localised risks. Unregistered private abstractions occur in the catchment, making PFOS exceedances in the lower catchment of particularly concern.

Risks to recreational use of the river may arise due to widespread microbial contamination and elevated metals at all sites, as well as elevated surfactants and ammonia at most sites, and slightly acidic conditions at a few locations. Of particular concern are the potentials risks to swimmers at Rocky Pool and Nyaania Pool due to elevated *E. coli*, *Enterococci* and ammonia.

Although fishing is prohibited in drinking water catchments, anecdotal evidence indicates that some people may still consume fish and crustaceans from the Mandoon catchment, including recreational fishers and Noongar people sourcing traditional foods. Given the widespread prevalence of PFOS, there is a potential human health risk associated with PFAS accumulation in aquatic animals that are subsequently consumed. There are currently no guidelines to address PFAS exposure through consumption of fish or shellfish, although Food Standards Australia New Zealand has set trigger points for PFAS concentrations in fish to indicate when further investigation or dietary restrictions may be required. Further assessment is warranted wherever PFAS is present and fishing or harvesting may occur.

Potential Risks to Primary Industries

Risks to primary industries through agricultural irrigation or livestock drinking water may also exist, due to elevated microbes, metals, nutrients or major ions at most sites, as well as elevated PFOS and total dissolved solids (TDS) in the lower catchment. PFOS is of particular concern for grazing properties in the lower catchment, because current livestock guidelines do not account for bioaccumulation or human consumption of affected animals. No guidelines exist to assess PFOS in agricultural irrigation water.

Conclusion

Overall, the most consistent issues across the catchment were low dissolved oxygen and elevated PFOS, nutrients, metals, dissolved solids and microbial contamination, reflecting a combination of natural processes, human influences and seasonal variability. Exceedances of default guideline values (DGVs) were widespread, indicating potential risks to freshwater ecosystems, human health and primary industries.

DGV exceedances were more frequent in the lower catchment compared to the middle and upper reaches, indicating a general decline in water quality downstream of the Lower Pumpback Dam. The poorest water quality occurred at Whiteman Rd and Helena Roe, both located immediately downstream of historical heavy industry and contaminated sites including the former Midland Railway Workshops and the former Bellevue Waste facility, the site of one of Australia's largest hazardous materials fires[1–4].

Localised issues were also evident elsewhere in the catchment. Elevated salinity in the upper catchment reflects historical land clearing, while high nitrogen and nitrate concentrations in Piesse Brook are likely associated with horticultural land uses. Although clearing is now carefully managed to limit rising salinity, the presence of mining tenements, and the potential for future strip mining, remains a significant risk. Alcoa recently withdrew exploration plans for the Mandoon catchment following strong public opposition, with advocacy from BNAA and local governments playing a key role [5–7]. However, mining remains a real possibility within tenements held by Alcoa, South32, Telupac and others. Any vegetation clearing for mining would be expected to increase salinity in the catchment, posing risks to aquatic ecosystems and drinking water[8]. BNAA maintains that strip mining poses unacceptable risks in drinking water catchments[9].

The results indicate that the river's health would benefit from increased water flows to raise dissolved oxygen levels, flush accumulated sediment, and dilute nutrients and other contaminants. Water Corporation currently releases water from the Lower Pumpback Dam in summer to maintain downstream habitat; however, there is no surface water allocation plan to guide these releases, and no releases occur from Mundaring Weir. Community members and scientists have long called for measures to enable water releases from Mundaring Weir to the middle catchment[10]. Restoring water flow throughout the catchment is a key long term aspiration of the BBB program, as identified by BNAA Senior Elders.

Site-specific strategies are also needed where land use drives poor water quality, particularly along Piesse Brook and in the lower catchment. In Piesse Brook, landowner education on fertiliser use could reduce nutrient loads. In the lower catchment, extensive clearing has significantly degraded the river's riparian zone and floodplain. Restoring these areas would help to moderate nutrient and sediment loads and attenuate localised contaminants. BNAA is working to establish the *Mandoon Bilya Riverpark* and restore riparian and floodplain areas along the lower river from the Derbarl Yerrigan (Swan River) to the Helena Valley foothills. This is expected to improve water quality while providing significant community amenity.

The current assessment is limited to the use of DGVs. DGVs are not available for all contaminants or exposure pathways, and exceedances do not necessarily indicate an impact, instead they indicate a need for further investigation. Determining actual impacts on aquatic ecosystems and water users would require a detailed risk assessment, which is beyond the scope of this report. Development of catchment-specific DGVs would provide a more accurate basis for assessing potential risks.

Overall, the sampling results highlight the need for continued monitoring and targeted management responses to address key pressures in the catchment, including protecting forested areas to help prevent rising salinity, restoring riparian and floodplain environments to moderate contaminants, nutrients and sediment loads, and improving community education to reduce localised inputs.

Recommendations

It is recommended to undertake similar sampling in September 2026 to enable comparison of results and build a three-year baseline. This is particularly important for sampling sites and laboratory analysis that were introduced for the first time in 2025, and also to help determine if variations observed in 2025 represent emerging trends or natural year-to-year variability. Consideration should also be given to:

- Additional sampling sites in the lower catchment to better characterise poorer water quality, as well as along Piesse Brook, to assess nutrient inputs to the Lower Pumpback Dam drinking water source.
- Analysis of total iron and chromium III concentrations, rather than dissolved, to align with new DGVs.
- Analysis of microplastics, trifluoroacetic acid (TFA) and/or other emerging contaminants of concern.
- Additional sampling events during low flow conditions, such as following the first heavy rains after summer (approximately April-June).
- Salinity testing in the upper catchment during both low and high flows, targeting both surface and bottom waters to assess potential stratification.
- Passive sampling to assess the presence of herbicides and pesticides at low concentrations.
- Development of catchment-specific DGVs to improve risk assessment, including consideration of the cultural and spiritual values of the river to Noongar people.
- Detailed risk assessment and/or ecotoxicology testing to determine actual impacts to human health and the environment, including exposure pathways that are specific to Noongar people during cultural practices.

Contents

Background

Less than 1% of major Western Australian rivers are in pristine condition[11]. River management is fragmented across multiple agencies and landowners, and despite the important work of many, river health continues to decline. In 2014, the WA Auditor General reported that both the community and parliament lack insufficient understanding of this decline, and that no comprehensive plan exists to guide the actions and resources needed for restoration[12]. If we are to reverse this trend, new approaches are urgently needed.

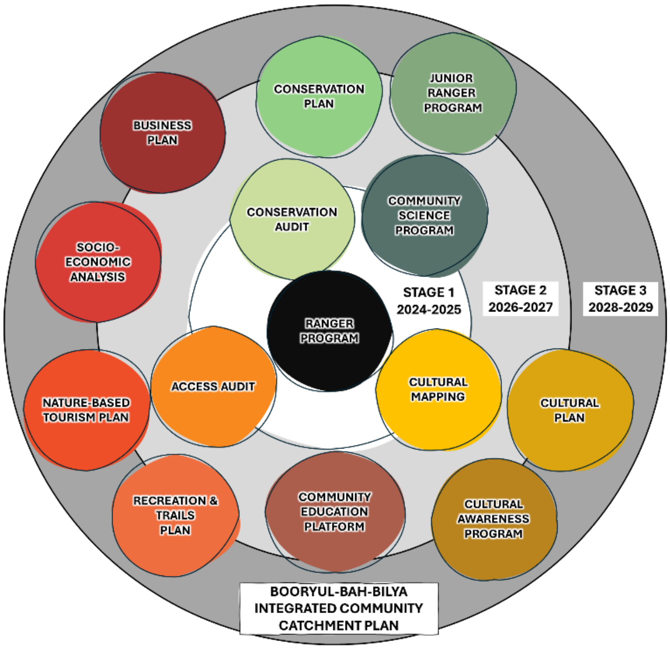
One such approach is the BoorYul-Bah-Bilya (BBB) program, developed by Bibbul Ngarma Aboriginal Association (BNAA). BNAA is an Aboriginal-led environmental charity located in the Perth Hills on Whadjuk-Noongar Boodja. We combine traditional Noongar knowledge, millennia of stewardship and modern scientific approaches to forge a shared, community-led journey to healing and reviving Country. Our work centres around restoring ecosystems, reinvigorating cultural heritage and strengthening communities through reconnection to Country.

BoorYul-Bah-Bilya (BBB) is our community-led program for healing Country. Through BBB, we are using the Mandoon Bilya (Helena River) to develop a transformative new model of river catchment management to mark the 2029 Perth Bicentenary. Our ambition is not only to restore one river, but to create a transferable model that inspires the revival of rivers across Australia and beyond.

BBB is the first program of its kind to integrate environmental, social, cultural and economic values at a landscape scale. Its grassroots approach ensures local knowledge is embedded throughout and invites the whole community to participate in a shared journey of healing and transformation.

The launch of the BBB model process and the accompanying integrated community catchment plan will coincide with the 2029 Perth Bicentenary – an important moment to reflect on the impact of colonisation on our rivers and the future challenges of a drying climate and growing population.

The BBB Rangers contribute to maintaining and enhancing the natural and cultural environment of the Mandoon Bilya (Helena River) catchment, while strengthening community connection to Country through culturally appropriate education and events. They are involved in in a wide range of activities, including land and water management; ecosystem restoration; conservation and biodiversity monitoring; biosecurity and pest management; weed and feral animal control; environmental sampling; fire management; cultural mapping; heritage preservation; cultural activities; and community events.



This report presents the results of surface water and sediment sampling undertaken in the Mandoon catchment in 2024 and 2025. It forms part of the BBB conservation audit, which aims to assess the river's ecological health.

The sampling was enabled by collaborative funding from three local governments (Shire of Mundaring, City of Kalamunda and City of Swan) that was facilitated by the Local Health Authorities Analytical Committee (LHAAC), a statutory WA Government entity under the *Health (Miscellaneous Provisions) Act 1911*. LHAAC funding supported the laboratory analysis, while sampling and reporting was self-funded by BNAA and Evergreen Consultancy WA. Sampling equipment was loaned by the Department of Biodiversity, Conservation and Attractions (DBCA).

This report also includes a summary of environmental DNA (eDNA) sampling undertaken in October 2025 with support from Lotterywest and Edith Cowan University. While the full eDNA results will be reported separately, key findings are included in this report to provide a more comprehensive picture of river health.

Objectives

To undertake surface water and sediment sampling that will improve understanding of the river's health and establish a multi-year baseline to support future work.

Mandoon Bilya (Helena River) Catchment

Mandoon Bilya (Helena River) flows from Ballardong and Gnaala Karla Booja near York and Beverley, through Mundaring and Kalamunda in the Perth Hills, down into Whadjuk Country through Midland, before joining the Derbarl Yerrigan (Swan River) in Guildford (refer **Figure 1**). The Mandoon catchment includes six local government areas: Swan, Mundaring, Kalamunda, York, Beverley and Northam, with small areas also located in Armadale and Wandering.

The catchment includes 900+ seasonal waterways that flow into the Derbarl Yerrigan as part of Mandoon Bilya including Darkin River, Beraking Brook, Pickering Brook, Piesse Brook, Nyaania Creek, Quenda Creek, Elder Creek, Bourkes Gully, Helena Brook, Wariin Brook and Kadina Brook (refer **Figure 2**). The waterways are predominantly fresh and ephemeral, flowing only in the wetter months, typically in the seasons of Makuru, Djilba and into Kambarang (approximately June to October).

The catchment has two dams, Mundaring Weir and the Lower Pumpback Dam, which supply public drinking water for areas of Perth and the Goldfields. The dams divide the catchment into three parts:

- Upper – upstream of Mundaring Weir
- Middle – between Mundaring Weir and Lower Pumpback Dam
- Lower – downstream of Lower Pumpback Dam

Water Corporation release water from the Lower Pumpback Dam in summer to maintain downstream habitat[13]. However, there are no releases from Mundaring Weir, meaning that the middle catchment is mostly devoid of water flow. Community members and scientists have called for measures to enable water flows from Mundaring Weir to the middle catchment[10]. Restoring some water flow is also an important long term aspiration of the BoorYul-Bah-Bilya program as identified by BNAA Senior Elders.

Land use in the upper catchment is mostly state forest, drinking water catchment, forestry plantations and conservation estate managed by state government agencies, with a few private properties used for agriculture and sand mining. Land use in the middle catchment has many more private residences in suburbs like Glen Forrest, Darlington and Mahogany Creek, as well as properties associated with agriculture, viticulture and tourism. This includes Piesse Brook, a major tributary that flows from Pickering Brook townsite through the Bickley Valley tourism precinct and into the Lower Pumpback Dam. Most of the lower catchment has been developed for private residential, commercial and industrial use, with the river forming a thin green corridor through the suburbs of Guildford, Woodbridge, Midland, Hazelmere, Bellevue, Boya, Koongamia, Bushmead and Helena Valley.

Noongar people are recognised as the Traditional Owners of the catchment by the South West Native Title Settlement. The catchment is predominantly within Whadjuk country with the easternmost area within Ballardong and the southernmost in Gnaala Karla Booja (refer **Figure 1**). The river is highly significant to Noongar people. In Noongar culture, the river was formed by the Wagyl, the Great Creation Spirit. The river continues to sustain Noongar people with freshwater, food, medicine and provides an important route from Whadjuk to Ballardong Country.

When Europeans arrived in 1829, they immediately recognised the river's value. They renamed it "Helena River", likely after the sister of Ensign Robert Dale, a 19 year old who explored the river and hills east of Perth in 1829[14,15]. They quickly divided up the river for the Swan River Colony and forced Noongar people off the land. By 1832, Noongar leader Midgegooroo was captured on the banks of the Mandoon Bilya and executed days later by firing squad without trial, after acting-Governor Irwin declared him and son Yagan

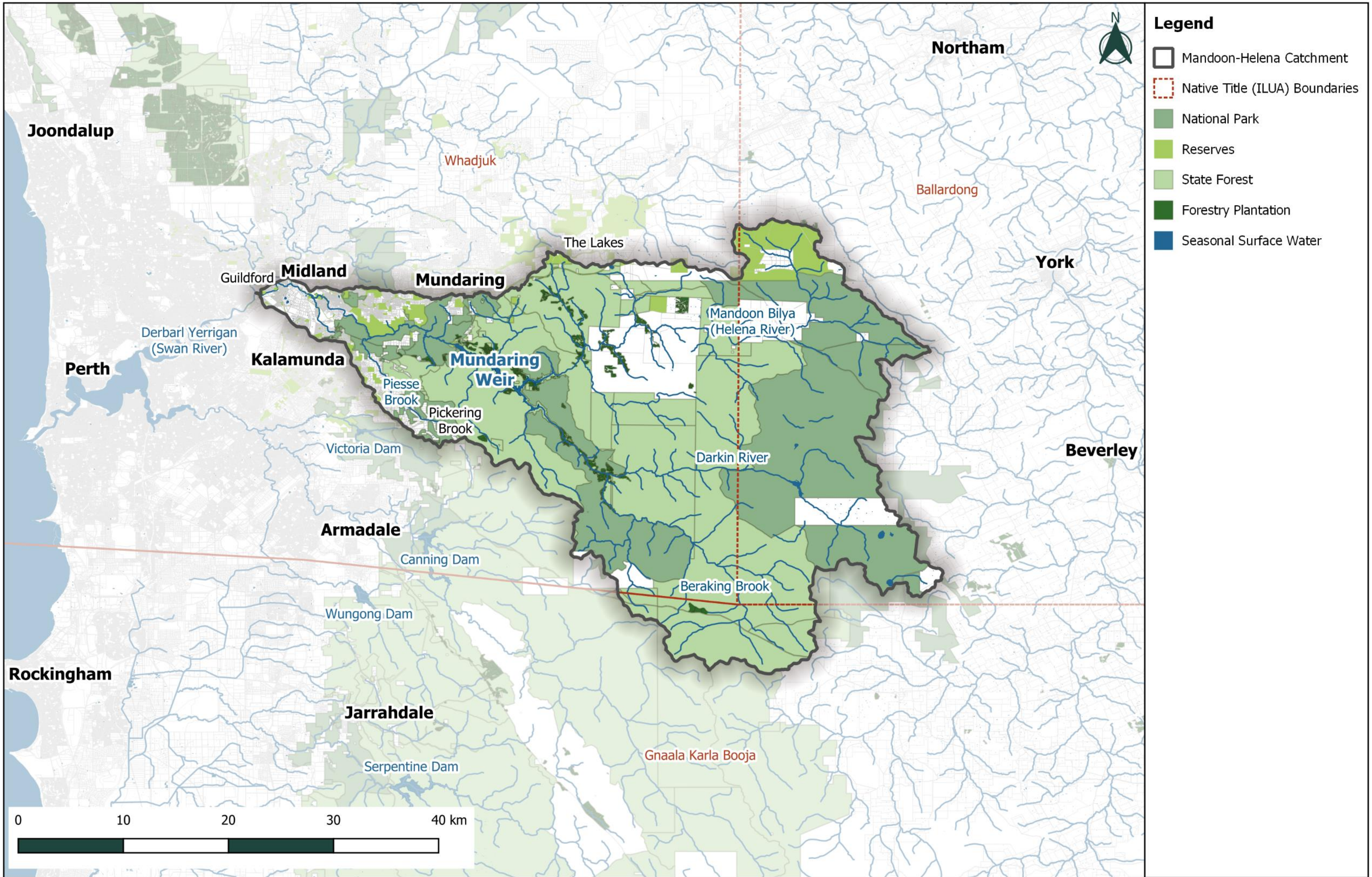


Figure 1 Mandoon Bilya (Helena River) Catchment Location

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Data Sources: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan

Ref: BBB-MBHR-BWQS-001
Date: 12 December 2025

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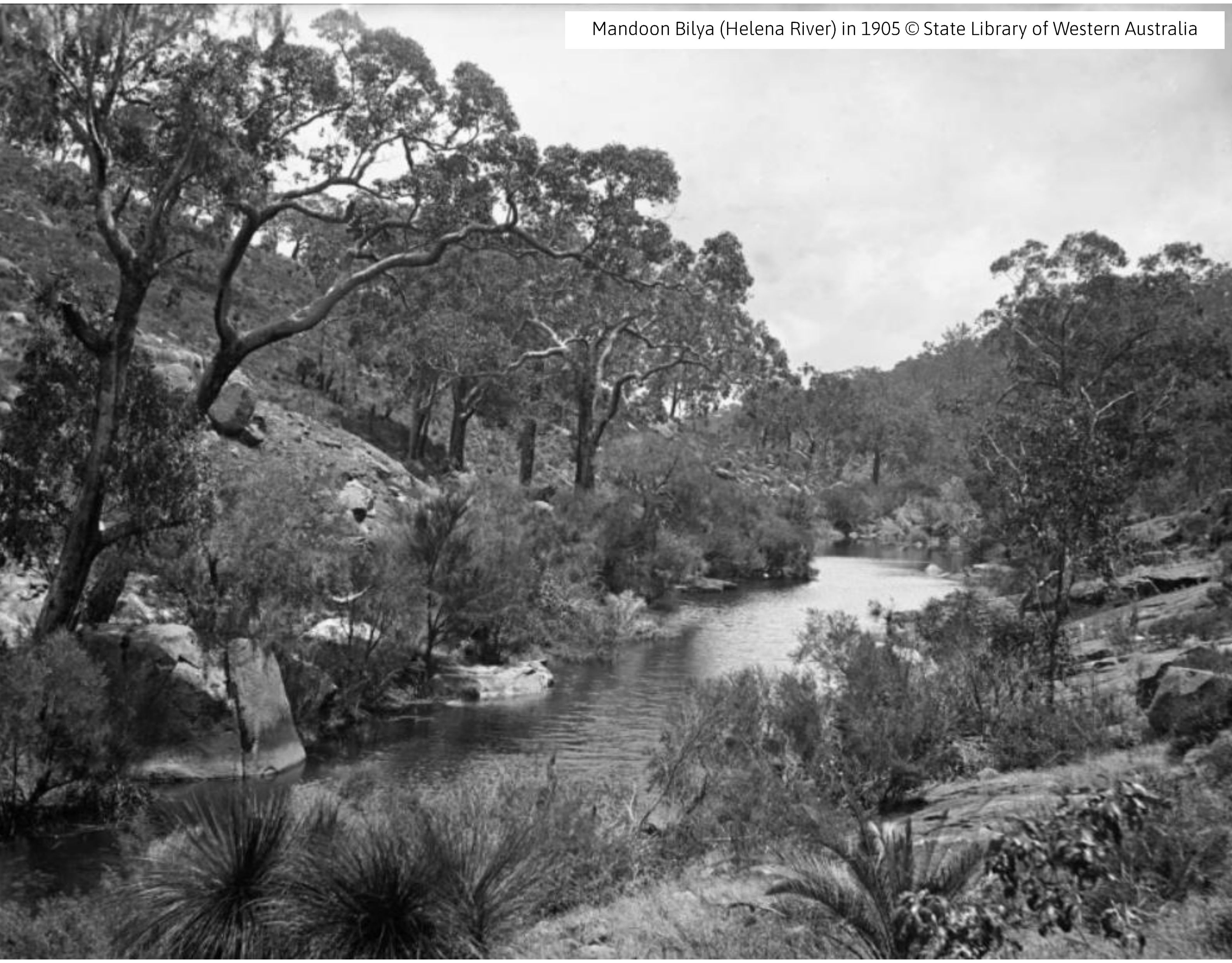
outlaws for their role in Noongar resistance[16]. Yagan was captured weeks later, his head cut off, smoked, and sent to England for display, coincidentally transported by Robert Dale[17].

By 1903, Mundaring Weir had been built, flooding a deep valley in the upper catchment, and C Y O'Connor's "Golden Pipeline" now transported the river's water 526 km east to the desert[18]. Construction of Mundaring Weir fuelled the gold rush, giving rise to Kalgoorlie and the Goldfields, and permanently altering the course of what we now know as Western Australia[19–21]. The Lower Pumpback Dam was constructed in 1971 to collect runoff from the middle catchment and supplement Mundaring Weir via the pumpback pipeline[8].


Mandoon Bilya (Helena River) in 1905 © State Library of Western Australia

The Mandoon catchment has very high ecological, cultural and social significance:

- Entire river is an Aboriginal heritage site with 40+ individual sites registered along its length.
- Lower floodplain has the second oldest archaeological site in southwest WA, dated at 29,000 years[22].
- Important public drinking water source via Mundaring Weir and the Lower Pumpback Dam.
- Relatively unknown river that is often overlooked compared to other Perth rivers.
- Significant freshwater system of waterways, wetlands and groundwater-dependent ecosystems.
- Large and regionally significant natural space (approx. 1,655 km^2).

- Important biodiversity habitat with 3 biogeographic regions: Swan Coastal Plain, Jarrah Forest and Avon Wheatbelt.
- Only major river valley in Perth that is still relatively natural with large areas of native vegetation and few sealed roads in the upper catchment.
- Seven National Parks: Beelu, Greenmount, Gooseberry Hill, Helena, Kalamunda, Korung, Wandoo.
- Home to threatened and priority plants and animals including chuditch, numbat, quenda, Western ringtail possum, Dell's skink, Muir's corella, white egret, rainbow bee-eater, peregrine falcon, Carters freshwater mussel, three black cockatoo species, quokkas and Balston's pygmy perch. Both the quokka and Balston's pygmy perch were thought to be locally extinct and were discovered through BBB program activities[23–25].
- Home to three Black Cockatoo species (Forest Red Tailed, Carnaby's and Baudin's)[23].
- Home to 5 threatened and protected ecological communities including the priority 4 *Central Northern Darling Scarp Granite Shrubland* and critically endangered *Shrublands and Woodlands of the Eastern Side of the Swan Coastal Plain*[23].
- The catchment's granite outcrops and claypan wetlands, including Darkin, Little Darkin, Goonaping and Dobaderry, have particularly unique ecological and cultural values[26,27].
- Some of the oldest geology in the world: Archaean granite formed 2,600 million years ago[28].
- Contains the trailheads for the Bibbulmun Track, Munda Biddi Foundation and Kep Track.

Middle Mandoon Catchment near Glen Forrest

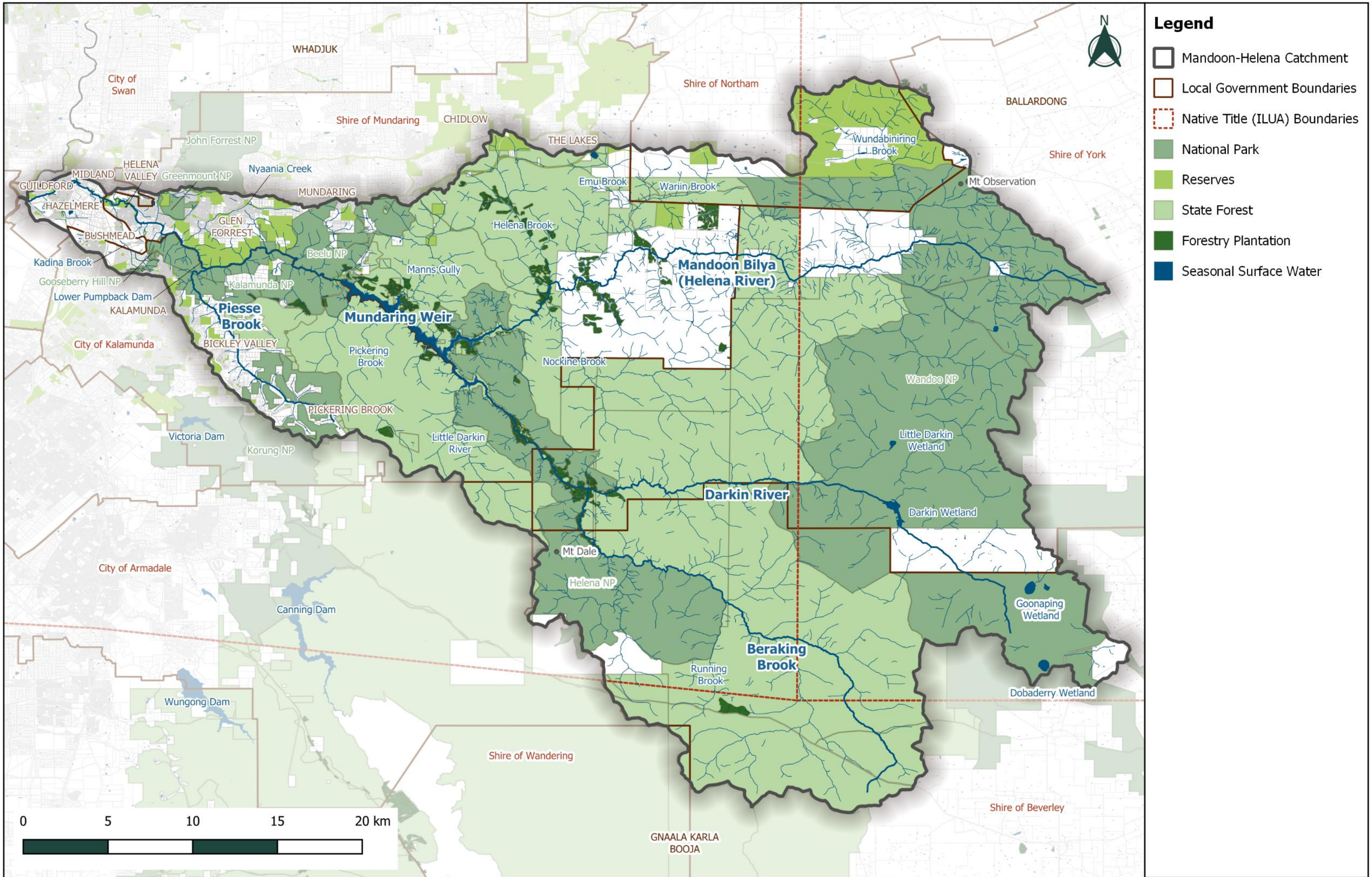


Figure 2 Mandoon Bilya (Helena River) Catchment Seasonal Waterways

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Data Sources: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan

Ref: BBB-MBHR-BWQS-002
Date: 12 December 2025

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Mandoon Catchment Management

Management of the Mandoon catchment is highly fragmented, with responsibility shared by many state and local government agencies, each with different legislation. Work effort and priorities are focused on individual legislation, with widely varying resources and capacities across agencies. Outside of the drinking water catchment area, no one agency has overall responsibility, meaning there is no overarching plan for the entire catchment. The complexity of current governance structures that manage the river's values is demonstrated in the simplified diagram below (**Diagram 1**) and summarised in **Appendix 1**.

Row groups: WA Government Departments; WA Government Agencies and Bodies; Local Government; Native Title Bodies; Non-Governmental Organisations; Residents, Businesses, Education and Others

Water & Natural Resources

- **DWER** Manages water resources incl. Mundaring Weir Catchment
- **DEED** Manages mining under State Agreements e.g. Alcoa
- **DMPE** Regulates mining activities
- **DOH** Regulates drinking water quality to Australian Drinking Water Guidelines
- **Water Corporation** Supplies drinking water, wastewater and drainage
- **Advisory Committee for Purity of Water** Monitors drinking water quality for DOH
- **Forest Products Commission WA** Manages state forest and plantations
- **WA Conservation and Parks Commission** Advises Minister on conservation
- **Action Sand Supplies** Operates sand quarry in Upper Mandoon
- **Mining Companies** Hold mining tenements e.g Alcoa, South32, Telupac
- **Acciona Agua** Operates Water Treatment Plant at Mundaring Weir
- **Others** Businesses incl. mining, agriculture, viticulture, forestry
- **Others** Private properties with on-site wastewater disposal

Environment & Biodiversity

- **DWER** Manages environmental regulation incl. licenses/permits
- **DBCA** Manages forest, conservation estate, biodiversity, threatened species and Swan-Canning Riverpark, incl. lower Mandoon Bilya
- **DPIRD** Administers Fish Resources Management Act 1994
- **Swan River Trust** Advises DBCA on management and protection of Swan-Canning Riverpark
- **WA Environmental Protection Authority** Advises Minister on scheme assessments and significant land use proposals
- **6 Local Governments** Sets environmental strategy, manages local reserves, supports volunteers
- **EMRC** Flood assessments in Perth's Eastern Region
- **Others** Private properties that include riverbank and floodplain e.g. Helena River Waldorf School and private residences

Planning & Land Use

- **DPLH** Sets land use, planning and administration regime
- **DWER** Advises planning authorities about water resources, waterway foreshores and environment
- **DBCA** Manages land use and development in Swan-Canning Riverpark, advises planning authorities about conservation and biodiversity
- **WAPC** Advises DPLH on planning, holds large areas of land along lower Mandoon Bilya
- **Development WA** Develops areas of lower Mandoon foreshore
- **6 Local Governments** Sets local planning scheme, manages private development
- **Others** Residential, commercial and industrial properties incl. farms, orchards, wineries and nurseries

Planning & Land Use / Culture, Arts & Heritage

- **Whadjuk, Ballardong and Gnaala Karla Booja Aboriginal Corporations** Manages land and heritage under Southwest Native Title Settlement, advises planning authorities about cultural heritage protection

Environment & Biodiversity / Planning & Land Use

- **Landcare Organisations** Delivers environmental, landcare and regenerative agriculture programs e.g. Trillion Trees, Perth NRM
- **Volunteer Groups** Works with DBCA and Local Gov to deliver landcare projects e.g. Lower Helena Association, Friends of Piesse Brook
- **Community Groups** Environmental interest groups e.g. Darling Range Naturalists, WA Wildflower Society

Culture, Arts & Heritage

- **DPLH** Manages heritage assets incl. registered Aboriginal heritage sites
- **DCITS** Supports creative industries and multicultural interests
- **Heritage Council WA** Advises Minister for Heritage on WA heritage matters and registered sites
- **6 Local Governments** Sets local heritage strategy and RAP

  6 LGAs = City of Swan, City of Kalamunda, Shire of Mundaring, Shire of York, Shire of Beverley, Shire of Northam
- **National Trust** Manages Mundaring Weir Heritage Precinct incl. No. 1 Pump House and Golden Pipeline Heritage Trail
- **Community Groups** Preserves heritage e.g. Darlington History Group, Guildford Association
- **Others** Private properties with heritage listing or sites

Economy & Public Services

- **DTMI** Manages transport and major infrastructure
- **DFES** Manages fire and emergency response
- **DEED** Manages energy and economic diversity
- **Main Roads WA** Maintains main roads incl. major road bridges
- **Western Power** Manages power corridors
- **State Emergency Management Committee** Sets emergency policy framework
- **6 Local Governments** Manages local road network and bridges, bushfire mitigation in local reserves
- **Bibbulmun Track** Manages long-distance walk trail through Mandoon catchment
- **Munda Biddi Trail Foundation** Manages long-distance bike trail through Mandoon catchment
- **Kalamunda Mountain Bike Collective** Maintains mountain bike trails in middle catchment
- **Hiking Clubs** Promotes and advocates trails e.g. Trails WA, Hikewest, Orienteering WA

Sport, Leisure & Tourism

- **DBCA** Manages visitor and tourism services in the Swan-Canning Riverpark, national parks and state reserves
- **DWER & Water Corporation** Regulates public access and land use in public drinking water source areas
- **DCITS** Supports tourism, sport and recreation
- **Tourism WA** Promotes WA as a premier visitor and leisure destination
- **Perth Hills Tourism Alliance** Local Gov collaboration
- **Destination Perth** Promotes Perth Hills tourism sub-region
- **Track Care WA** Maintains tracks and supports access
- **East Suburbs 4WD** Maintains 4wd tracks in upper catchment
- **Perth Polo Club** Operates polo club on lower Mandoon Bilya
- **Tourism Businesses** Operates in catchment e.g. Off the Beaten Track, Rock n Roll Mountain Biking
- **West Cycle** Promotes WA cycling and mountain biking

Economy & Public Services / Sport, Leisure & Tourism

- **Others** Private properties used for recreation, leisure or tourism in the catchment e.g. Darlington Winery, Mundaring Weir Hotel, Chalet Rigi

All columns

- **Research & Education Institutes** Undertaking research and data collection on various aspects of the Mandoon Catchment

Diagram 1 Mandoon Catchment Simplified Governance

Mandoon Catchment Health

Based on our current understanding, the Mandoon Bilya is not in great health. Due to a drying climate and up to 40% less rainfall since the 1970s[29], the catchment's streams no longer provide enough water flow to fill the dams[29]. Desalinated water and groundwater must be pumped into Mundaring Weir to maintain adequate drinking water supply[30].

Decades of water abstraction from the dams have taken their toll on the river's values. Impacts include low water flows, loss of habitat, disconnection of pools, siltation, barriers to fish movement, limited gene flow, poor water quality, low oxygen and restricted public access[23]. Many river pools are no longer permanent and the lower reaches are heavily sedimented[31]. Catchment-wide threats such as Phytophthora dieback, feral species, weeds, erosion, sedimentation, unauthorised vehicle access, unsealed tracks, mining, water extraction and increased bushfire risk contribute to the extraordinary pressure placed on the river[32,33].

Studies in 2001 and 2018 revealed extensive weeds, degraded vegetation, eroded riverbanks and a mostly cleared lower floodplain[23,34]. Sampling has identified pollutants such as nutrients, hydrocarbons, metals, pesticides, herbicides, surfactants and per- and polyfluoroalkyl substances (PFAS) in the river[32,35–40].

Decline of riverbank vegetation has been recorded at the river's confluence with the Derbarl Yerrigan (Swan River) in Guildford since 2010[41]. Studies confirm that numbers of native fish, crayfish, mussels and invertebrates have declined, likely due to a combination of pressure from low water flows, drying of pools, vegetation clearance, habitat degradation, poor water quality and feral species[10,13,42,43]. It is thought that deformed freshwater mussels found in the river may demonstrate chronic effects of water pollution[44,45].

The river is predominantly fresh but is highly vulnerable to rising salinity caused by land clearing[8,46–50]. Shortly after construction of Mundaring Weir, over 20,000 acres of trees were ringbarked to increase water flow into the dam[51,52]. This caused increased salinity in Mundaring Weir, although it was not until the 1920s that there was widespread acceptance of the link between clearing and salinity[8]. The lessons were short lived when forest clearing resumed between the 1940s and 1970s, however, the government eventually adopted a strategy to purchase freehold land to protect and reforest [8]. Now, even though 97% of the weir's catchment is forested, the salinity of runoff is very sensitive to the remaining 3% that is not forested[8]. Salinity impacted runoff still occurs in the upper north-east of the catchment where land was historically cleared[8]. Rising salinity is exacerbated by a drying climate, reduced rainfall and increased evaporation[8].

Although clearing is now carefully managed to limit rising salinity, the presence of mining tenements, and the potential for future strip mining, remains a significant risk. Alcoa recently withdrew exploration plans for the Mandoon catchment following strong public opposition, with advocacy from BNAA and local governments playing a key role[5–7]. However, mining remains a real possibility within tenements held by Alcoa, South32, Telupac and others. Any vegetation clearing for mining would be expected to increase salinity in the catchment, posing risks to aquatic ecosystems and drinking water[8]. BNAA maintains that strip mining poses unacceptable risks in drinking water catchments[9].

Perth has undergone a rapid expansion of population and infrastructure in recent years, with extensive clearing of native vegetation and floodplain development. Mandoon's middle and upper reaches are largely protected from urban development by the presence of drinking water catchment and national parks. However, the lower floodplain and its few remaining wetlands are highly vulnerable to a continuous pressure to develop land for Perth's growing population. The floodplain is gradually being rezoned and infilled for housing as the government pushes towards a target population of 3.5 million in Perth by 2050, compared to the current population of 2.45 million[53–62]. As a result, the floodplain has lost most of its "Guildford Complex", a rare and threatened vegetation type, and developments continue to be approved that will clear what little remains.

Since colonisation, the river has had a history of neglect. The lower reaches have a legacy of industrial land use and historical contaminated sites including the former Midland Railway Workshops, OPEX oil refinery, brickworks, a tannery and an abattoir[63–71]. Stockpiles of contaminated soil that were excavated from the railway workshops still remain on the river's floodplain in Midland[65,72,73]. The former Bellevue Waste Facility was the site of one of Australia's largest hazardous materials fires in 2001[1–4]. Post-fire monitoring revealed that groundwater beneath the site was contaminated with hydrocarbons and halogenated solvents and was migrating toward the Mandoon Bilya[74–79]. Nearly a decade later, WA's first permeable reactive barrier was installed to prevent this from reaching the river and the adjacent floodplain 'damplands'[80].

Threats to the river's health are exacerbated by complex land ownership, fragmented management and lack of investment in landcare. Catchment land use includes a mix of private property, conservation estate, drinking water catchment and state forest that stretches over six local governments and at least six state government agencies. Management is governed by a complicated web of overlapping policies and plans[31].

There is a widespread lack of awareness about the value of Mandoon Bilya (Helena River) compared to the Derbarl Yerrigan (Swan River) and Djarlgarro (Canning River). A common misconception is that Mandoon is not a "real" river due to its reduced flows following dam construction. This has contributed to a broader failure to recognise the significance of the lower floodplain, despite its high ecological and cultural values, with its wetlands largely overlooked.

Many people remain unaware of both the importance of Mandoon Bilya and its vulnerability to incremental threats. Proposals such as rerouting a heavy freight rail line directly through the river valley[80], and a recent planning application by GreenSquareDC to construct a hyperscale data centre within 40 metres of the lower river, demonstrate a deep lack of understanding of the river's ecological and cultural values. The data centre application was withdrawn in May 2026 following strong community opposition by BNAA, Helena River Waldorf School, and numerous local community groups[81,82].

Limited access to many parts of the river contributes to growing community disconnection, reducing awareness of its vales and weakening support for its protection. In this sense, Mandoon Bilya is threatened not only by environmental pressures, but also by a lack of public knowledge and appreciation. A 2014 report by the WA Auditor General found that despite numerous plans and strategies, the Swan Canning river system is inadequately protected and its water quality continues to decline[12]. The report noted that although long-term monitoring data exists, it has not been effectively used to inform the community or parliament about the river's deterioration, and that there is no overarching plan outlining the actions and resources required to restore river health. The 2015 *Swan Canning River Protection Strategy* aimed to address these issues; however, it excludes the Avon River, one of the Swan's major tributaries, and only applies to the lower reaches of Mandoon Bilya up to the Lower Pumpback Dam[83].

Declining health is not unique to Mandoon Bilya. Among Western Australia's 208 major rivers, fewer than 1% are in "pristine or near pristine" condition[11]. River management is working as designed by government, and there are many people and organisations doing great work, yet river health continues to decline.

Globally, rivers are under similar threat from population growth, urban expansion and climate change. Common risks include pollution, acidification, vegetation decline, altered flow, erosion and sedimentation. Internationally, there have been recent calls by scientists to give rivers the same legal rights to exist as people to protect them for the generations of the future[84,85]. In Australia, Birrarung, or the Yarra River, was the first to be legally recognized as a living entity in 2017, although it was not granted legal personhood[86].


Helena Roe site in the lower catchment

Water and Sediment Quality Monitoring

Water and sediment quality are critical indicators of river health that guide how water resources are managed. Key monitoring programs in the Mandoon Bilya catchment are outlined below.

DBCA Swan Canning Water Quality Monitoring Program

The *Swan Canning Water Quality Monitoring Program* is a long-term routine water monitoring program that supports the Department of Biodiversity, Conservation and Attractions (DBCA) in managing the Swan Canning Estuary, including the lower Mandoon Bilya up to the Lower Pumpback Dam. The program tracks water quality and assesses compliance with nutrient targets established under the *Swan Canning Cleanup Program*[87]. It measures a suite of nutrients and water quality parameters, and data is available in the Water Information Reporting (WIR) platform: (https://wir.water.wa.gov.au/Pages/Water-Information-Reporting.aspx). The program monitors one site on the Mandoon Bilya, located at Whiteman Road.

DWER Healthy Rivers Program

The Department of Water and Environmental Regulation (DWER) coordinates the *Healthy Rivers* program, which collects data and develops management solutions to improve river health. Assessments use standard methods from the *South West Index of River Condition*[88] including physical form, land use, hydrology (flow), fringing vegetation, water quality (nutrients and water quality parameters), and aquatic biota (fish, crayfish and macroinvertebrates).

Until recently, two *Healthy Rivers* sites had been monitored on the Mandoon Bilya: Whiteman Road in the lower catchment (Whiteman Road–SWN10) and Looksee Pool in the middle catchment (Mundaring Weir Downstream–HRDSMW). Both sites were last assessed by DWER in 2012 and were sampled by BNAA as part of the current assessment. In December 2025, DWER and BNAA collaborated to undertake *Healthy Rivers* assessments at two sites in the upper Mandoon catchment for the first time. The results will be published on the *Healthy Rivers* website in 2026. BNAA continues to work with DWER to explore further opportunities for assessments in the catchment, including potential sites on the Darkin River and Beraking Brook.

Other Studies

Most government monitoring is focused on nutrients and salinity, with the major exceptions listed below. These studies have detected a range of pollutants in the river's water and sediment, including hydrocarbons, metals, microbes, pesticides, herbicides, surfactants and PFAS.

- *Assessment of Per- and Poly-Fluoroalkyl Substances (PFAS) in Surface Water and Biota of the Swan Canning Estuary and its Catchment* (DBCA, 2022)[38] – one site on the lower river.
- *Assessment of Contaminants in the Sediments of the Swan Canning Estuary* (DBCA, 2022)[39] – one site on the lower river.
- *Helping the Helena* (EMRC, 2014)[32] – eight sites downstream of Mundaring Weir.
- *Baseline Study of Contaminants in the Swan and Canning Catchment Drainage System* (DOW, 2009)[36] – one site on the lower river.
- *Baseline Study of Contaminants in the Sediments of the Swan and Canning Estuaries* (DOW, 2009)[37] – one site at the confluence with the Derbarl Yerrigan (Swan River).
- *Baseline Study of Organic Contaminants in the Swan and Canning Catchment Drainage System using Passive Sampling Devices* (DOW, 2009)[35] – one site on the lower river.

Other studies that contribute to our understanding of the river's health include:

- 2020 'Fish Response to Flow in the Lower Helena River'[89]
- 2019 'Lower Helena River Ecological Condition Assessment'[90]
- 2018 'Helena River (Mandoon) Tributary Foreshore Assessment'[23]

- 2014 'Evaluation of Environmental Water Releases on the Aquatic Fauna of the Helena River'[13]
- 2011 'Freshwater Mussel Response to Drying in the Lower Helena Pipehead Dam'[44]
- 2011 'Helena River Fish and Macroinvertebrate Surveys'[42]
- 2010 'Lower Helena River Trial Environmental Releases'[10]
- 2007 'Helena River Salinity Situation Statement'[8]
- 2006 'Helena River Freshwater Fish Habitat Survey'[43]
- 2001 'Foreshore Assessment in the Helena River Catchment'[34]
- 1999 'Stream Salinity Response to Clearing and Revegetation of the Helena Catchment'[50]
- 1991 'Lower Helena Catchment Water Quality Study'[91]
- 1990 'Bioaccumulation of Pesticides by Freshwater Mussels in Lower Helena River'[45]
- 1987 'Environment and Recreation Study of the Lower Helena Water Catchment'[92]

BoorYul-Bah-Bilya Baseline Sampling 2024

Surface water and sediment were sampled from 12 sites across the Mandoon catchment in September 2024 as part of the BBB program[40]. The findings are summarised below and presented alongside the 2025 results in this report.

- The river is predominantly fresh, although elevated salinity was recorded in the upper northeast of the catchment, consistent with historical vegetation clearing.
- Dissolved oxygen levels were low at most sites, likely influenced by the presence of the large water supply dams, and slightly acidic conditions were observed at several locations.
- Nutrient concentrations were elevated, particularly nitrogen in Piesse Brook near agricultural areas.
- Pesticides were detected at two sites: dieldrin at Piesse Brook and DDT/DDE in the lower river.
- Metals were elevated at most sites, reflecting naturally occurring elements, although some results suggested possible human influence, particularly in the lower catchment and in Piesse Brook.
- Microbial contamination was widespread, with all sites reporting faecal bacteria. Thermophilic Amoebae were detected at three sites although *Naegleria* species were not identified at any location.
- Hydrocarbons were elevated in sediment at most locations, although it is unclear whether these are naturally occurring. Hydrocarbons were not detected in water except for very low levels at one site.
- PFAS were detected in water all but one site, with concentrations exceeding the ecosystem guidelines at almost all sites, and the human health and livestock guidelines at two sites in the lower catchment.
- Surfactants were elevated at most locations.
- Volatile and semi-volatile organic compounds were not detected at any location.
- Water quality was generally lower within the lower catchment.

Recommendations were made to repeat a similar sampling program in September 2025 to allow comparison of results and begin building a multi-year baseline, with the following suggested amendments:

- Analysis of dissolved metals, rather than total metals, to assess bioavailability.
- Analysis of leachable concentrations in sediment, rather than total concentrations, to provide a better metric for risk assessment.
- Silica gel clean-up of any detectable hydrocarbons to assess if they are petroleum based.
- Additional sampling sites in the lower catchment, to better characterise poorer water quality, and at Nyaania Pool, a known swimming location.

Contaminants of Potential Concern

Contaminants of potential concern (COPC) can enter the environment via a range of industrial, agricultural, rural, recreational, residential and ecological activities. Previous studies indicate that the river contains a range of pollutants, including hydrocarbons, metals, microbes, pesticides, herbicides, surfactants and PFAS[32,35–40]. The catchment is also highly sensitive to rising salinity due to vegetation clearing[8].

COPC were identified through review of current and past land uses, including:

- Historical land use e.g. Bellevue Waste Facility, OPEX Oil Refinery and Midland Railway Workshops.
- Agricultural land use, wineries and orchards along Piesse Brook in Bickley Valley and Pickering Brook.
- Land clearing in the upper catchment associated with agriculture, sand mining and forestry.

COPC are presented in full in **Appendix 2** and summarised below:

- Herbicides and pesticides
- Hydrocarbons (polyaromatic hydrocarbons (PAH) and petroleum hydrocarbons (TPH))
- Metals, major ions and other inorganics
- Microbes
- Nutrients
- Per- and polyfluoroalkyl substances (PFAS)
- Surfactants
- Volatile and semi-volatile organic compounds (VOC/SVOC) and polychlorinated biphenyls (PCB)
- Water quality parameters

All COPC were analysed in 2024[40], whereas the 2025 analysis was amended slightly, as summarised below:

- Removal of VOC/SVOC and PCB given their association with historical land uses and absence in 2024. It may be prudent to re-test these COPC in the lower catchment during future monitoring.
- Analysis of dissolved metals, rather than total metals, to assess bioavailability of metals, including filtration to remove suspended sediment from water samples.
- Analysis of leachable concentrations in sediment, rather than total concentrations. Guideline values for sediment are limited in availability and applicability, as contaminants must first partition into porewater to pose a risk to aquatic ecosystems or water users. Leachable analysis provides a better metric for risk assessment as it provides a porewater surrogate that can be directly compared with water guidelines. Leachable analysis was undertaken using pH 7 reagent to reflect river conditions.
- Standard level PAH analysis, rather than low level, given the absence of PAH in 2024.
- Allowance was made to undertake silica gel clean up on any detectable hydrocarbons to help distinguish natural from petroleum sources, however hydrocarbons were not detected in 2025.

Analysis was undertaken by Eurofins-ARL in Welshpool, a NATA accredited laboratory who provided discounted rates in support of the BBB program. The full laboratory analysis suite is detailed in **Appendix 2**.

Helena Swan site in the lower catchment

Guideline Values

Guideline values are a useful tool to help ensure that the physical and chemical properties of rivers do not present a risk to the environment or surrounding communities.

Default Guideline Values

Default guideline values (DGVs) can be used to assess whether the quality of water or sediment in a river may pose a potential risk to a river's "community values". According to the *Australian and New Zealand Guidelines for Fresh & Marine Water Quality* (ANZG), community values are defined as: "*A particular value or use of the environment that is important for a healthy ecosystem or for public benefit, health, safety or welfare, and requires protection from the effects of stressors*"[93].

The ANZG identifies the following community values that may apply to waterways:

- **Aquatic ecosystems:** Maintaining the health and integrity of aquatic life and habitats.
- **Cultural and spiritual values:** Recognising the cultural significance of water to Indigenous people.
- **Drinking water:** Ensuring water is safe for human consumption.
- **Recreation and aesthetics:** Enabling recreational use without illness or loss of aesthetic appeal.
- **Industrial water:** Supporting industrial uses such as mining, manufacturing and electricity generation.
- **Primary industries**: Providing water suitable for farming, irrigation, livestock, aquaculture and the production of aquatic foods for human consumption.

Under the ANZG, community engagement is recommended to identify the values relevant to a specific waterway. For the Mandoon Bilya (Helena River), these values were outlined in the *Mandoon – Helena River Confluence* report[31]. These include:

- **Aquatic ecosystems:** Supporting a healthy freshwater environment for ecological communities that live in or are dependent on the river's waterways and wetlands, and promoting biodiversity (e.g. plants, animals, microorganisms, physical/chemical conditions and climatic influences).
- **Cultural and spiritual values**: Recognising the cultural and spiritual importance of the Mandoon Bilya and its water sources for Noongar people, including the maintenance of minimum water flows.
- **Drinking water:** Providing safe and clean drinking water for human consumption.
- **Non-potable uses:** Providing water that is suitable for household irrigation and other non-drinking purposes. Where the river flows through private property, landowners may exercise "riparian rights" to use the river's water. Along the Mandoon Bilya, some landowners use the river's water for watering their gardens/vegetable plots, as well as other unspecified purposes.
- **Recreation**: Enabling use of the river for swimming and kayaking, and supporting adjacent recreational experiences through walking and cycling tails.
- **Aesthetics:** contributing to the visual appeal and social amenity of the surrounding environment.
- **Primary industries**: Providing water that is suitable for irrigating crops, watering livestock, and supporting healthy aquatic fauna for potential human consumption.

In Western Australia, DGVs are used to protect both ecosystem health, by safeguarding a defined proportion species, and the beneficial use" of rivers by communities. These terms are defined in the *Environmental Protection Act 1986*[94] as follows:

- Ecosystem health condition relevant to the maintenance of ecological structure ecological function or ecological process[94].
- Beneficial use of the environment that is conductive to public benefit, public amenity, public safety, public health or aesthetic enjoyment[94].

An exceedance of a DGV indicates that further investigation is required to determine whether an actual risk or impact exists, however, it does not automatically require management action.

DGVs used to assess water quality in the Mandoon Bilya catchment are summarised below and discussed in detail in **Appendix 3**. The DGVs and notes on their application are presented in **Tables T1–T3** appended at the back of this report.

- **DGVs for freshwater ecosystems:**
  - Australian and New Zealand default guideline values for toxicants in freshwater at 99% level of species protection (ANZG, 2026 and ANZECC, 2000) [93,95]
  - Australian and New Zealand guidelines for PFAS in freshwater ecosystems (HEPA, 2025)[96]
  - Swan Canning Catchment water quality targets (SRT, 1999)[87]
  - South West Index of River Condition (SWIRC) (DWER, 2020)[88]
  - Wastewater effluent criteria for on-site discharge in the Mandoon catchment (COK, 2020)[97]
  - Australian and New Zealand guidelines for sediment quality (ANZG, 2018)[93]
  - Australian and New Zealand guidelines for sediment quality (ANZECC, 2000)[95]
- **DGVs for human health:**
  - Australian drinking water guidelines (ADWG) (NHMRC, 2011)[98]
  - American tap water regional screening levels used in the absence of ADWG (US EPA, 2024)[99]
  - World Health Organisation drinking water guidelines used in the absence of ADWG (WHO, 2008)[100]
  - Western Australian non-potable use guidelines (DOH, 2014)[101]
  - Western Australian microbial assessment levels (DWER, 2021)[102]
  - Western Australian guidelines for non-potable uses of recycled water (DOH, 2011)[103]
  - Australian and New Zealand guidelines for recreational water quality (ANZECC, 2000)[95]
  - Australian guidance for PFAS in recreational water (NHMRC, 2019)[104]
- **DGVs for primary industries:**
  - Australian and New Zealand draft livestock drinking water guidelines (ANZG, 2023)[105]
  - Australian and New Zealand guidelines for primary industries (ANZECC, 2000)[95]

The DGVs for sediment quality were applied to the total solid concentrations measured in sediment samples analysed in 2024. In contrast, the DGVs for water quality were applied to the leachable sediment analysis undertaken in 2025.

DGVs are periodically revised to incorporate the latest scientific evidence, particularly for drinking water. Since the 2024 sampling, several DGVs have been updated, including PFAS drinking water guidelines, and freshwater ecosystem guidelines for chromium III, iron, nitrate and PFOS. Accordingly, the 2024 results have been rescreened against the updated DGVs to ensure consistency in interpretation.

Catchment-specific Guideline Values

Through the BBB program, BNAA aims to develop guideline values tailored to the Mandoon catchment that can be embedded within a broader management framework, including measurable targets to track progress over time.

Protecting the cultural significance of water is a high priority for many Aboriginal people, yet no Australian guidelines currently exist to assess cultural or spiritual values. As the BBB program progresses, BNAA intends to establish culturally grounded guidelines for the Mandoon catchment, including targets for minimum water flows downstream of dams to support cultural and spiritual wellbeing.

Sampling Locations

The number of sampling sites was determined by the LHAAC approved budget and the cost of laboratory analysis, resulting in 14 locations being sampled in 2025 and 12 locations in 2024. Samson St and Nyaania Pool were both sampled in 2025 only.

Sites were selected based on proximity to current and historical land use, including:

- Historical industry and contaminated sites in the lower catchment, including the former Bellevue Hazardous Waste Facility, OPEX Oil Refinery and Midland Railway Workshops.
- Agricultural and rural land use, including wineries, cideries and orchards along Piesse Brook in the Bickley Valley and Pickering Brook tourism precincts.
- Land clearing in the upper catchment, linked to both historical and ongoing land uses such as agriculture, sand mining and forestry.
- Known swimming locations, including Rocky Pool on Piesse Brook and Nyaania Creek waterfall.

All sites were located upstream of the maximum extent of tidally influenced saline water in the Derbarl Yerrigan (Swan River). Sites were also selected to align with government monitoring locations and previous sampling sites where possible, particularly Whiteman Rd and LookSee Pool.

All sites were located on public land and were accessible using established tracks. Alternative sites were identified in case access could not be safely achieved e.g. wet/soft ground or prescribed burns.

Water Corporation does not allow BNAA to collect samples within 200 m upstream of Mundaring Weir or the Lower Pumpback Dam. Ongoing discussions with Water Corporation indicate that they are willing to share a summary of their data with BNAA; however, this would likely be subject to a confidentiality agreement, preventing it from being shared with the community. These discussions are ongoing and BNAA hopes that Water Corporation will work towards collaborative sampling and data sharing in the future.

Sampling sites are shown on **Figure 3** and **Figure 4**. Site details and rationale are presented in **Table 1** below along with the Water Information Reporting (WIR) government database ID where applicable.

Whiteman Rd site in the lower catchment

Site Name	WIR Ref	Waterway	Section	Local Gov	Coords	Location	Rationale
Helena Swan	N/A (6161091 is 90 m upstream)	Mandoon Bilya (Helena River)	Lower	Swan	-31.89708 115.98581	In the main river channel under Bushmead Rd bridge.	– Most downstream site that is not tidally influenced by the Derbarl Yerrigan (Swan River). – Downstream of former Midland Railway Workshops. – Upstream of long term restoration site of the Lower Helena Association.
Whiteman Rd	616086	Mandoon Bilya	Lower	Swan	-31.90006 116.00762	At the former Whiteman Rd bridge.	– DBCA Swan Canning Water Quality Monitoring Program site SWN10 (site will soon move slightly upstream to downstream of Roe Hwy). – DWER Healthy Rivers site HELENR. – Downstream of Hazelmere industrial estate and Bellevue Hazardous Waste Facility. – Location of BNAA river restoration works, including Community Rivercare 9 grant in 2025.
Helena Roe	N/A (6167030 is 80 m upstream)	Mandoon Bilya	Lower	Swan	-31.90540 116.01589	Under Military Rd bridge.	– Immediately downstream of City of Swan and Shire of Mundaring boundary. – Adjacent former Bellevue Hazardous Waste Facility. – WIR 6167030 is a Helping the Helena site (Helena2)[32] that previously had elevated metals and acidic conditions.
Samson St (2025 only)	N/A	Mandoon Bilya	Lower	Mundaring	-31.91924 116.03736	Adjacent Samson Street, access from the south on Lomandra Rd.	– Located between Craignish and Helena Roe sites to assess general water quality decline in the lower catchment. – Upstream of proposed BBB Mandoon Bilya Riverpark initiative.
Nyaania Pool (2025 only)	N/A	Nyaania Creek	Lower	Mundaring	- 31.93109, 116.0692	Upstream of Victor Road bridge at the largest waterfall pool.	– Major tributary that flows into the Mandoon Bilya downstream of the Lower Pumpback Dam. – Flows through Darlington, Glen Forrest and Mahogany Creek residential areas. – Known swimming spot. – Location of BNAA river restoration works, including Community Rivercare 8 grant in 2025.
Craignish US	6167032	Mandoon Bilya	Lower	Mundaring-Kalamunda	-31.93560 116.06864	Immediately upstream of Craignish Weir gauging station.	– Long-established gauging station (WIR 616018). – Helping the Helena site (Helena4)[32] previously had elevated hydrocarbons (PAH). – Location of BNAA river restoration works, including Community Rivercare 8 grant in 2025.

Site Name	WIR Ref	Waterway	Section	Local Gov	Coords	Location	Rationale
Lower Pumpback Dam	N/A	Mandoon Bilya	Lower	Mundaring-Kalamunda	-31.94179 116.07608	In river channel, immediately downstream of dam.	- The dam is a public drinking water source that collects water which is then pumped up to Mundaring Weir. - Water Corporation will not allow BNAA to sample the dam or any watercourse within 200 m upstream of it.
Rocky Pool	N/A (6161250 is 175 m upstream)	Piesse Brook	Middle	Kalamunda	-31.95366 116.07148	At the large lower pool.	- Major tributary that flows into Lower Pumpback Dam. - Downstream of Bickley Valley, Pickering Brook and Kalamunda town centre. - Known swimming spot, noting that swimming is prohibited under the *Country Areas Water Supply (CAWS)* Act By-Laws 1957. - Long term restoration site of Friends of Piesse Brook.
Pipe Bridge	6161604	Mandoon Bilya	Middle	Mundaring-Kalamunda	-31.93825 116.12176	Under the pipe crossing, access via pipe track.	- Upstream of Lower Pumpback Dam. - Historically identified as high public health significance due to elevated metals and hydrocarbons detected in the 1980s.
Cobblers Pool	N/A (6167034 is 360 m downstream)	Mandoon Bilya	Middle	Mundaring-Kalamunda	-31.94693 116.13484	At large river pool, access via track crossing.	- Upstream of Lower Pumpback Dam and downstream of Mundaring Weir. - Large permanent river pool. - Downstream of Gunjin Gully tributary confluence.
LookSee Pool	N/A (6163844 is 55 m downstream)	Mandoon Bilya	Middle	Mundaring-Kalamunda	-31.94991 116.14592	At large river pool, access via pipe track.	- Large permanent river pool. - Downstream of Bourkes Gully tributary. - Near to DWER Healthy Rivers site HRDSMW (6163844).
Piesse Culvert	6161254	Piesse Brook	Middle	Kalamunda	-32.03306 116.13711	At Patterson Rd-Bracken Rd culvert.	- Major tributary that flows into Lower Pumpback Dam. - Furthest upstream location on Piesse Brook that is accessible via public land. - Surrounded by agricultural and rural properties in the townsite of Pickering Brook.
Salty Pool	N/A	Mandoon Bilya	Upper	York	-31.93913 116.51495	At seasonal river pool, access via Pony Rd.	- Furthest upstream location on Mandoon Bilya with sufficient water to sample. - Downstream of salinity-impacted Wundabiniring Brook.
Beraking Yarra	6161259	Beraking Brook	Upper	Beverley	-32.18171 116.43514	Immediately downstream of Yarra Rd culvert.	- Major tributary of the Darkin River that flows into Mundaring Weir. - Upstream of any private property and cleared land. - In upper headwaters of Mandoon catchment. - Reflective of background conditions.

Table 1 Sampling Locations

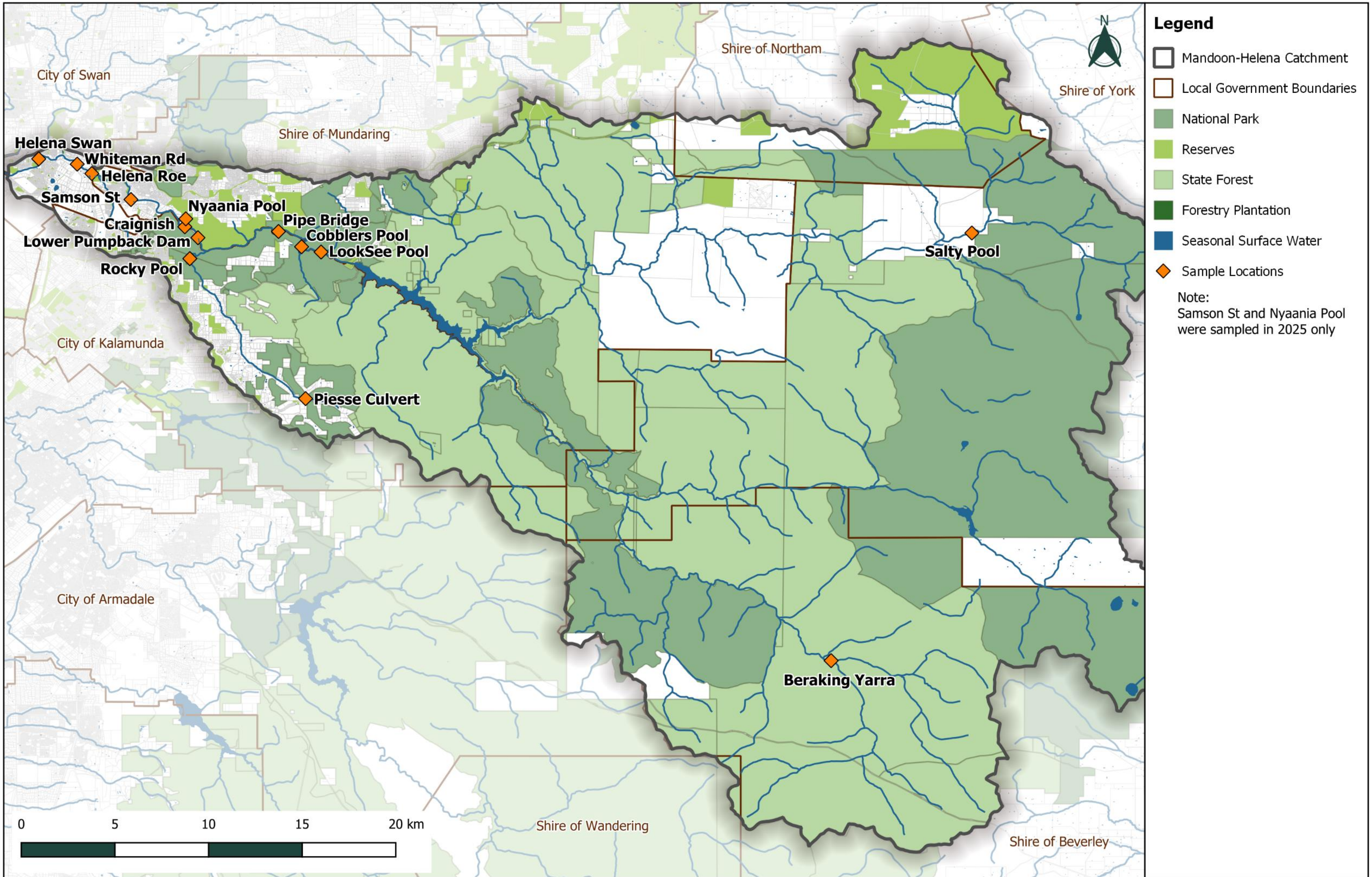

Figure 3 Sample Locations

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Data Sources: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan

Ref: BBB-MBHR-BWQS-003
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.

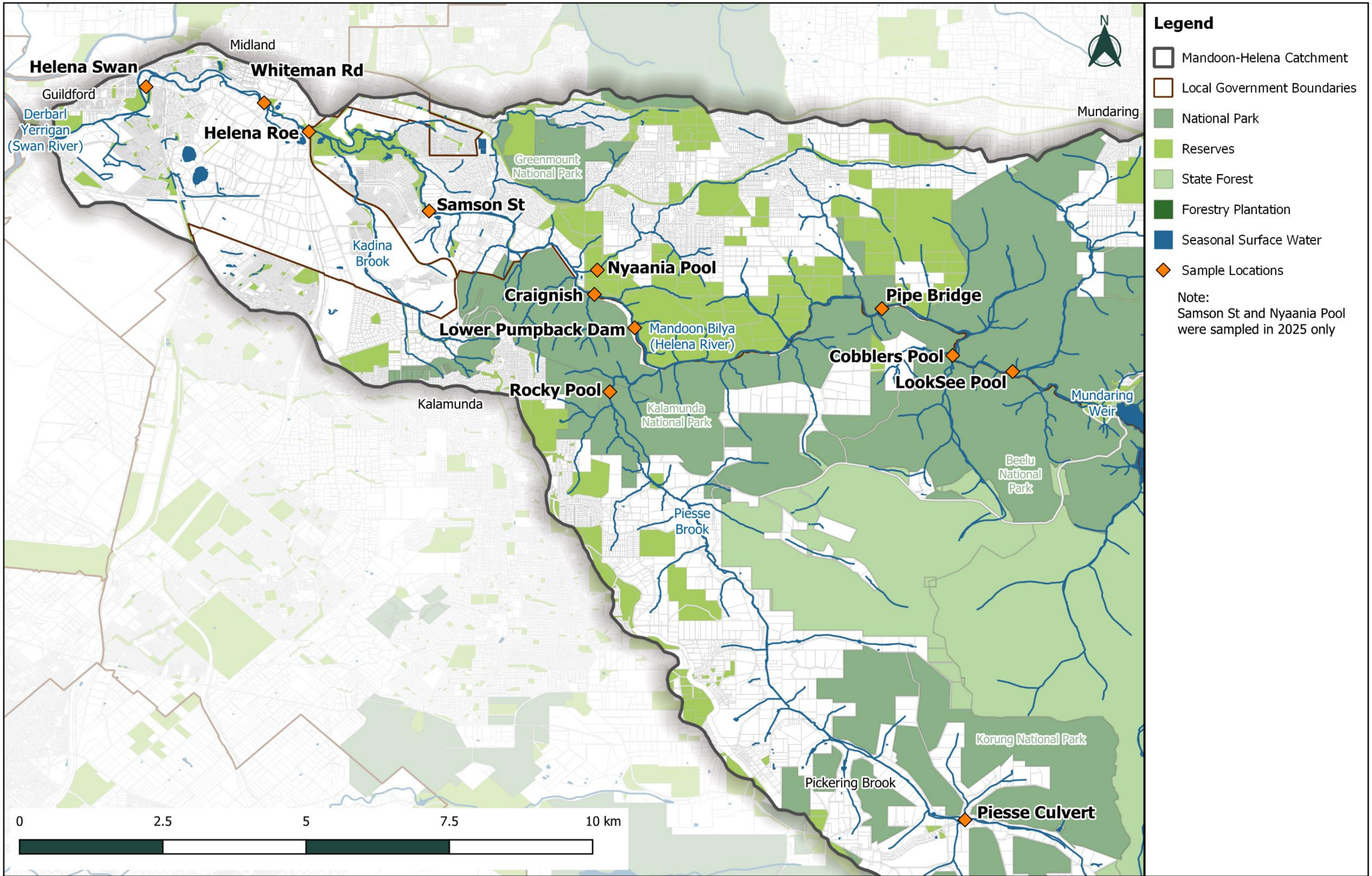

Figure 4 Sample Locations - Lower and Middle Catchment

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Data Sources: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan

Ref: BBB-MBHR-BWQS-004
Date: 12 December 2025

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Sampling Methodology

Sampling was completed on 16-18 September 2024 and 22-23 September 2025 by Francesca Flynn and Callum Haines of Bibbul Ngarma Aboriginal Association (BNAA).

Sampling dates were chosen to reflect base flow condition in the season of djilba (spring). Flows were checked regularly in the lead up to sampling to avoid heavy flows and storm conditions.

Sampling was undertaken in accordance with the methodology in **Appendix 4**. Physiochemical parameters were measured in the field using a YSI Pro DSS multiprobe and surface water and sediment samples were collected in laboratory-supplied containers. Site access was undertaken in accordance with the Water Corporation Catchment Access Agreement for the BoorYul-Bah-Bilya program.

When developing the sampling methodology, consideration was given to the following documents:

- DBCA (2022) Swan Canning Catchment Sampling and Analysis Plan, Rivers and Estuaries Science[106]
- DWER (2018) Swan Canning Water Quality Improvement Plan (Project: SG-C-SCWQIP), Sampling and Analysis Plan, TRIM File No: WT9835, Aquatic Science Branch[107]
- DWER (2018) Swan and Canning River Catchment Water Quality Monitoring Program (Project: SG-C-SWANCATCH), Sampling and Analysis Plan, TRIM File No: WT895, Water Science Branch[108]
- Government of Queensland (2018) Environmental Protection (Water) Policy 2009 – Monitoring and Sampling Manual, Collection and Preservation of Sediment
- DWER (2016) Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS): Contaminated Sites Guidelines[109]
- DOW (2009) Field Sampling Guidelines: A Guideline for Field Sampling for Surface Water Quality Monitoring Programs[110]
- DOW (2009) Surface Water Sampling Methods and Analysis – Technical Appendices: Standard Operating Procedures for Water Sampling – Methods and Analysis[111]
- DOW (2009) Water Quality Monitoring Program Design: A Guideline to the Development of Surface Water Quality Monitoring Programs[112]
- CSIRO (2005) Handbook for Sediment Quality and Assessment[113]

eDNA

In October 2025, additional water samples were collected from each site for environmental DNA (eDNA) analysis as part of the BBB program. eDNA is an emerging technology that enables detection of animals, plants and microbes through traces of genetic material in the environment. Two samples per site were submitted to Wilderlab for comprehensive 'tree-of-life' analysis. While full results will be reported separately, key findings from sites included in the current assessment are summarised in this report to provide a more comprehensive picture of river health.


White Myrtle *(Hypocalymma angustifolium)* in Mandoon catchment

Results

Sampling results are compared against the default guideline values (DGVs) in **Tables T1-T3** appended at the back of this report. A conservative approach is used, in that concentrations equal to the DGV are treated as an exceedance. Summary results are provided below, with location-specific data in **Appendix 5** and laboratory documentation in **Appendix 6**.

Water Quality Parameters

Water quality parameters describe the chemical, physical, and biological condition of water and help assess its suitability for aquatic ecosystems and other uses.

Field measurements were collected where possible **(Tables T1a-T1b)** and supplemented with laboratory analysis of water samples (**Tables T2a-T2b**). Because the 2025 water quality meter did not measure salinity and turbidity, both laboratory and field results are presented for comparison.

Field Measurements

Salinity is the concentration of dissolved salts in water, with values below 5,000 mg/L considered to be fresh.

Salinity was low across the catchment, with all sites except Salty Pool recording freshwater conditions. Salty Pool had elevated salinity at 5,400 mg/L in 2025 and 3,900–4,620 mg/L in 2024, placing it in the marginally brackish range (5,000–25,000 mg/L). This is consistent with its location downstream of Wundabiniring Brook, which is impacted by rising salinity due to historical land clearing in the upper catchment. Salinity was low at other sites: 70–480 mg/L in 2025 and 76–590 mg/L in 2024. Beraking Yarra consistently recorded the lowest salinity, representing background conditions in the river's headwaters. Further monitoring in the upper catchment is recommended, including during different flow conditions and at varying depths, to better understand the extent and impacts of elevated salinity.

Conductivity is the ability of water to conduct electrical current, which increases with higher concentrations of dissolved ions from salts and inorganic materials. Conductivity is commonly used as a salinity indicator.

Conductivity exceeded the ANZG trigger value for lowland rivers in southwest Australia (<300 uS/cm) at all sites except Beraking Yarra. Salty Pool recorded the highest levels (11,194 uS/cm in 2025 and 8,274 uS/cm in 2024), consistent with its marginally brackish conditions. At the other sites, conductivity was generally higher in the lower catchment (322–973 µS/cm in 2025 and 443–1,176 µS/cm in 2024) compared to the middle catchment (367–459 µS/cm in 2025 and 416–648 µS/cm in 2024). Beraking Yarra had the lowest values (143–162 uS/cm), representing natural background conditions in the river's headwaters.

Dissolved Oxygen (DO) is the amount of oxygen in the water that is available to aquatic organisms. When levels fall too low, organisms become vulnerable to stress or death, particularly native fish and crustaceans. Low-flow conditions often reduce DO because slower water mixes less with the air (aeration) and absorbs less oxygen. Still water also tends to be warmer, further reducing its capacity to hold DO.

DO was low at most sites. Only a few sites met the ANZG trigger value of 80% saturation: Rocky Pool and Nyaania Pool in 2025, and Rocky Pool, Pipe Bridge and Piesse Culvert in 2024. At all other sites, DO ranged from 32–79% in 2025 and 28–71% in 2024. DO fell below the 4 mg/L lower limit for the South West Index of River Condition (SWIRC) at three sites: Salty Pool in 2024 and Lower Pumpback Dam and Beraking Yarra in 2025. Water temperatures were between 12.2–17.4 °C, with cooler conditions in the upper catchment.

pH is a measure of hydrogen ion concentrations and indicates how acidic or basic (alkaline) a substance is. The pH scale ranges from 0 to 14, with 7 representing neutral conditions.

pH was generally neutral across the catchment, ranging from 6.3–7.9 in 2025 and 6.2–7.4 in 2024. Slightly acidic conditions were recorded at 4 sites that fell just below the ANZG guideline range for lowland rivers (6.5–8.0): Craignish, Lower Pumpback Dam, Cobblers Pool and Salty Pool (the latter in 2024 only).

Turbidity is a measure of water clarity, expressed as the amount of light that cannot pass through due to suspended and dissolved particles. Elevated turbidity can limit aquatic plant growth and contribute to sedimentation and habitat degradation.

Turbidity was below the ANZG trigger value for lowland rivers in southwest Australia (<20 NTU) at all sites except Craignish in 2024 (29–36 NTU). Turbidity was typically higher in the lower catchment (4–36 NTU) compared to the middle and upper catchment (0.3–7 NTU).

Laboratory Results

Water quality parameters were analysed in all water samples in 2024 and 2025.

Biochemical Oxygen Demand (BOD) represents how much dissolved oxygen is required by bacteria and other microorganisms to break down organic matter in the water. It reflects the impact of natural decomposition and can indicate organic pollution from sources such as sewage and fertilizers. High BOD indicates elevated organic matter, reduced oxygen availability and generally poorer water quality.

BOD was at detectable levels (>5 mg/L) at three sites in 2025 (Samson St, Rocky Pool and Cobblers Pool) and one site in 2024 (LookSee Pool). Concentrations were similar across years: 5–12 mg/L in 2025 and 5.4 mg/L in 2024. In all other locations, BOD was below the detectable level (<5 mg/L).

Colour reflects the amount of dissolved and suspended particles in water and is measured on the platinum cobalt unit scale (0–500 PCU). Colour is an important consideration for both drinking water and aquatic ecosystems, as higher colour can impact light penetration and affect the distribution of plants and animals.

Colour was detected in all samples except Rocky Pool and Piesse Culvert in 2025 and Whiteman Rd and LookSee Pool in 2024. Colour was similar between years: 13–100 mg/L in 2025 and 8–130 mg/L in 2024.

Hardness reflects the amount of dissolved minerals in water, primarily calcium and magnesium, and recorded as a calcium carbonate ($CaCO_3$) equivalent. Elevated hardness can lead to limescale buildup in pipes and appliances, and reduce the effectiveness of soap and detergent. Water with less than 60 mg/L $CaCO_3$ is generally considered to be soft, while higher concentrations are moderately hard, hard or very hard.

With the exception of Salty Pool, sites in the middle and upper catchment generally had soft water (40–57 mg/L in 2025 and 38–75 mg/L in 2024). Sites in the lower catchment generally had moderately-hard water (46–160 mg/L in 2025 and 69–200 mg/L in 2024). Salty Pool had very hard water (1,700–2,000 mg/L), reflecting marginally brackish conditions. The softest water was at Beraking Yarra in the river's headwaters.

Total Dissolved Solids (TDS) is the amount of dissolved particles in water, including salts, inorganics and organic matter.

TDS was highest at Salty Pool, 7,280 mg/L in 2025 and 5,390 mg/L in 2024, consistent with its marginally brackish conditions. At all other sites, TDS was generally higher in the lower catchment (209–631 mg/L in 2025 and 288–764 mg/L in 2024) compared to the middle catchment (239–319 mg/L in 2025 and 271–421 mg/L in 2024). The lowest TDS was at Beraking Yarra in the river's headwaters (93–105 mg/L).

Total Suspended Solids (TSS) is the amount of non-dissolved particles that are suspended in the water column, including silt, algae, bacteria, and organic debris floating in the water.

TSS was reported at six sites: Lower Pumpback Dam, Salty Pool and Beraking Yarra in both 2025 and 2024, and at Helena Swan, Helena Roe and Samson St in 2025, and Whiteman Rd, Craignish and Piesse Culvert in 2024. Concentrations were similar across years, ranging from 6–24 mg/L in 2025 and 5–23 mg/L in 2024.

Total Organic Carbon (TOC) is the amount of carbon within organic compounds in the water. It provides an indication of the organic matter present, which may originate from natural sources (e.g. plant material) as well as anthropogenic input (e.g. wastewater).

TOC results varied between 2025 and 2024. TOC was recorded at all sites except Whiteman Rd, Lower Pumpback Dam, Rocky Pool and Piesse Culvert in 2025, whilst in 2024, TOC was only recorded at Pipe Bridge, Cobblers Pool, LookSee Pool and Salty Pool. Concentrations were similar between years: 5–25 mg/L in 2025 and 5–21 mg/L in 2024.

DGV Exceedances – Water

Water quality parameters were analysed in all water samples in 2024 and 2025 (refer **Figure 5** and **Tables T2a-T2b** appended at the back of this report).

There were several exceedances of the default guideline values (DGVs). Freshwater ecosystem DGV exceedances were mainly associated with elevated conductivity, low dissolved oxygen and occasional slightly acidic conditions. Human health DGV exceedances were widespread, occurring at all sites except Nyaania Pool and Beraking Yarra, and were linked to elevated BOD, hardness, TDS, TSS and turbidity and slightly acidic conditions. For primary industries, exceedances were limited to elevated TDS at four sites. A summary of the DGV exceedances is presented in **Table 2** below.

DGVs	September 2025	September 2024
Freshwater Ecosystem DGVs	Exceedances at all 14 sites: – **Conductivity** (322–11,194 mg/L) above the DGV (300) at all sites except Beraking Yarra. – **DO** (31.9–78.9%) below the DGV (>80%) at all sites except Nyaania Pool and Rocky Pool. – **DO** (3.18 mg/L) below the SWIRC lower limit (>4) at Salty Pool. – **pH** (6.31–6.49) below the DGV (6.5-8.5) at Craignish, Lower Dam, Cobblers Pool and Salty Pool.	Exceedances at 11 of 12 sites: – **Conductivity** (416–8,274 mg/L) above the DGV (300) at all sites except Beraking Yarra. – **DO** (27.6–70.5%) below the DGV (>80%) at all sites except Rocky Pool, Pipe Bridge and Piesse Culvert. – **DO** (2.76–3.85 mg/L) below the SWIRC lower limit (>4) at Lower Pumpback Dam and Beraking Yarra. – **pH** (6.24–6.49) below the DGV (6.5-8.5) at Craignish, Lower Dam and Cobblers Pool. – **Turbidity** (29–36 NTU lab) above the DGV (<10-20) at Craignish.
Human Health DGVs	Exceedances at 12 of 14 sites: – **BOD** (11-12 mg/L) above the non-potable DGV (10) at Samson St and Rocky Pool. – **Hardness** (2,000 mg/L) above the drinking water aesthetic (200) and recreation (500) DGVs at Salty Pool. – **pH** (6.31–6.49) below the drinking water, non-potable and recreation DGVs (6.5-8.5) at Craignish, Lower Dam, Cobblers Pool and Salty Pool. – **TDS** (611–7,280 mg/L) above the drinking water aesthetic DGV (600) at Helena Swan, Whiteman Rd, Helena Roe and Salty Pool. – **TDS** (7,280 mg/L) above the recreation DGV (1,000) at Salty Pool. – **TSS** (12-24 mg/L) above the non-potable DGV (10) at Helena Roe and Salty Pool. – **Turbidity** (5.6–15 NTU) above the drinking water aesthetic and non-potable DGVs (5) at Helena Swan, Whiteman Rd, Helena Roe, Samson St, Craignish, Lower Dam, Pipe Bridge, Cobblers Pool and Looksee Pool.	Exceedances at 8 of 12 sites: – **Hardness** (200–1,700 mg/L) equal to or above the drinking water aesthetic DGV (200) at Whiteman Rd and Salty Pool. – **Hardness** (1,700 mg/L) above the recreation DGV (500) at Salty Pool. – **pH** (6.24–6.49) below the drinking water, non-potable and recreation DGVs (6.5-8.5) at Craignish, Lower Dam and Cobblers Pool. – **TDS** (712–5,390 mg/L) above the DGV for drinking water aesthetic (600) at Helena Swan, Whiteman Rd, Helena Roe and Salty Pool. – **TDS** (5,390 mg/L) above the recreation DGV (1,000) at Salty Pool. – **TSS** (23 mg/L) above the non-potable DGV (10) at Craignish. – **Turbidity** (5.1–36 NTU) above drinking water aesthetic and non-potable DGVs (5) at Helena Swan, Whiteman Rd, Helena Roe, Craignish, Lower Dam and Beraking Yarra.
Primary Industries DGVs	Exceedances at 4 of 14 sites: – **TDS** (611–7,280 mg/L) above the livestock watering DGV (500) at Helena Swan, Whiteman Rd, Helena Roe and Salty Pool.	Exceedances at 4 of 12 sites: – **TDS** (712–5,390 mg/L) above the livestock watering DGV (500) at Helena Swan, Whiteman Rd, Helena Roe and Salty Pool.

Table 2 Water Quality Parameters - DGV Exceedances in Water

DGV Exceedances – Sediment

Most water quality parameters are not applicable to sediment, meaning only a limited suite of parameters could be analysed where appropriate (refer **Figure 6** and **Tables T3a-T3b** appended at the back of this report).

Sediment analysis methods differed between 2025 and 2024, so the results cannot be directly compared:

- 2025 analysis: leachable concentrations in sediment (liquid phase)
- 2024 analysis: total concentrations in sediment (solid phase)

Leachable concentrations were analysed in 2025 to provide a better metric for risk assessment.

pH exceeded both the freshwater ecosystem and human health DGVs at two sites in the lower catchment in 2025: Craignish and Lower Pumpback Dam. There are no DGVs available to assess water quality parameters in solid sediment. A summary of the DGV exceedances is presented in **Table 3** below.

DGV	September 2025 (leachable)	September 2024 (solid)
Freshwater Ecosystem DGVs	Exceedances at 2 of 14 sites: – **pH** (6.1–6.4) below the DGV (6.5-8.5) at Craignish and Lower Dam. Limited DGVs exist.	DGVs do not exist.
Human Health DGVs	Exceedances at 2 of 14 sites: – **pH** (6.1–6.4) below the drinking water, non-potable and recreation DGVs (6.5-8.5) at Craignish and Lower Dam. Limited DGVs exist.	DGVs do not exist.

Table 3 Water Quality Parameters - DGV Exceedances in Sediment

Summary

Water quality across the Mandoon catchment is shaped by natural geology, land-use pressures and altered hydrology and water flows resulting from major water supply dams.

Salinity was low across the catchment, with freshwater conditions recorded at all sites except Salty Pool. Salty Pool consistently had marginally brackish conditions due to its location downstream of Wundabiniring Brook, which is salinity-impacted due to historical land clearing in the upper catchment.

The most persistent issues across the catchment were low dissolved oxygen (DO) and elevated conductivity. DO fell below guideline thresholds at most sites, indicating potential stress for aquatic fauna, particularly where DO fell below the SWIRC lower limit (Salty Pool in 2024 and Lower Pumpback Dam and Beraking Yarra in 2025). Low DO levels are consistent with the presence of major dams, which substantially reduce water flow velocity and limit natural aeration.

The low conductivity at Beraking Yarra (in the river's headwaters) represents natural background conditions. The elevated conductivity in all other locations is evidence of the impacts of post-colonisation activities such as land clearing and urban land use and stormwater inputs. These same processes increase total dissolved solids (TDS) and contribute to higher turbidity, particularly where reduced flows limit sediment flushing and where land clearing, bank erosion and urban runoff supply fine suspended material.

Slightly acidic conditions were recorded at the same three sites in both years – Craignish, Lower Pumpback Dam and Cobblers Pool – with an additional occurrence at Salty Pool in 2025.

Although not all parameters have established DGVs, the results demonstrate that exceedances were widespread and varied between years, highlighting the need for continued monitoring and targeted management actions to address key pressures across the catchment.


Salty Pool site in the upper catchment

Helena Swan	2025	2024
Alkalinity (mg/L)	74	100
BOD (mg/L)	<5	<5
Colour (PCU)	62	22
Conductivity (uS/cm)	938	1,095
Dissolved Oxygen (%)	62.8	54.8
Dissolved Oxygen (mg/L)	6.00	5.30
Hardness (mg/L)	160	180
pH	7.00	6.76
Salinity (mg/L)	470	550
TDS (mg/L)	611	712
TOC (mg/L)	8.9	<5
TSS (mg/L)	6.0	<5
Turbidity (NTU)	15	17.6

Whiteman Rd	2025	2024
Alkalinity (mg/L)	83	110
BOD (mg/L)	<5	<5
Colour (PCU)	37	<5
Conductivity (uS/cm)	960	1,176
Dissolved Oxygen (%)	67.9	56.5
Dissolved Oxygen (mg/L)	6.49	5.50
Hardness (mg/L)	160	200
pH	7.03	6.64
Salinity (mg/L)	480	590
TDS (mg/L)	624	764
TOC (mg/L)	<5	<5
TSS (mg/L)	<5	6
Turbidity (NTU)	11	14.7

Helena Roe	2025	2024
Alkalinity (mg/L)	85	110
BOD (mg/L)	<5	<5
Colour (PCU)	39	25
Conductivity (uS/cm)	973	1,128
Dissolved Oxygen (%)	56.4	59.1
Dissolved Oxygen (mg/L)	5.48	5.67
Hardness (mg/L)	160	190
pH	7.02	6.73
Salinity (mg/L)	480	560
TDS (mg/L)	630.5	733
TOC (mg/L)	7.9	<5
TSS (mg/L)	24	<5
Turbidity (NTU)	13	17.8

Samson St	2025
Alkalinity (mg/L)	39
BOD (mg/L)	12
Colour (PCU)	25
Conductivity (uS/cm)	390
Dissolved Oxygen (%)	78.9
Dissolved Oxygen (mg/L)	7.77
Hardness (mg/L)	88
pH	6.75
Salinity (mg/L)	350
TDS (mg/L)	448.5
TOC (mg/L)	7.3
TSS (mg/L)	6.0
Turbidity (NTU)	12

Nyaania Pool	2025
Alkalinity (mg/L)	31
BOD (mg/L)	<5
Colour (PCU)	13
Conductivity (uS/cm)	578.3
Dissolved Oxygen (%)	89.4
Dissolved Oxygen (mg/L)	9.00
Hardness (mg/L)	69
pH	7.89
Salinity (mg/L)	290
TDS (mg/L)	375.7
TOC (mg/L)	5.8
TSS (mg/L)	<5
Turbidity (NTU)	4

Pipe Bridge	2025	2024
Alkalinity (mg/L)	19	27
BOD (mg/L)	<5	<5
Colour (PCU)	21	25
Conductivity (uS/cm)	391.1	509
Dissolved Oxygen (%)	64.9	94.4
Dissolved Oxygen (mg/L)	6.34	9.10
Hardness (mg/L)	40	59
pH	6.66	6.73
Salinity (mg/L)	190	250
TDS (mg/L)	254.2	331
TOC (mg/L)	6.2	6.8
TSS (mg/L)	<5	<5
Turbidity (NTU)	6.4	1.1

Cobblers Pool	2025	2024
Alkalinity (mg/L)	22	30
BOD (mg/L)	5.0	<5
Colour (PCU)	18	24
Conductivity (uS/cm)	458.5	591
Dissolved Oxygen (%)	62.9	69.3
Dissolved Oxygen (mg/L)	6.35	6.93
Hardness (mg/L)	46	62
pH	6.49	6.44
Salinity (mg/L)	220	290
TDS (mg/L)	297.7	384
TOC (mg/L)	5.4	5.1
TSS (mg/L)	<5	<5
Turbidity (NTU)	7.0	2.2

Legend

Water Quality Parameters 2025

- Exceeds Human Health and Primary Industries and/or Freshwater Ecosystem DGV
- Exceeds Freshwater Ecosystem DGV

Water Quality Parameters 2024

- Exceeds Human Health and Primary Industries and/or Freshwater Ecosystem DGV
- Exceeds Freshwater Ecosystem DGV

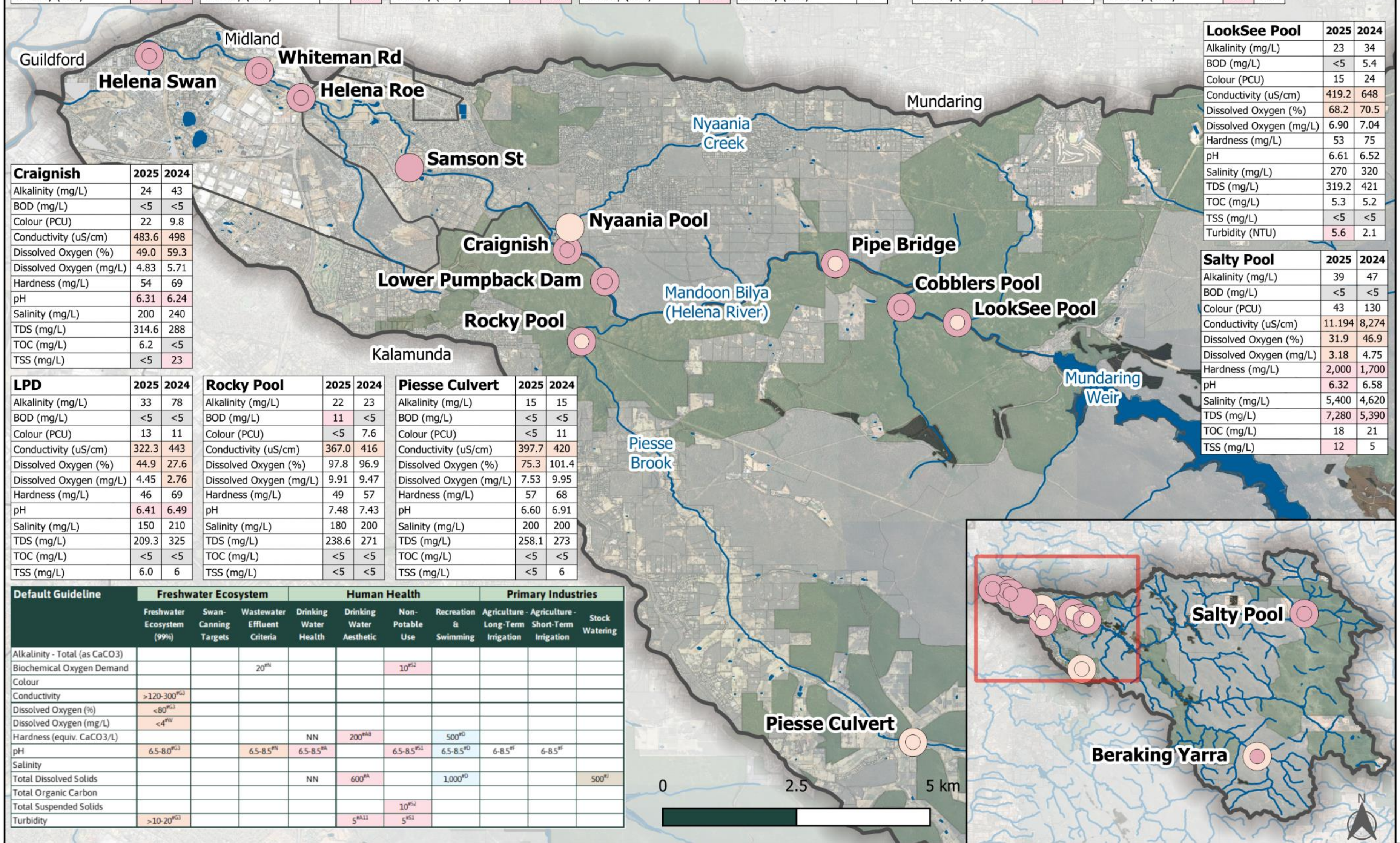
Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
A8: NHMRC (2011) 60-200mg/L good quality; 200-500mg/L scaling; >500mg/L severe scaling.
A11: NHMRC (2011) 5 NTU is noticeable in a glass; <1 NTU for disinfection; insufficient data to set drinking water guideline.
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3.
F: ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use.
G3: ANZECC (2000) Default trigger values for lowland rivers in south-west Australia, Tables 3.3.6 and 3.3.7.
J: ANZG (2023) Draft Livestock Drinking Water Guidelines
N: COK (2020) Common wastewater effluent criteria in Mandoon Catchment.
NN: Not necessary, NHMRC 2011.
S1: DOH (2011) Compliance value for minimum ongoing monitoring for high exposure risk, Table 8.
S2: DOH (2011) Compliance value for commissioning validation and verification monitoring for high exposure risk, used for screening in the absence of an ongoing monitoring guideline, Table 7.
W: DWER (2020) South West Index of River Condition (SWIRC), <4 mg/L is considered to be the lower limit for dissolved oxygen when assessing river condition.

Samson St and Nyaania Pool sampled in 2025 only.

LookSee Pool	2025	2024
Alkalinity (mg/L)	23	34
BOD (mg/L)	<5	5.4
Colour (PCU)	15	24
Conductivity (uS/cm)	419.2	648
Dissolved Oxygen (%)	68.2	70.5
Dissolved Oxygen (mg/L)	6.90	7.04
Hardness (mg/L)	53	75
pH	6.61	6.52
Salinity (mg/L)	270	320
TDS (mg/L)	319.2	421
TOC (mg/L)	5.3	5.2
TSS (mg/L)	<5	<5
Turbidity (NTU)	5.6	2.1

Salty Pool	2025	2024
Alkalinity (mg/L)	39	47
BOD (mg/L)	<5	<5
Colour (PCU)	43	130
Conductivity (uS/cm)	11,194	8,274
Dissolved Oxygen (%)	31.9	46.9
Dissolved Oxygen (mg/L)	3.18	4.75
Hardness (mg/L)	2,000	1,700
pH	6.32	6.58
Salinity (mg/L)	5,400	4,620
TDS (mg/L)	7,280	5,390
TOC (mg/L)	18	21
TSS (mg/L)	12	5

Craignish	2025	2024
Alkalinity (mg/L)	24	43
BOD (mg/L)	<5	<5
Colour (PCU)	22	9.8
Conductivity (uS/cm)	483.6	498
Dissolved Oxygen (%)	49.0	59.3
Dissolved Oxygen (mg/L)	4.83	5.71
Hardness (mg/L)	54	69
pH	6.31	6.24
Salinity (mg/L)	200	240
TDS (mg/L)	314.6	288
TOC (mg/L)	6.2	<5
TSS (mg/L)	<5	23



LPD	2025	2024
Alkalinity (mg/L)	33	78
BOD (mg/L)	<5	<5
Colour (PCU)	13	11
Conductivity (uS/cm)	322.3	443
Dissolved Oxygen (%)	44.9	27.6
Dissolved Oxygen (mg/L)	4.45	2.76
Hardness (mg/L)	46	69
pH	6.41	6.49
Salinity (mg/L)	150	210
TDS (mg/L)	209.3	325
TOC (mg/L)	<5	<5
TSS (mg/L)	6.0	6

Rocky Pool	2025	2024
Alkalinity (mg/L)	22	23
BOD (mg/L)	11	<5
Colour (PCU)	<5	7.6
Conductivity (uS/cm)	367.0	416
Dissolved Oxygen (%)	97.8	96.9
Dissolved Oxygen (mg/L)	9.91	9.47
Hardness (mg/L)	49	57
pH	7.48	7.43
Salinity (mg/L)	180	200
TDS (mg/L)	238.6	271
TOC (mg/L)	<5	<5
TSS (mg/L)	<5	<5

Piesse Culvert	2025	2024
Alkalinity (mg/L)	15	15
BOD (mg/L)	<5	<5
Colour (PCU)	<5	11
Conductivity (uS/cm)	397.7	420
Dissolved Oxygen (%)	75.3	101.4
Dissolved Oxygen (mg/L)	7.53	9.95
Hardness (mg/L)	57	68
pH	6.60	6.91
Salinity (mg/L)	200	200
TDS (mg/L)	258.1	273
TOC (mg/L)	<5	<5
TSS (mg/L)	<5	6

Beraking Yarra	2025	2024
Alkalinity (mg/L)	28	37
BOD (mg/L)	<5	<5
Colour (PCU)	100	31
Conductivity (uS/cm)	143.3	162
Dissolved Oxygen (%)	43.1	36.4
Dissolved Oxygen (mg/L)	4.82	3.85
Hardness (mg/L)	24	38
pH	6.70	6.91
Salinity (mg/L)	70	80
TDS (mg/L)	93.0	105
TOC (mg/L)	25	<5
TSS (mg/L)	7.0	5

Default Guideline	Freshwater Ecosystem			Human Health				Primary Industries		
	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Alkalinity - Total (as CaCO3)										
Biochemical Oxygen Demand			20[#N]			10[#S2]				
Colour										
Conductivity	>120-300[#G3]									
Dissolved Oxygen (%)	<80[#G3]									
Dissolved Oxygen (mg/L)	<4[#W]									
Hardness (equiv. CaCO3/L)				NN	200[#A8]		500[#D]			
pH	6.5-8.0[#G3]		6.5-8.5[#N]	6.5-8.5[#A]		6.5-8.5[#S1]	6.5-8.5[#D]	6-8.5[#F]	6-8.5[#F]	
Salinity										
Total Dissolved Solids				NN	600[#A]		1,000[#D]			500[#J]
Total Organic Carbon										
Total Suspended Solids						10[#S2]				
Turbidity	>10-20[#G3]				5[#A11]	5[#S1]				

Figure 5 Water Sampling Results: Water Quality Parameters

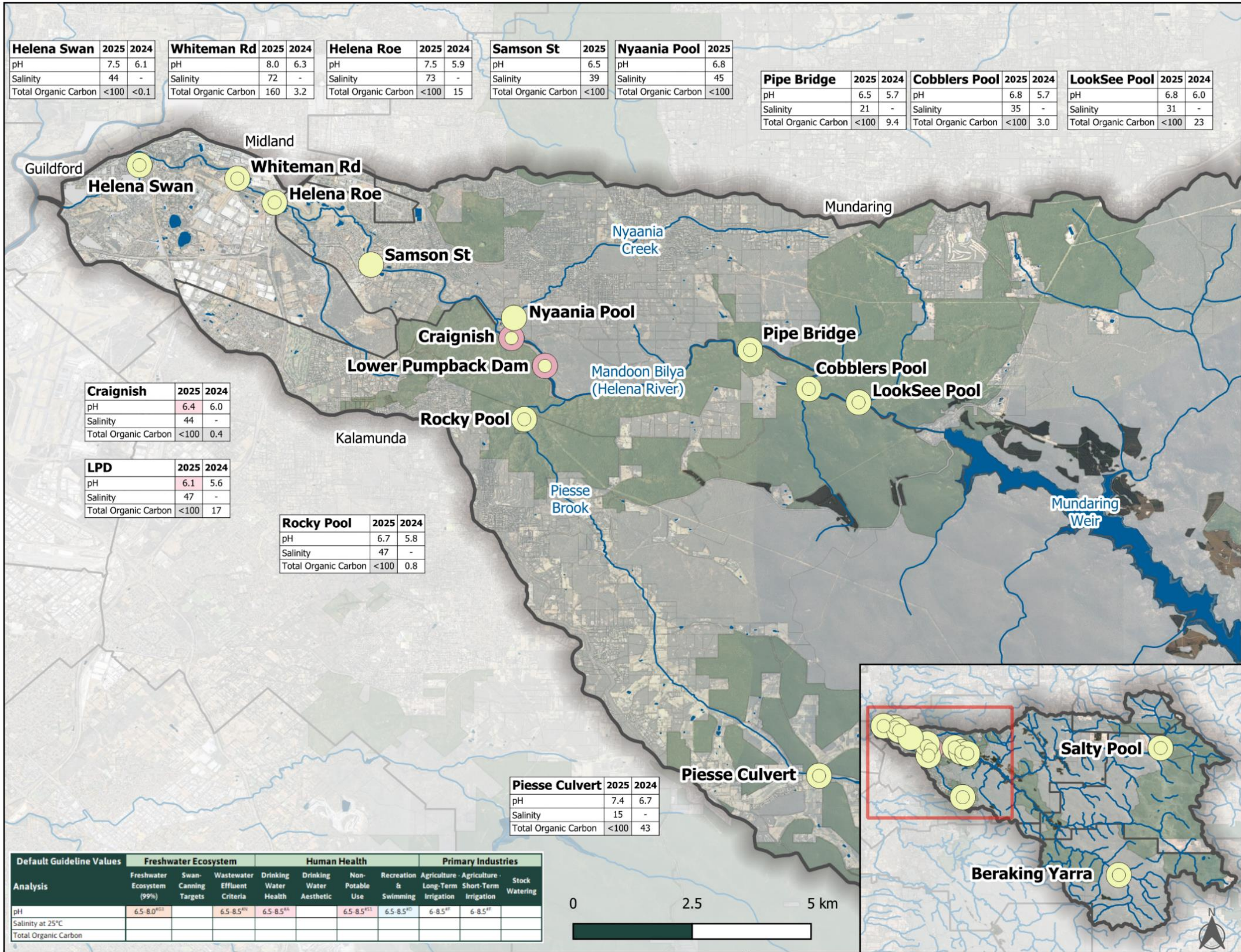
BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment) Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-005
Date: 24 May 2026

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.



Helena Swan	2025	2024
pH	7.5	6.1
Salinity	44	-
Total Organic Carbon	<100	<0.1

Whiteman Rd	2025	2024
pH	8.0	6.3
Salinity	72	-
Total Organic Carbon	160	3.2

Helena Roe	2025	2024
pH	7.5	5.9
Salinity	73	-
Total Organic Carbon	<100	15

Samson St	2025
pH	6.5
Salinity	39
Total Organic Carbon	<100

Nyaania Pool	2025
pH	6.8
Salinity	45
Total Organic Carbon	<100

Pipe Bridge	2025	2024
pH	6.5	5.7
Salinity	21	-
Total Organic Carbon	<100	9.4

Cobblers Pool	2025	2024
pH	6.8	5.7
Salinity	35	-
Total Organic Carbon	<100	3.0

LookSee Pool	2025	2024
pH	6.8	6.0
Salinity	31	-
Total Organic Carbon	<100	23

Craignish	2025	2024
pH	6.4	6.0
Salinity	44	-
Total Organic Carbon	<100	0.4

LPD	2025	2024
pH	6.1	5.6
Salinity	47	-
Total Organic Carbon	<100	17

Rocky Pool	2025	2024
pH	6.7	5.8
Salinity	47	-
Total Organic Carbon	<100	0.8

Piesse Culvert	2025	2024
pH	7.4	6.7
Salinity	15	-
Total Organic Carbon	<100	43

Salty Pool	2025	2024
pH	6.7	6.1
Salinity	110	-
Total Organic Carbon	<100	4.1

Beraking Yarra	2025	2024
pH	7.1	6.1
Salinity	18	-
Total Organic Carbon	<100	1.9

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
pH	6.5-8.0 [#G3]		6.5-8.5 [#N]	6.5-8.5 [#A]		6.5-8.5 [#S1]	6.5-8.5 [#D]	6-8.5 [#F]	6-8.5 [#F]	
Salinity at 25°C										
Total Organic Carbon										

Legend

- Forestry Plantation
- National Park

Water Quality Parameters in Sediment 2025

- Exceeds Human Health and Freshwater Ecosystem DGV
- Detected Below DGV or No DGV Exist

Water Quality Parameters in Sediment 2024

- Detected Below DGV or No DGV Exist

Sediment analysis differed between 2025 and 2024, so the results cannot be directly compared.

- 2025 analysis: Leachable concentrations in sediment as a liquid (mg/L).
- 2024 analysis: Total concentrations in sediment as a solid (mg/kg).
Leachable analysis was undertaken in 2025 as a better metric for risk assessment.

Units: 2025 = mg/L; 2024 = mg/kg.

DGV are only available for pH.
DGV do not exist for salinity or total organic carbon.

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3.
F: ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use.
G3: ANZECC (2000) Default trigger values for lowland rivers in south-west Australia, Tables 3.3.6 and 3.3.7.
N: COK (2020) Common wastewater effluent criteria for on-site disposal in Mandoon-Helena Catchment.
S1: DOH (2011) Compliance value for minimum ongoing monitoring for high exposure risk, Table 8.

Samson St and Nyaania Pool sampled in 2025 only.

Figure 6 Sediment Sampling Results: Water Quality Parameters

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-006
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.

Major Ions

Major ions are the positively and negatively charged ions that are naturally present in water, typically occurring at concentrations in the parts-per-million (mg/L) or higher range. These ions are fundamental to ecosystem health as they influence water quality, support aquatic life, and provide indicators of environmental changes, including shifts driven by human activity.

DGV Exceedances – Water

Major ions were analysed in all water samples in 2024 and 2025 (refer **Figure 7** and **Tables T2a-T2b** appended at the back of this report).

There were several exceedances of the default guideline values (DGVs). Freshwater ecosystem DGV exceedances were associated with elevated fluoride in the lower catchment, as well as at Salty Pool and Beraking Yarra in the upper catchment. Human health DGV exceedances were linked to elevated chloride in the lower catchment, as well as chloride and sodium at Salty Pool. For primary industries, exceedances reflected elevated chloride and sodium in the lower catchment and at Salty Pool, as well as elevated magnesium at Salty Pool. A summary of the DGV exceedances is presented in **Table 4** below.

DGVs	September 2025	September 2024
Freshwater Ecosystem DGVs	Exceedances at 7 of 14 sites: – **Fluoride** (0.3–0.5 mg/L) above the DGV (0.29) at Helena Swan, Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Salty Pool and Beraking Yarra.	Exceedances at 2 of 12 sites: – **Fluoride** (0.3–0.5 mg/L) above the DGV (0.29) at Whiteman Rd and Salty Pool.
Human Health DGVs	Exceedances at 1 of 14 sites: – **Chloride** (4,100 mg/L) above the drinking water aesthetic and non-potable (250) and recreation (400) DGVs at Salty Pool. – **Sodium** (1,500 mg/L) above the drinking water aesthetic (180) and recreation (300) DGVs at Salty Pool.	Exceedances at 3 of 12 sites: – **Chloride** (250–2,500 mg/L) equal to or above the drinking water aesthetic and non-potable DGVs (250) at Whiteman Rd, Helena Roe and Salty Pool. – **Chloride** (2,500 mg/L) above the recreation DGV (400) at Salty Pool. – **Sodium** (1,000 mg/L) above the drinking water aesthetic (180) and recreation (300) DGVs at Salty Pool.
Primary Industries DGVs	Exceedances at 5 of 14 sites: – **Chloride** (190–4,100 mg/L) above the agricultural irrigation (175) DGV at Helena Swan, Whiteman Rd, Helena Roe, Samson St and Salty Pool. – **Magnesium** (520 mg/L) above livestock watering DGV (125) at Salty Pool. – **Sodium** (1,500 mg/L) above the agricultural irrigation DGV (115) at Salty Pool.	Exceedances at 4 of 12 sites: – **Chloride** (230–2,500 mg/L) above the agricultural irrigation DGV (175) at Helena Swan, Whiteman Rd, Helena Roe and Salty Pool. – **Magnesium** (340 mg/L) above the livestock watering DGV (125) at Salty Pool. – **Sodium** (140–1,000 mg/L) above the agricultural irrigation DGV (115) at Helena Swan, Whiteman Rd, Helena Roe and Salty Pool.

Table 4 Major Ions - DGV Exceedances in Water

DGV Exceedances – Sediment

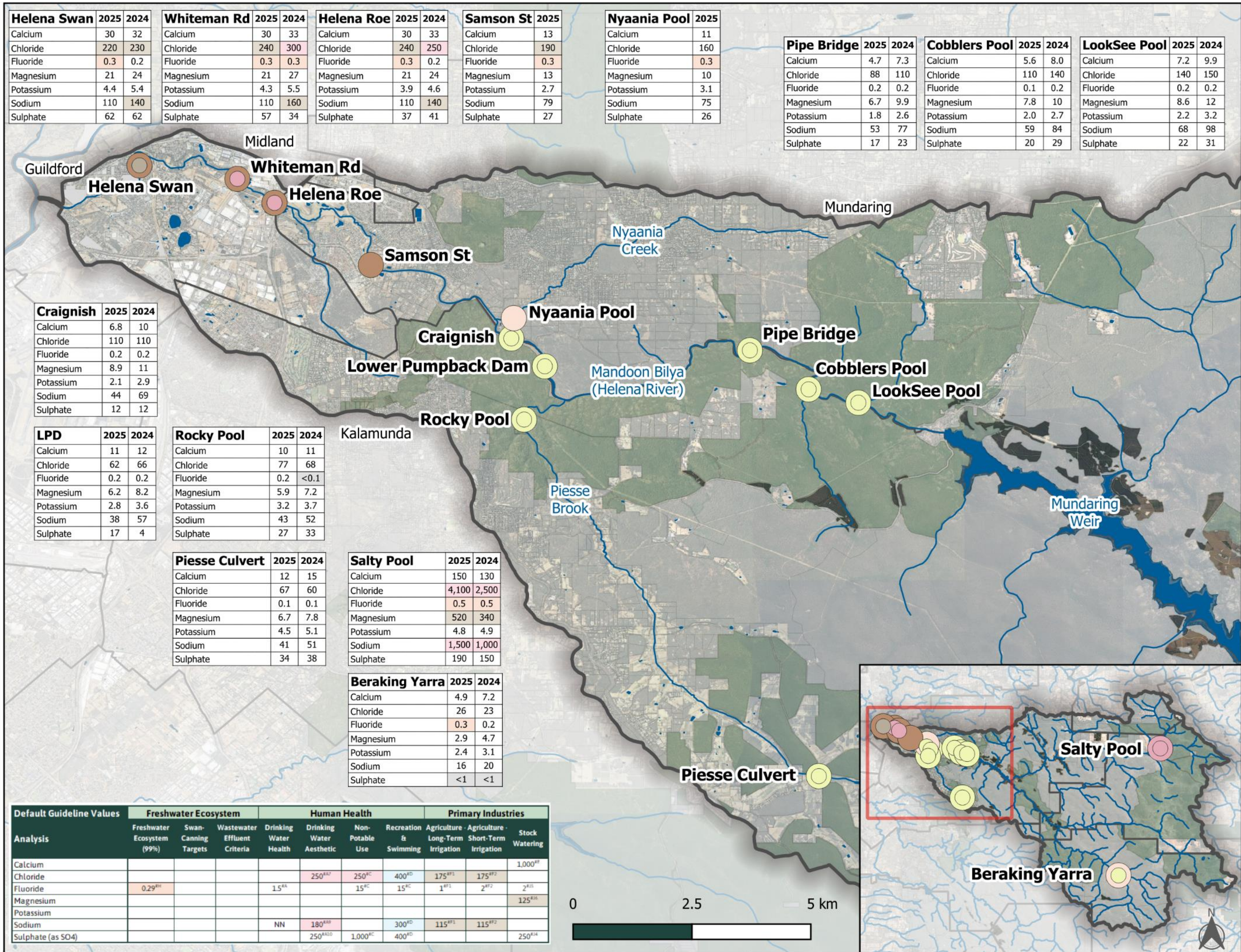
Sediment analysis methods differed between 2025 and 2024:

- 2025 analysis: leachable concentrations in sediment (liquid phase)
- 2024 analysis: total concentrations in sediment (solid phase)

Major ions analysis was only undertaken in 2024, as it is not applicable to the leachable analysis undertaken in 2025 (refer **Figure 8** and **Tables T3a-T3b** appended at the back of this report). Major ions were detected in all sediment samples in 2024, however there are no DGVs available to assess these results.

Summary

Major ions were detected at all sites, reflecting their natural presence in rocks and soils. Chloride, fluoride, magnesium and sodium were substantially elevated at Salty Pool in the upper catchment, where historical land clearing has resulted in rising salinity. Elevated calcium and fluoride was also observed in the lower catchment, suggesting potential human impacts, while elevated fluoride at Beraking Yarra indicates a natural source in the headwaters. As DGVs are not available for all major ions, their interpretation is limited.



Helena Swan	2025	2024
Calcium	30	32
Chloride	220	230
Fluoride	0.3	0.2
Magnesium	21	24
Potassium	4.4	5.4
Sodium	110	140
Sulphate	62	62

Whiteman Rd	2025	2024
Calcium	30	33
Chloride	240	300
Fluoride	0.3	0.3
Magnesium	21	27
Potassium	4.3	5.5
Sodium	110	160
Sulphate	57	34

Helena Roe	2025	2024
Calcium	30	33
Chloride	240	250
Fluoride	0.3	0.2
Magnesium	21	24
Potassium	3.9	4.6
Sodium	110	140
Sulphate	37	41

Samson St	2025
Calcium	13
Chloride	190
Fluoride	0.3
Magnesium	13
Potassium	2.7
Sodium	79
Sulphate	27

Nyaania Pool	2025
Calcium	11
Chloride	160
Fluoride	0.3
Magnesium	10
Potassium	3.1
Sodium	75
Sulphate	26

Pipe Bridge	2025	2024
Calcium	4.7	7.3
Chloride	88	110
Fluoride	0.2	0.2
Magnesium	6.7	9.9
Potassium	1.8	2.6
Sodium	53	77
Sulphate	17	23

Cobblers Pool	2025	2024
Calcium	5.6	8.0
Chloride	110	140
Fluoride	0.1	0.2
Magnesium	7.8	10
Potassium	2.0	2.7
Sodium	59	84
Sulphate	20	29

LookSee Pool	2025	2024
Calcium	7.2	9.9
Chloride	140	150
Fluoride	0.2	0.2
Magnesium	8.6	12
Potassium	2.2	3.2
Sodium	68	98
Sulphate	22	31

Craignish	2025	2024
Calcium	6.8	10
Chloride	110	110
Fluoride	0.2	0.2
Magnesium	8.9	11
Potassium	2.1	2.9
Sodium	44	69
Sulphate	12	12

LPD	2025	2024
Calcium	11	12
Chloride	62	66
Fluoride	0.2	0.2
Magnesium	6.2	8.2
Potassium	2.8	3.6
Sodium	38	57
Sulphate	17	4

Rocky Pool	2025	2024
Calcium	10	11
Chloride	77	68
Fluoride	0.2	<0.1
Magnesium	5.9	7.2
Potassium	3.2	3.7
Sodium	43	52
Sulphate	27	33

Piesse Culvert	2025	2024
Calcium	12	15
Chloride	67	60
Fluoride	0.1	0.1
Magnesium	6.7	7.8
Potassium	4.5	5.1
Sodium	41	51
Sulphate	34	38

Salty Pool	2025	2024
Calcium	150	130
Chloride	4,100	2,500
Fluoride	0.5	0.5
Magnesium	520	340
Potassium	4.8	4.9
Sodium	1,500	1,000
Sulphate	190	150

Beraking Yarra	2025	2024
Calcium	4.9	7.2
Chloride	26	23
Fluoride	0.3	0.2
Magnesium	2.9	4.7
Potassium	2.4	3.1
Sodium	16	20
Sulphate	<1	<1

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Calcium										1,000[#E]
Chloride					250[#A7]	250[#C]	400[#D]	175[#F1]	175[#F2]	
Fluoride	0.29[#H]			1.5[#A]		15[#C]	15[#C]	1[#F1]	2[#F2]	2[#J5]
Magnesium										125[#J6]
Potassium										
Sodium				NN	180[#A9]		300[#D]	115[#F1]	115[#F2]	
Sulphate (as SO4)					250[#A10]	1,000[#C]	400[#D]			250[#J4]

Legend

National Park

Major Ions in Water 2025

- Exceeds Human Health and Primary Industries and Freshwater Ecosystem DGV
- Exceeds Primary Industries and Freshwater Ecosystem DGV
- Exceeds Freshwater Ecosystem DGV
- Detected Below DGV or No DGV Exist

Major Ions in Water 2024

- Exceeds Human Health and Primary Industries and Freshwater Ecosystem DGV
- Exceeds Primary Industries DGV
- Detected Below DGV or No DGV Exist

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
A7: NHMRC (2011) Insufficient data for guideline.
A9: NHMRC (2011) Guideline is a taste threshold.
A10: NHMRC (2011) Guideline is a taste threshold - insufficient data, >500 mg/L can be purgative.
C: DOH (2014) Guidelines for Non-Potable Use (NPUG) e.g. watering gardens/parks, edible garden produce.
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3.
E: ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality.
F: ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use.
F1: ANZECC (2000) Long Term Trigger Value (LTV), non-domestic irrigation for <100 years, Table 4.2.10.
F2: ANZECC (2000) Short Term Trigger Value (STV), Table 4.2.10.
G3: ANZECC (2000) Default trigger values for lowland rivers in south-west Australia, Tables 3.3.6 and 3.3.7.
H: ANZG (2026) Default Australian Water Quality Guidelines for Toxicants in Freshwater Ecosystems at 99% level of species protection (LOSP).
J: ANZG (2023) Draft Livestock Drinking Water Guidelines.
J4: ANZG (2023) 25 mg/L for poultry, 500 mg/L for livestock in general, pigs may tolerate higher levels
J5: ANZG (2023) If livestock feed contains fluoride, DGV reduces to 1.0 mg/L.
J6: ANZG (2023) 125 mg/L for poultry, 250 mg/L for lactating cows and ewes with lambs, 500 mg/L for general ruminants. If sulphate levels are high, poultry may be affected at magnesium concentrations >50 mg/L.
NN: Not Necessary, NHMRC (2011).

All units in mg/L.

Samson St and Nyaania Pool sampled in 2025 only.

Figure 7 Water Sampling Results: Major Ions

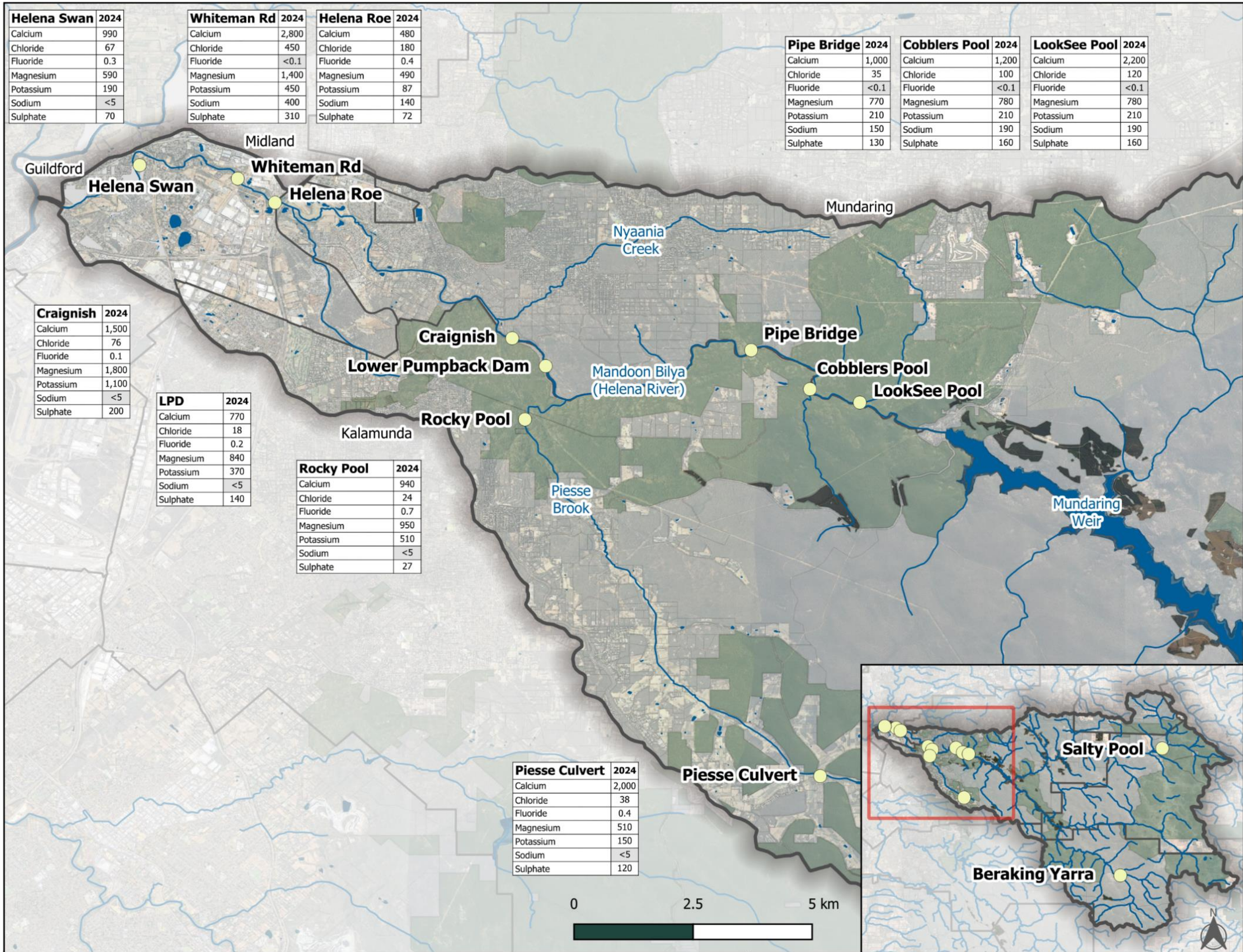
Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-007
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.



Helena Swan	2024
Calcium	990
Chloride	67
Fluoride	0.3
Magnesium	590
Potassium	190
Sodium	<5
Sulphate	70

Whiteman Rd	2024
Calcium	2,800
Chloride	450
Fluoride	<0.1
Magnesium	1,400
Potassium	450
Sodium	400
Sulphate	310

Helena Roe	2024
Calcium	480
Chloride	180
Fluoride	0.4
Magnesium	490
Potassium	87
Sodium	140
Sulphate	72

Pipe Bridge	2024
Calcium	1,000
Chloride	35
Fluoride	<0.1
Magnesium	770
Potassium	210
Sodium	150
Sulphate	130

Cobblers Pool	2024
Calcium	1,200
Chloride	100
Fluoride	<0.1
Magnesium	780
Potassium	210
Sodium	190
Sulphate	160

LookSee Pool	2024
Calcium	2,200
Chloride	120
Fluoride	<0.1
Magnesium	780
Potassium	210
Sodium	190
Sulphate	160

Craignish	2024
Calcium	1,500
Chloride	76
Fluoride	0.1
Magnesium	1,800
Potassium	1,100
Sodium	<5
Sulphate	200

LPD	2024
Calcium	770
Chloride	18
Fluoride	0.2
Magnesium	840
Potassium	370
Sodium	<5
Sulphate	140

Rocky Pool	2024
Calcium	940
Chloride	24
Fluoride	0.7
Magnesium	950
Potassium	510
Sodium	<5
Sulphate	27

Piesse Culvert	2024
Calcium	2,000
Chloride	38
Fluoride	0.4
Magnesium	510
Potassium	150
Sodium	<5
Sulphate	120

Legend

Forestry Plantation

National Park

Major Ions in Sediment 2024

Detected - No DGV Exist

Sediment analysis methods differed between 2025 and 2024.

- 2025 analysis: Leachable concentrations in sediment as a liquid (mg/L).
- 2024 analysis: Total concentrations in sediment as a solid (mg/kg).

Leachable analysis was undertaken in 2025 as a better metric for risk assessment.

Major ions analysis is not applicable to leachable concentrations in sediment.

Therefore major ions concentrations are only shown for the 2024 sampling.

All units in mg/kg.

DGV are not available for interpreting total major ions concentrations in sediment.

Salty Pool	2024
Calcium	1,700
Chloride	1,300
Fluoride	0.3
Magnesium	1,500
Potassium	200
Sodium	1,000
Sulphate	150

Beraking Yarra	2024
Calcium	610
Chloride	34
Fluoride	<0.1
Magnesium	690
Potassium	410
Sodium	250
Sulphate	<10

Figure 8 Sediment Sampling Results: Major Ions

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment) Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-008
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.

Nutrients

Nutrients such as nitrogen and phosphorus are essential components of river ecosystems. Both are naturally occurring but can become elevated due to human activities. Excess nutrients in waterways typically arise from fertiliser use, agricultural or forestry runoff, and wastewater discharges. When nutrient levels become excessive, they can trigger eutrophication, where algal blooms reduce oxygen levels and harm aquatic life.

Nitrogen is the most abundant element in the atmosphere and its cycle is a fundamental process in aquatic environments. In this cycle, highly toxic ammonia in the waste of fish and other organisms is converted by bacteria into nitrite (a toxic intermediate) and then into nitrate, a less toxic form that is used for plant growth.

Phosphorus is a naturally occurring trace element found in rocks, soil and water, and is another key nutrient that supports aquatic productivity.

DGV Exceedances – Water

Nutrients were analysed in all water samples in 2025 and 2024 (refer **Figure 9** and **Tables T2a-T2b** appended at the back of this report).

There were several exceedances of the default guideline values (DGVs). Freshwater ecosystem DGV exceedances were widespread, occurring to varying degrees at most sites and most commonly associated with elevated nitrogen in various forms, along with phosphorus at three sites in 2025. Human health DGV exceedances were linked to elevated ammonia above the recreation DGVs at most sites in 2025 and around half of the sites in 2024. For primary industries, exceedances related to elevated phosphorus at approximately half of the sites and nitrogen at Piesse Culvert.

A summary of the DGV exceedances is presented in **Table 5** below. Note: the freshwater DGV for nitrate has been updated since the 2024 sampling, as described in **Appendix 3**. The 2024 results have been rescreened against the revised DGV to ensure consistency in interpretation.

DGVs	September 2025	September 2024
Freshwater Ecosystem DGVs	Exceedances at 12 of 14 sites: – **Nitrate** (1.3–5.7 mg/L) above the DGV (0.64–1.0) at Rocky Pool and Piesse Culvert. – **Nitrogen (oxidised)** (0.2–5.7 mg/L) above the DGV (0.15) at Helena Swan, Whiteman Rd, Helena Roe, Nyaania Pool, Rocky Pool and Piesse Culvert. – **Nitrogen (total)** (1.2–5.7 mg/L) equal to or above the DGV (1.2) at Rocky Pool, Pipe Bridge, Piesse Culvert and Beraking Yarra. – **Nitrogen (total)** (1.1–5.7 mg/L) above the long-term Swan Canning target (1.0) at Rocky Pool, Pipe Bridge, Piesse Culvert, Salty Pool and Beraking Yarra. – **Phosphorus (reactive)** (0.07 mg/L) above the DGV (0.04) at Salty Pool. – **Phosphorus (total)** (0.07–0.10 mg/L) above the DGV (0.065) at Nyaania Pool, Craignish and Salty Pool. – **Phosphorus (total)** (0.10 mg/L) equal to the long term Swan Canning target (0.1) at Nyaania Pool.	Exceedances at 8 of 12 sites: – **Nitrate** (1.4–6.9 mg/L) above the DGV (0.64–1.0) at Rocky Pool and Piesse Culvert. – **Nitrogen (oxidised)** (0.18–6.9 mg/L) above the DGV (0.15) at Helena Swan, Whiteman Rd, Rocky Pool and Piesse Culvert. – **Nitrogen (total)** (1.2–6.9 mg/L) above the DGV (1.2) at Helena Swan, Rocky Pool and Piesse Culvert. These concentrations also exceed the Swan Canning water quality target (1.0).
Human Health DGVs	Exceedances at 11 of 14 sites: – **Ammonia** (0.03–0.18 mg/L) above the recreation DGV (0.01) at all sites except Cobblers Pool, LookSee Pool and Piesse Culvert.	Exceedances at 5 of 12 sites: – **Ammonia** (0.02–0.13 mg/L) above the recreation DGV (0.01) at Helena Swan, Whiteman Rd, Helena Roe, Craignish and Salty Pool.
Primary Industries DGVs	Exceedances at 7 of 14 sites: – **Nitrogen (total)** (5.7 mg/L) above the long-term agricultural irrigation DGV (5) at Piesse Culvert. – **Phosphorus (total)** (0.05–0.1 mg/L) above the long-term agricultural irrigation DGV (0.05) at Nyaania Pool, Craignish, Lower Dam, Pipe Bridge, Salty Pool and Beraking Yarra.	Exceedances at 6 of 12 sites: – **Nitrogen (total)** (6.9 mg/L) above the long-term agricultural irrigation DGV (5) at Piesse Culvert. – **Phosphorus (total)** (0.06 mg/L) above the long-term agricultural irrigation DGV (0.05) at Helena Swan, Pipe Bridge, Cobblers Pool, LookSee Pool and Beraking Yarra.

Table 5 Nutrients - DGV Exceedances in Water

DGV Exceedances – Sediment

Nutrients were analysed in all sediment samples in 2025 and 2024 (refer **Figure 10** and **Tables T3a-T3b** appended to the back of this report). Sediment analysis methods differed between 2025 and 2024, so the results cannot be directly compared:

- 2025 analysis: leachable concentrations in sediment (liquid phase)
- 2024 analysis: total concentrations in sediment (solid phase)

Leachable concentrations were analysed in 2025 to provide a better metric for risk assessment.

Leachable nutrient concentrations in sediment exceeded the DGVs at several locations, while DGVs are not available to assess nutrients in solid sediment. Freshwater ecosystem DGV exceedances were associated with elevated phosphorus at all sites and elevated nitrogen at approximately half of the sites. For primary industries, exceedances were associated with elevated phosphorus at all sites and elevated nitrogen at Piesse Culvert and Beraking Yarra. A summary of the DGV exceedances is presented in **Table 6** below.

DGVs	September 2025 (leachable)	September 2024 (solid)
Freshwater Ecosystem DGVs	Exceedances at all 14 sites: – **Nitrogen (total)** (1.2–12 mg/L) above the DGV (1.2) at Whiteman Rd, Samson St, Craignish, Piesse Culvert and Beraking Yarra. – **Nitrogen (total)** (1.1–12 mg/L) above the long-term Swan Canning water quality target (1) at Helena Swan, Whiteman Rd, Samson St, Nyaania Pool, Craignish, Piesse Culvert, Salty Pool and Beraking Yarra. – **Phosphorus (reactive)** (0.08 mg/L) above the DGV (0.04) at Helena Swan. – **Phosphorus (total)** (0.08–0.77 mg/L) above the DGV (0.065) at all sites. – **Phosphorus (total)** (0.11–0.77 mg/L) above the long-term Swan Canning water quality target (0.1) at Helena Swan, Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Craignish, Lower Dam, Rocky Pool, Cobblers Pool, Piesse Culvert and Salty Pool.	DGVs do not exist.
Primary Industries DGVs	Exceedances at all 14 sites: – **Nitrogen (total)** (11–12 mg/L) above the long-term agricultural irrigation DGV (5) at Piesse Culvert and Beraking Yarra – **Phosphorus (total)** (0.08–0.77 mg/L) above the long-term agricultural irrigation DGV (0.05) at all sites.	DGVs do not exist.

Table 6 Nutrients - DGV Exceedances in Sediment

Summary

Nutrients were present in water and sediment across the Mandoon catchment and appear to reflect a combination of land-use influences, hydrological conditions and natural attenuation processes.

The highest nitrogen concentrations occurred at the two sites on Piesse Brook, a major tributary of the Mandoon Bilya that flows into the Lower Pumpback Dam. Concentrations were greatest at Piesse Culvert and declined substantially downstream at Rocky Pool. At both sites, nitrogen was in the form of nitrate, with no detectable organic nitrogen or ammonia, indicating an active nitrogen cycle. The consistently high levels in Piesse Brook suggest inputs from surrounding horticultural land and orchards in Pickering Brook, while the marked reduction downstream at Rocky Pool reflects dilution, uptake and natural processing as the brook flows through the forested Kalamunda National Park.

Elevated nitrogen was also recorded on the Mandoon Bilya, but in a different form. Several sites in the middle and upper catchment recorded substantially higher nitrogen concentrations in 2025 compared to 2024. For example, elevated nitrogen was recorded at Pipe Bridge in 2025, despite it not being detected in 2024, and nitrogen concentrations at Salty Pool and Beraking Yarra increased nearly ten-fold.

Unlike Piesse Brook, the elevated nitrogen at these three sites was in the form of organic nitrogen rather than nitrate. This generally indicates that the nitrogen cycle is not fully established, has been disrupted, or that organic matter is accumulating faster than it can be broken down. Low dissolved oxygen at these sites likely contributes to this, as poorly oxygenated water slows decomposition and can trap nitrogen in organic form until oxygen becomes available. These results may also reflect increased organic inputs.

Elevated nitrogen was also observed in the lower catchment. Helena Swan recorded elevated nitrogen in the form of total Kjeldahl nitrogen (TKN) in 2024, although concentrations declined substantially in 2025. The TKN was predominantly comprised of organic nitrogen with some nitrate and low ammonia. At Whiteman Rd and Helena Roe, ammonia concentrations were consistently an order of magnitude higher than at other sites, likely reflecting urban stormwater and drainage influences. Slower water flows and higher organic loads in the lower catchment can promote the accumulation of ammonia and organic nitrogen, and contribute to eutrophication and algal blooms.

Elevated total nitrogen was observed in leachable sediment samples at Samson St, but not in the corresponding dissolved phase concentrations, indicating that the nitrogen is mainly present solely in the solid phase and has not partitioned into porewater at this site.

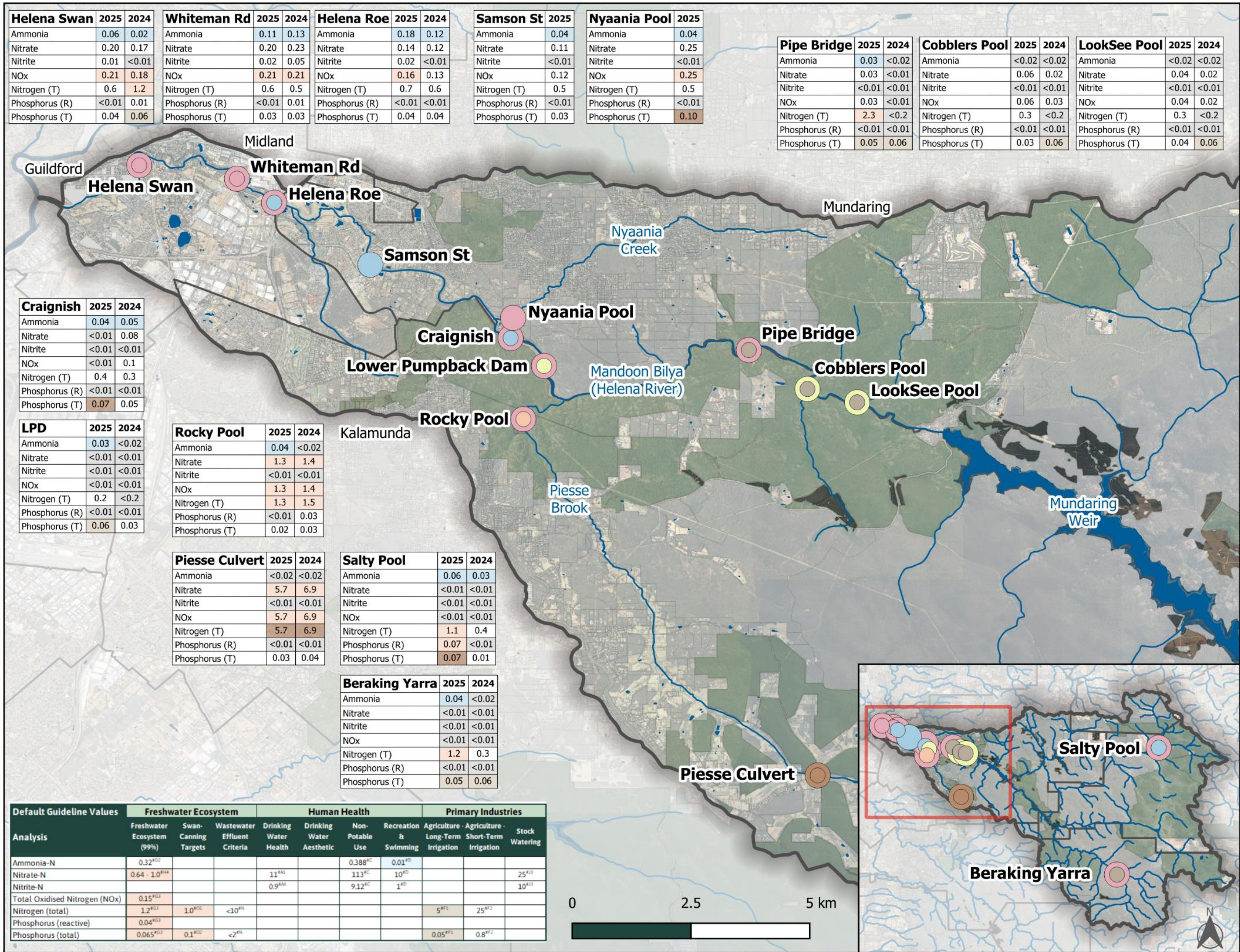
Slightly elevated phosphorus was reported at several sites in both years, including Beraking Yarra in the river's headwaters, suggesting a natural geological source. The highest concentration occurred at Nyaania Pool, downstream of residential gardens in Glen Forrest, indicating a localised anthropogenic contribution.

Overall, the results indicate year-to-year variability in nutrient inputs and highlight how nutrient loads respond to changing flow conditions and localised land-use activities. Together with the broader water quality findings, these patterns reinforce the need for continued monitoring and targeted management to address nutrient sources and protect ecological conditions across the catchment.

With the exception of elevated nitrogen at Piesse Culvert (5.7–6.9 mg/L), nutrient concentrations were broadly similar to those reported in the *Swan Canning Catchment Nutrient Report for the Helena River*[114]:

- Total nitrogen: 0.2–2.3 mg/L, compared to 0.6–1.0 mg/L (median) in 2008-2018
- Total phosphorus: 0.01–0.10 mg/L, compared to 0.01–0.02 mg/L (median) in 2008-2018

Piesse Culvert site on Piesse Brook, a tributary that flows into the Lower Pumpback Dam



Helena Swan	2025	2024
Ammonia	0.06	0.02
Nitrate	0.20	0.17
Nitrite	0.01	<0.01
NOx	0.21	0.18
Nitrogen (T)	0.6	1.2
Phosphorus (R)	<0.01	0.01
Phosphorus (T)	0.04	0.06

Whiteman Rd	2025	2024
Ammonia	0.11	0.13
Nitrate	0.20	0.23
Nitrite	0.02	0.05
NOx	0.21	0.21
Nitrogen (T)	0.6	0.5
Phosphorus (R)	<0.01	0.01
Phosphorus (T)	0.03	0.03

Helena Roe	2025	2024
Ammonia	0.18	0.12
Nitrate	0.14	0.12
Nitrite	0.02	<0.01
NOx	0.16	0.13
Nitrogen (T)	0.7	0.6
Phosphorus (R)	<0.01	<0.01
Phosphorus (T)	0.04	0.04

Samson St	2025
Ammonia	0.04
Nitrate	0.11
Nitrite	<0.01
NOx	0.12
Nitrogen (T)	0.5
Phosphorus (R)	<0.01
Phosphorus (T)	0.03

Nyaania Pool	2025
Ammonia	0.04
Nitrate	0.25
Nitrite	<0.01
NOx	0.25
Nitrogen (T)	0.5
Phosphorus (R)	<0.01
Phosphorus (T)	0.10

Pipe Bridge	2025	2024
Ammonia	0.03	<0.02
Nitrate	0.03	<0.01
Nitrite	<0.01	<0.01
NOx	0.03	<0.01
Nitrogen (T)	2.3	<0.2
Phosphorus (R)	<0.01	<0.01
Phosphorus (T)	0.05	0.06

Cobblers Pool	2025	2024
Ammonia	<0.02	<0.02
Nitrate	0.06	0.02
Nitrite	<0.01	<0.01
NOx	0.06	0.03
Nitrogen (T)	0.3	<0.2
Phosphorus (R)	<0.01	<0.01
Phosphorus (T)	0.03	0.06

LookSee Pool	2025	2024
Ammonia	<0.02	<0.02
Nitrate	0.04	0.02
Nitrite	<0.01	<0.01
NOx	0.04	0.02
Nitrogen (T)	0.3	<0.2
Phosphorus (R)	<0.01	<0.01
Phosphorus (T)	0.04	0.06

Craignish	2025	2024
Ammonia	0.04	0.05
Nitrate	<0.01	0.08
Nitrite	<0.01	<0.01
NOx	<0.01	0.1
Nitrogen (T)	0.4	0.3
Phosphorus (R)	<0.01	<0.01
Phosphorus (T)	0.07	0.05

LPD	2025	2024
Ammonia	0.03	<0.02
Nitrate	<0.01	<0.01
Nitrite	<0.01	<0.01
NOx	<0.01	<0.01
Nitrogen (T)	0.2	<0.2
Phosphorus (R)	<0.01	<0.01
Phosphorus (T)	0.06	0.03

Rocky Pool	2025	2024
Ammonia	0.04	<0.02
Nitrate	1.3	1.4
Nitrite	<0.01	<0.01
NOx	1.3	1.4
Nitrogen (T)	1.3	1.5
Phosphorus (R)	<0.01	0.03
Phosphorus (T)	0.02	0.03

Piesse Culvert	2025	2024
Ammonia	<0.02	<0.02
Nitrate	5.7	6.9
Nitrite	<0.01	<0.01
NOx	5.7	6.9
Nitrogen (T)	5.7	6.9
Phosphorus (R)	<0.01	<0.01
Phosphorus (T)	0.03	0.04

Salty Pool	2025	2024
Ammonia	0.06	0.03
Nitrate	<0.01	<0.01
Nitrite	<0.01	<0.01
NOx	<0.01	<0.01
Nitrogen (T)	1.1	0.4
Phosphorus (R)	0.07	<0.01
Phosphorus (T)	0.07	0.01

Beraking Yarra	2025	2024
Ammonia	0.04	<0.02
Nitrate	<0.01	<0.01
Nitrite	<0.01	<0.01
NOx	<0.01	<0.01
Nitrogen (T)	1.2	0.3
Phosphorus (R)	<0.01	<0.01
Phosphorus (T)	0.05	0.06

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Ammonia-N	0.32[#G2]					0.388[#C]	0.01[#D]			
Nitrate-N	0.64 - 1.0[#H4]			11[#A5]		113[#C]	10[#D]			25[#J3]
Nitrite-N				0.9[#A6]		9.12[#C]	1[#D]			10[#J3]
Total Oxidised Nitrogen (NOx)	0.15[#G3]									
Nitrogen (total)	1.2[#G3]	1.0[#O1]	<10[#N]					5[#F1]	25[#F2]	
Phosphorus (reactive)	0.04[#G3]									
Phosphorus (total)	0.065[#G3]	0.1[#O2]	<2[#N]					0.05[#F1]	0.8[#F2]	

Legend

Nutrients in Water 2025

- Exceeds Recreation and and Primary Industries and/or Freshwater Ecosystem DGV
- Exceeds Recreation DGV
- Exceeds Primary Industries and Freshwater Ecosystem DGV
- Detected Below DGV or No DGV Exist

Nutrients in Water 2024

- Exceeds Recreation and and Primary Industries and/or Freshwater Ecosystem DGV
- Exceeds Recreation DGV
- Exceeds Primary Industries and Freshwater Ecosystem DGV
- Exceeds Primary Industries DGV
- Exceeds Freshwater Ecosystem DGV
- Detected Below DGV or No DGV Exist

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
A5: NHMRC (2011) Adults/children up to 100 mg/L.
A6: NHMRC (2011) Rapidly oxidised to nitrate.
C: DOH (2014) Guidelines for Non-Potable Use (NPUG).
D: ANZECC (2000) Guidelines for Recreational Water.
F: ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use.
F1: ANZECC (2000) Long Term Trigger Value, non-domestic irrigation for <100 years, Table 4.2.10.
F2: ANZECC (2000) Short Term Trigger Value.
G2: ANZECC (2000) Total Ammonia (NH3-N) at pH 8, drops to 2.18 mg/L at pH 7, Table 8.3.7.
G3: ANZECC (2000) Trigger values for lowland rivers in south-west Australia, Tables 3.3.6 and 3.3.7.
H: ANZG (2026) Australian Water Quality Guidelines for Toxicants in Freshwater Ecosystems at 99% LOSP.
H4: ANZG (2026) Hardness <30mg/L CaCO3: 0.64mg/L, 30-150mg/L: 1.0mg/L, >150mg/L: 18mg/L, updated 2025. Protects against toxicity, not eutrophication.
J: ANZG (2023) Draft Livestock Drinking Water Guidelines.
J3: ANZG (2023) Nitrate: 25mg/L poultry, 100mg/L livestock, 400mg/L cattle. Nitrite: 10mg/L livestock.
N: COK (2020) Wastewater effluent criteria in Mandoon Catchment.
O1: SRT (1999) Catchment target, nitrogen: 1.0mg/L long term/20yrs; 2.0mg/L short term/5yrs. Target for Helena River inflow: 1.0mg/L.
O2: SRT (1999) Catchment target, phosphorus: 0.1mg/L long term/20yrs; 0.2mg/L short term/5yrs. Target for Helena River inflow: 0.1mg/L.

Samson St and Nyaania Pool sampled in 2025 only.

Figure 9 Water Sampling Results: Nutrients

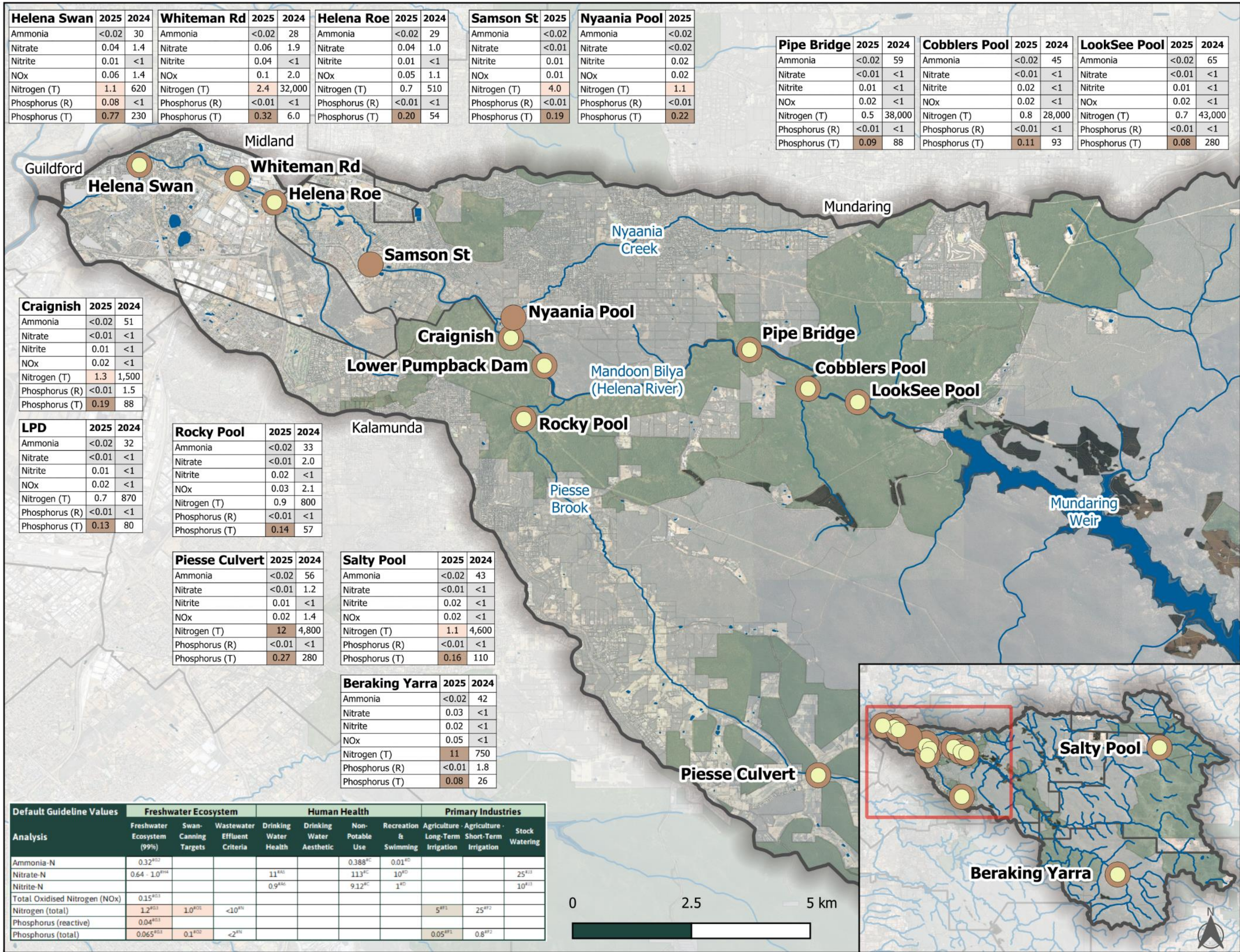
BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-009
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.



Helena Swan	2025	2024
Ammonia	<0.02	30
Nitrate	0.04	1.4
Nitrite	0.01	<1
NOx	0.06	1.4
Nitrogen (T)	1.1	620
Phosphorus (R)	0.08	<1
Phosphorus (T)	0.77	230

Whiteman Rd	2025	2024
Ammonia	<0.02	28
Nitrate	0.06	1.9
Nitrite	0.04	<1
NOx	0.1	2.0
Nitrogen (T)	2.4	32,000
Phosphorus (R)	<0.01	<1
Phosphorus (T)	0.32	6.0

Helena Roe	2025	2024
Ammonia	<0.02	29
Nitrate	0.04	1.0
Nitrite	0.01	<1
NOx	0.05	1.1
Nitrogen (T)	0.7	510
Phosphorus (R)	<0.01	<1
Phosphorus (T)	0.20	54

Samson St	2025
Ammonia	<0.02
Nitrate	<0.01
Nitrite	0.01
NOx	0.01
Nitrogen (T)	4.0
Phosphorus (R)	<0.01
Phosphorus (T)	0.19

Nyaania Pool	2025
Ammonia	<0.02
Nitrate	<0.02
Nitrite	0.02
NOx	0.02
Nitrogen (T)	1.1
Phosphorus (R)	<0.01
Phosphorus (T)	0.22

Pipe Bridge	2025	2024
Ammonia	<0.02	59
Nitrate	<0.01	<1
Nitrite	0.01	<1
NOx	0.02	<1
Nitrogen (T)	0.5	38,000
Phosphorus (R)	<0.01	<1
Phosphorus (T)	0.09	88

Cobblers Pool	2025	2024
Ammonia	<0.02	45
Nitrate	<0.01	<1
Nitrite	0.02	<1
NOx	0.02	<1
Nitrogen (T)	0.8	28,000
Phosphorus (R)	<0.01	<1
Phosphorus (T)	0.11	93

LookSee Pool	2025	2024
Ammonia	<0.02	65
Nitrate	<0.01	<1
Nitrite	0.01	<1
NOx	0.02	<1
Nitrogen (T)	0.7	43,000
Phosphorus (R)	<0.01	<1
Phosphorus (T)	0.08	280

Craignish	2025	2024
Ammonia	<0.02	51
Nitrate	<0.01	<1
Nitrite	0.01	<1
NOx	0.02	<1
Nitrogen (T)	1.3	1,500
Phosphorus (R)	<0.01	1.5
Phosphorus (T)	0.19	88

LPD	2025	2024
Ammonia	<0.02	32
Nitrate	<0.01	<1
Nitrite	0.01	<1
NOx	0.02	<1
Nitrogen (T)	0.7	870
Phosphorus (R)	<0.01	<1
Phosphorus (T)	0.13	80

Rocky Pool	2025	2024
Ammonia	<0.02	33
Nitrate	<0.01	2.0
Nitrite	0.02	<1
NOx	0.03	2.1
Nitrogen (T)	0.9	800
Phosphorus (R)	<0.01	<1
Phosphorus (T)	0.14	57

Piesse Culvert	2025	2024
Ammonia	<0.02	56
Nitrate	<0.01	1.2
Nitrite	0.01	<1
NOx	0.02	1.4
Nitrogen (T)	12	4,800
Phosphorus (R)	<0.01	<1
Phosphorus (T)	0.27	280

Salty Pool	2025	2024
Ammonia	<0.02	43
Nitrate	<0.01	<1
Nitrite	0.02	<1
NOx	0.02	<1
Nitrogen (T)	1.1	4,600
Phosphorus (R)	<0.01	<1
Phosphorus (T)	0.16	110

Beraking Yarra	2025	2024
Ammonia	<0.02	42
Nitrate	0.03	<1
Nitrite	0.02	<1
NOx	0.05	<1
Nitrogen (T)	11	750
Phosphorus (R)	<0.01	1.8
Phosphorus (T)	0.08	26

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Ammonia-N	0.32[#G2]					0.388[#C]	0.01[#D]			
Nitrate-N	0.64 - 1.0[#H4]			11[#A5]		113[#C]	10[#D]			25[#J3]
Nitrite-N				0.9[#A6]		9.12[#C]	1[#D]			10[#J3]
Total Oxidised Nitrogen (NOx)	0.15[#G3]									
Nitrogen (total)	1.2[#G3]	1.0[#O1]	<10[#N]					5[#F1]	25[#F2]	
Phosphorus (reactive)	0.04[#G3]									
Phosphorus (total)	0.065[#G3]	0.1[#O2]	<2[#N]					0.05[#F1]	0.8[#F2]	

Legend

Forestry Plantation

National Park

Nutrients in Sediment 2025

Exceeds Primary Industries and Freshwater Ecosystem DGV

Nutrients in Sediment 2024

Detected - No DGV Exist

Sediment analysis methods differed between 2025 and 2024, so the results cannot be directly compared.

- 2025 analysis: Leachable concentrations in sediment as a liquid (mg/L).
- 2024 analysis: Total concentrations in sediment as a solid (mg/kg).

Leachable analysis was undertaken in 2025 as a better metric for risk assessment.

Units: 2025 = mg/L; 2024 = mg/kg.

Default Guideline Values are applicable to 2025 leachable concentrations only. DGVs do not exist for total nutrients in sediment.

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
A5: NHMRC (2011) Protects bottle-fed infants, adults/children can safely drink up to 100 mg/L.
A6: NHMRC (2011) Rapidly oxidised to nitrate.
C: DOH (2014) Guidelines for Non-Potable Use (NPUG) e.g. watering gardens/parks, edible garden produce.
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3.
F: ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use.
F1: ANZECC (2000) Long Term Trigger Value, non-domestic irrigation for <100 years, Table 4.2.10.
F2: ANZECC (2000) Short Term Trigger Value.
G2: ANZECC (2000) Total Ammonia (NH3-N) at pH 8, drops to 2.18 mg/L at pH 7, Table 8.3.7.
G3: ANZECC (2000) Default trigger values for lowland rivers in south-west Australia, Tables 3.3.6 and 3.3.7.
H: ANZG (2026) Default Australian Water Quality Guidelines for Toxicants in Freshwater Ecosystems at 99% level of species protection (LOSP).
H4: ANZG (2026) DGV for 99% LOSP. Soft water <30 mg/L CaCO3: 0.64 mg/L, moderate water 30-150 mg/L: 1.0 mg/L, hard water >150 mg/L: 18 mg/L, updated 2025. Protects against toxicity, not eutrophication.
J: ANZG (2023) Draft Livestock Drinking Water Guidelines.
J3: ANZG (2023) Nitrate: 25 mg/L poultry, 100 mg/L general livestock, 400 mg/L cattle. Nitrite: 10 mg/L general livestock.
N: COK (2020) Common wastewater effluent criteria for on-site disposal in Mandoon-Helena Catchment.
O1: SRT (1999) Catchment target, maximum total nitrogen: 1.0 mg/L long term/20 yrs; 2.0 mg/L short term/5 yrs. Target for Helena River inflow: 1.0 mg/L.
O2: SRT (1999) Catchment target, maximum total phosphorus: 0.1 mg/L long term/20 yrs; 0.2 mg/L short term/5 yrs. Target for Helena River inflow: 0.1 mg/L.

Samson St and Nyaania Pool sampled in 2025 only.

Figure 10 Sediment Sampling Results: Nutrients

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-010
Date: 12 December 2025

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Metals and Other Inorganics

Metals occur naturally in rocks and soils and enter waterways through natural weathering processes. They can also be introduced through human activities such as road runoff, fossil fuel combustion, industrial processes and waste disposal.

Several naturally occurring metals are present in elevated concentrations in the Mandoon catchment, including aluminium, iron and manganese. Aluminium is the most abundant metal in the Earth's crust, while iron and manganese play key roles in major biogeochemical cycles, including the water, carbon, nitrogen, phosphorus and sulphur cycles.

Trace elements such as barium, boron, cobalt, copper, lithium, nickel, selenium, titanium, uranium, vanadium and zinc occur naturally in minute quantities and can enter waterways through weathering. Their levels may increase due to urban, industrial and agricultural inputs. Although many are essential for plant growth and biological processes, elevated concentrations can be toxic to aquatic organisms and humans.

Some metals are more strongly associated with anthropogenic sources. For example, elevated cadmium, chromium, lead and mercury are more likely to be associated with fossil fuel combustion, fertilizers, industrial activities, traffic emissions and/or waste disposal. These heavy metals are highly toxic and bioaccumulate in the food chain. Cyanide is an inorganic industrial chemical used in pesticides and metal extraction that can be naturally released from certain plants during fire-related germination[115].

DGV Exceedances – Water

Metals were analysed in all water samples in 2025 and 2024 (refer **Figure 11** and **Tables T2a-T2b** appended to the back of this report). Metals analysis methods differed between 2025 and 2024, so the results cannot be directly compared:

- 2025 analysis: dissolved metal concentrations from field filtered samples
- 2024 analysis: total metal concentrations from unfiltered samples

Dissolved metals were analysed in 2025 to assess bioavailability to aquatic organisms and provide a better metric for risk assessment.

There were several exceedances of the default guideline values (DGVs). Freshwater ecosystem DGV exceedances were widespread, occurring at all sites to varying degrees and typically involving elevated aluminium, copper, iron, vanadium and zinc. Isolated exceedances of the DGVs for boron, cobalt, cyanide, lead and uranium were also observed at several sites in 2024; however, this was based on total metal concentrations, and was not reflected in the corresponding dissolved metal results in 2025, suggesting that these metals may not be bioavailable to aquatic organisms.

Human health DGV exceedances were linked to elevated aluminium, iron and manganese, with concentrations at approximately half of the sites. For primary industries, exceedances were associated with elevated iron and manganese at most sites.

A summary of the DGV exceedances is presented in **Table 7** below. Note: the freshwater DGVs for chromium III and iron have been updated since the 2024 sampling, as described in **Appendix 3**. Whilst the revised DGVs are applicable to total concentrations, rather than dissolved, they are used for screening in the current assessment in the absence of other more suitable guidelines, noting that comparison of the dissolved concentrations to these DGVs may underestimate risk but is preferable to not assessing them at all. The 2024 results have been rescreened against the amended DGVs to ensure consistency in interpretation.

DGVs	September 2025 (dissolved)	September 2024 (total)
Freshwater Ecosystem DGVs	Exceedances at all 14 sites: – **Aluminium** (0.06–0.2 mg/L) above the DGV (0.027) at Helena Roe, Samson St, Nyaania Pool, Craignish, Rocky Pool, Pipe Bridge, Cobblers Pool, LookSee Pool and Beraking Yarra.	Exceedances at all 14 sites: – **Aluminium** (0.06–0.7 mg/L) above the DGV (0.027) at all sites except Whiteman Rd, Lower Dam and Salty Pool. – **Boron** (0.09–0.13 mg/L) above the DGV (0.09) at Whiteman Rd and Lower Dam.

DGVs	September 2025 (dissolved)	September 2024 (total)
	– **Copper** (0.002-0.005 mg/L) above the DGV (0.001) at Piesse Culvert, Salty Pool and Beraking Yarra. – **Iron** (0.16–1.20 mg/L) above the DGV (0.14) at all sites except Rocky Pool and Piesse Culvert. – **Vanadium** (0.006–0.007 mg/L) above the DGV (0.006) at Craignish, Lower Dam and Beraking Yarra. – **Zinc** (0.005–0.011 mg/L) above the DGV (0.0024) at all sites except Whiteman Rd, Pipe Bridge, Looksee Pool and Salty Pool.	– **Chromium total** (0.002 mg/L) above the DGV (0.00095 mg/L) at Craignish. DGV is below the limit of detection (<0.001). – **Cobalt** (0.001–0.002 mg/L) above the DGV (0.0014) at Craignish and Beraking Yarra. – **Copper** (0.001–0.003 mg/L) above the DGV (0.001) at Helena Swan, Craignish, Piesse Culvert and Beraking Yarra. DGV is the same as the limit of detection. – **Cyanide** (0.007 mg/L) above the DGV (0.004) at Beraking Yarra. – **Iron** (0.16–6.0 mg/L) equal to or above the DGV (0.14) at all sites except Piesse Culvert. – **Lead** (0.001 mg/L) at the DGV (0.001) at Craignish and Beraking Yarra. DGV is the same as the limit of detection. – **Uranium** (0.001–0.002 mg/L) above the DGV (0.0005) at Helena Swan, Whiteman Rd and Helena Roe. – **Vanadium** (0.007 mg/L) above the DGV (0.06) at Craignish. – **Zinc** (0.005–0.007 mg/L) above the DGV (0.0024) at Helena Swan, Whiteman Rd, LookSee Pool, Piesse Culvert, Salty Pool and Beraking Yarra.
Human Health DGVs	Exceedances at 6 of 14 sites: – **Aluminium** (0.2 mg/L) at the drinking water aesthetic, non-potable and recreation DGVs (0.2) at Nyaania Pool. – **Iron** (0.32–1.20 mg/L) above the drinking water aesthetic, non-potable and recreation DGVs (0.3) at Helena Swan, Whiteman Rd, Helena Roe, Samson St, Craignish, Lower Dam, Cobblers Pool and Beraking Yarra. – **Manganese** (0.1–0.24 mg/L) above the drinking water aesthetic and recreation DGVs (0.1) at Helena Swan, Whiteman Rd, Helena Roe, Lower Dam, Salty Pool and Beraking Yarra.	Exceedances at 10 of 12 sites: – **Aluminium** (0.22–0.7 mg/L) above the drinking water aesthetic, non-potable and recreation DGVs (0.2) at Craignish, Cobblers Pool and LookSee Pool. – **Iron** (0.53–6.0 mg/L) above the drinking water aesthetic, non-potable and recreation DGVs (0.3) at all sites except Rocky Pool and Piesse Culvert. – **Manganese** (0.12–0.46 mg/L) above the drinking water aesthetic and recreation DGVs (0.1) at Helena Swan, Whiteman Rd, Helena Roe, Craignish, Lower Dam, Salty Pool and Beraking Yarra.
Primary Industries DGVs	Exceedances at 11 of 14 sites: – **Iron** (0.22–1.20 mg/L) above the long-term agricultural irrigation DGV (0.2) at all sites except Nyaania Pool, Rocky Pool and Piesse Culvert. – **Manganese** (0.22–0.24 mg/L) above the long-term agricultural irrigation DGV (0.2) at Salty Pool and Beraking Yarra.	Exceedances at 10 of 12 sites: – **Iron** (0.53–6.0 mg/L) above the long-term agricultural irrigation DGV (0.2) at all sites except Rocky Pool and Piesse Culvert. – **Manganese** (0.22–0.46 mg/L) above the long-term agricultural irrigation DGV (0.2) at Lower Dam, Salty Pool and Beraking Yarra.

Table 7 Metals and Other Inorganics - DGV Exceedances in Water

DGV Exceedances – Sediment

Metals were analysed in all sediment samples in 2025 and 2024 (refer **Figure 12** and **Tables T3a-T3b** appended to the back of this report). Both the metals and sediment analysis methods differed between 2025 and 2024, so the results cannot be directly compared:

- 2025 analysis: leachable concentrations of dissolved metals in sediment (liquid phase)
- 2024 analysis: total metal concentrations in sediment (solid phase)

Leachable dissolved metal concentrations were analysed in 2025 to assess bioavailability to aquatic organism and provide a better metric for risk assessment. Leachable dissolved metals exceeded the DGVs at all sites, while limited DGVs are available to assess total metal concentrations.

Freshwater ecosystem DGV exceedances were widespread and predominantly associated with leachable aluminium, copper, iron, lead and zinc at all sites, as well as boron, chromium and vanadium at most sites. Leachable cobalt and nickel exceeded the DGVs at around half of the sites, and localised exceedances of cadmium and uranium were also observed at Whiteman Rd in the lower catchment. In solid sediment, total copper concentrations at Piesse Culvert and total mercury at Whiteman Rd exceeded the freshwater DGVs.

Human health DGV exceedances were also widespread, predominantly driven by elevated leachable aluminium and iron at all sites, and cobalt and lead at around half of the sites. Localised exceedances of other metals were observed across the lower catchment, in particular, elevated barium, uranium, vanadium and zirconium at Whiteman Rd.

For primary industries, exceedances were typically associated with elevated leachable aluminium and iron at most sites. Additional localised exceedances were observed at Whiteman Rd and Nyaania Pool.

A summary of the DGV exceedances is presented in **Table 8** below.

DGVs	September 2025 (leachable, dissolved)	Sept 2024 (solid, total)
Freshwater Ecosystem DGVs	Exceedances at all 14 sites: – **Aluminium** (1–45 mg/L) above the DGV (0.027) at all sites. – **Boron** (0.20–0.56 mg/L) above the DGV (0.09) at all sites except Piesse Culvert. – **Cadmium** (0.0002 mg/L) above the DGV (0.00006) at Whiteman Rd. DGV is below the limit of detection (<0.0002). – **Chromium** (0.001–0.043 mg/L) above the DGV (0.00095) at all sites except Craignish. – **Chromium III** (0.002–0.043 mg/L) above the DGV (0.00095) at all sites except Helena Swan and Craignish. – **Cobalt** (0.002–0.012 mg/L) above the DGV (0.0014) at Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Craignish, Rocky Pool, Piesse Culvert, Salty Pool and Beraking Yarra. – **Copper** (0.003-0.080 mg/L) above the DGV (0.001) at all sites. DGV is the same as the limit of detection (<0.001). – **Iron** (1.6–47 mg/L) above the DGV (0.14) at all sites. – **Lead** (0.001–0.081 mg/L) equal to or above the DGV (0.001) at all sites. DGV is the same as the limit of detection (<0.001). – **Nickel** (0.011–0.025 mg/L) above the DGV (0.008) at Whiteman Rd, Helena Roe, Nyaania Pool, Rocky Pool, Piesse Culvert and Salty Pool. – **Uranium** (0.032 mg/L) above the DGV (0.0005) at Whiteman Rd. – **Vanadium** (0.007–0.091 mg/L) above the DGV (0.006) at all sites except Helena Swan, Craignish and Cobblers Pool. – **Zinc** (0.022–0.310 mg/L) above the DGV (0.0024) at all sites.	Exceedances at 2 of 12 sites: – **Copper** (86 mg/kg) above the DGV (65) at Piesse Culvert. – **Mercury** (0.23 mg/kg) above the DGV (0.15) at Whiteman Rd. Limited DGVs exist.
Human Health DGVs	Exceedances at all 14 sites: – **Aluminium** (45 mg/L) above the drinking water DGV (20) at Pipe Bridge. – **Aluminium** (1–45 mg/L) above the drinking water aesthetic, non-potable and recreation DGVs (0.2) at all sites. – **Barium** (2.3 mg/L) above the drinking water (2) and recreation (1) DGVs at Whiteman Rd. – **Cobalt** (0.006–0.012 mg/L) equal to or above the drinking water DGV (0.006) at Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Craignish, Rocky Pool and Salty Pool. – **Iron** (15–47 mg/L) above the drinking water DGV (14) at Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Rocky Pool, Pipe Bridge and Salty Pool. – **Iron** (1.6–47 mg/L) above the drinking water aesthetic, non-potable and recreation DGVs (0.3) at all sites. – **Lead** (0.012–0.081 mg/L) above the drinking water DGV (0.01) at Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Rocky Pool, Piesse Culvert and Salty Pool. – **Lead** (0.081 mg/L) above the recreation DGV (0.05) at Whiteman Rd. – **Manganese** (0.15–0.21 mg/L) above the drinking water aesthetic and recreation DGVs (0.1) at Whiteman Rd, Helena Roe, Samson St and Nyaania Pool. – **Nickel** (0.025 mg/L) above the drinking water DGV (0.02) at Nyaania Pool. – **Uranium** (0.032 mg/L) above the drinking water DGV (0.02) at Whiteman Rd. – **Vanadium** (0.087–0.091 mg/L) above the drinking water DGV (0.086) at Whiteman Rd and Rocky Pool. – **Zirconium** (0.02 mg/L) above the drinking water DGV (0.0016) at Whiteman Rd. DGV is below the limit of detection (<0.01).	DGVs do not exist.
Primary Industries DGVs	Exceedances at all 14 sites: – **Aluminium** (45 mg/L) above the short-term agricultural irrigation DGV (20) at Pipe Bridge. – **Aluminium** (6–45 mg/L) above the long-term agricultural irrigation (5) and livestock watering (3.6) DGVs at all sites except Helena Swan, Craignish and Cobblers Pool. – **Barium** (2.3 mg/L) above the livestock watering DGV (2) at Whiteman Rd. – **Boron** (0.53–0.56 mg/L) above the agricultural irrigation DGV (0.5) at Whiteman Rd and Nyaania Pool. – **Iron** (1.6–47 mg/L) above the long-term irrigation DGV (0.2) at all sites. – **Iron** (15–47 mg/L) above the short-term irrigation DGV (10) at Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Rocky Pool, Pipe Bridge and Salty Pool.	DGVs do not exist.

DGVs	September 2025 (leachable, dissolved)	Sept 2024 (solid, total)
	– **Manganese** (0.21 mg/L) above the long-term irrigation DGV (0.2) at Whiteman Rd. – **Uranium** (0.032 mg/L) above the long-term irrigation DGV (0.01) at Whiteman Rd. – **Zirconium** (0.02 mg/L) above the livestock watering DGV (0.0016) at Whiteman Rd. DGV is below the limit of detection (<0.01).	

Table 8 Metals and Other Inorganics - DGV Exceedances in Sediment

Summary

In water, elevated concentrations were primarily associated with naturally occurring aluminium, iron and manganese, and to a lesser extent, elevated copper, vanadium and zinc. Localised elevated concentrations of boron, cobalt, cyanide, lead and uranium that were detected at several locations in 2024 were not observed in 2025, likely due to the shift in analytical method from totals metals to dissolved metals.

Dissolved metal concentrations measured in 2025 were substantially lower than total metal concentrations reported in 2024, reflecting the removal of suspended sediment during filtration. Dissolved concentrations represent the bioavailable fraction of metals, rather than the total load associated with suspended particles.

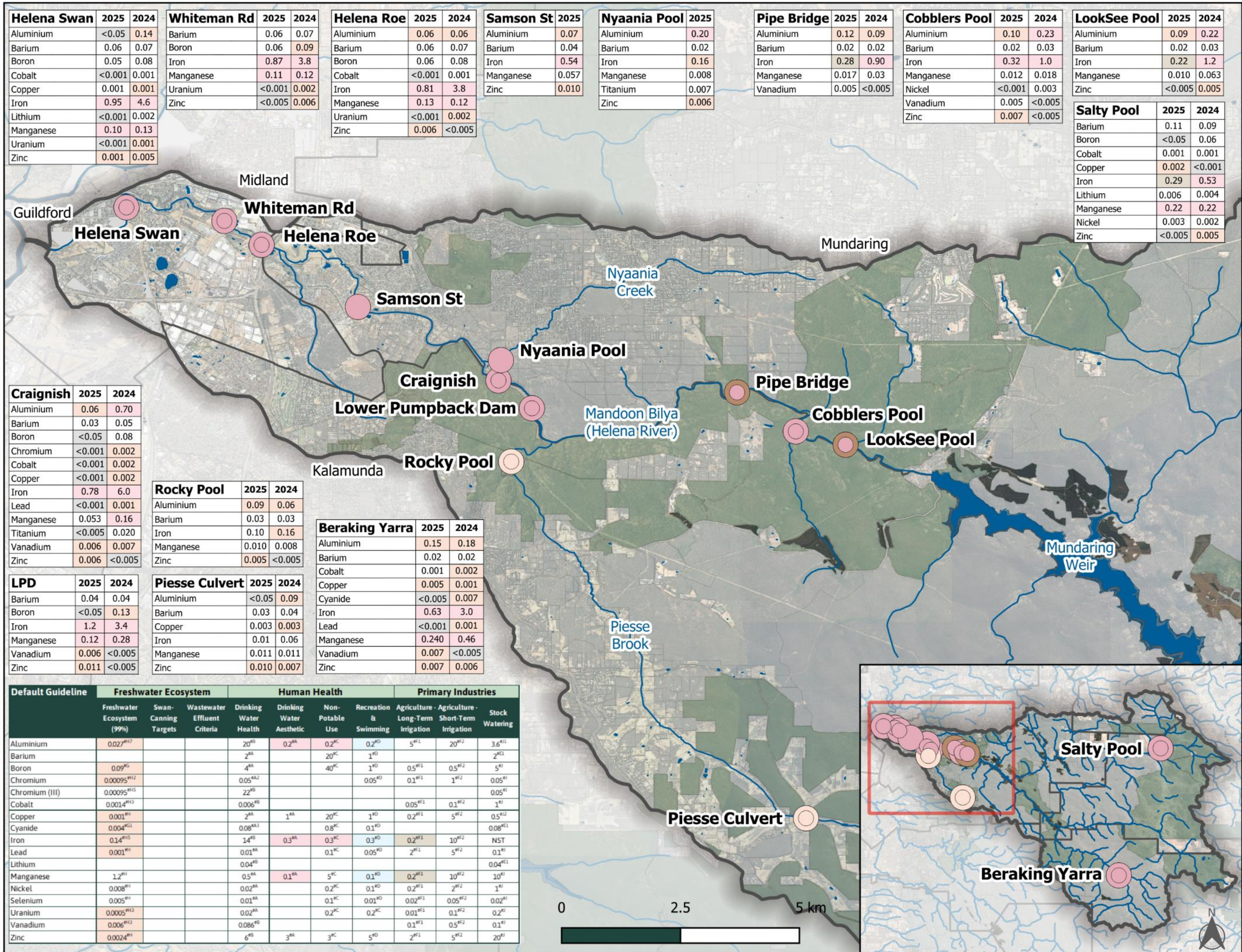
Sediment results showed elevated concentrations of naturally occurring metals across the catchment, with some localised patterns suggesting anthropogenic influence. Leachable concentrations commonly comprised elevated aluminium, boron, chromium, copper, iron, lead, vanadium and zinc, while cobalt, manganese and nickel were elevated at around half of the sites. Whiteman Rd in the lower catchment also recorded elevated barium, cadmium, uranium and zirconium. As anticipated, leachable metal concentrations were generally higher than dissolved concentrations in water, reflecting the natural presence of metals in sediment and their mobilisation through weathering processes.

In solid sediment, elevated copper at Piesse Culvert and elevated mercury at Whiteman Rd likely reflect anthropogenic sources. Although copper is naturally occurring, its magnitude suggests it may be linked to human inputs, such as copper-based pesticides commonly used in agricultural areas like Pickering Brook. Mercury concentrations at Whiteman Rd were an order of magnitude higher than at other sites, and potentially linked to historical contamination from the former Bellevue Hazardous Waste Facility and Midland Railway Workshops. Mercury was not detected in water or leachable sediment at any site.

Several metals were not detected at any location, including antimony, molybdenum, silver, thallium and tin. Additionally, arsenic, beryllium, cadmium, mercury, thorium and zirconium were not detected in water at any location, and cyanide was not detected in sediment.

Overall, concentrations of metals were broadly similar to those reported in the 2014 *Helping the Helena* study[32] although some differences were evident, including the absence of arsenic in water samples in 2025 and 2024. Not at all metals analysed in the current study were analysed in the 2014 assessment (e.g. barium, boron, cyanide, manganese vanadium and uranium).

Seasonal wetland in the upper catchment



Helena Swan	2025	2024
Aluminium	<0.05	0.14
Barium	0.06	0.07
Boron	0.05	0.08
Cobalt	<0.001	0.001
Copper	0.001	0.001
Iron	0.95	4.6
Lithium	<0.001	0.002
Manganese	0.10	0.13
Uranium	<0.001	0.001
Zinc	0.001	0.005

Whiteman Rd	2025	2024
Barium	0.06	0.07
Boron	0.06	0.09
Iron	0.87	3.8
Manganese	0.11	0.12
Uranium	<0.001	0.002
Zinc	<0.005	0.006

Helena Roe	2025	2024
Aluminium	0.06	0.06
Barium	0.06	0.07
Boron	0.06	0.08
Cobalt	<0.001	0.001
Iron	0.81	3.8
Manganese	0.13	0.12
Uranium	<0.001	0.002
Zinc	0.006	<0.005

Samson St	2025
Aluminium	0.07
Barium	0.04
Iron	0.54
Manganese	0.057
Zinc	0.010

Nyaania Pool	2025
Aluminium	0.20
Barium	0.02
Iron	0.16
Manganese	0.008
Titanium	0.007
Zinc	0.006

Pipe Bridge	2025	2024
Aluminium	0.12	0.09
Barium	0.02	0.02
Iron	0.28	0.90
Manganese	0.017	0.03
Vanadium	0.005	<0.005

Cobblers Pool	2025	2024
Aluminium	0.10	0.23
Barium	0.02	0.03
Iron	0.32	1.0
Manganese	0.012	0.018
Nickel	<0.001	0.003
Vanadium	0.005	<0.005
Zinc	0.007	<0.005

LookSee Pool	2025	2024
Aluminium	0.09	0.22
Barium	0.02	0.03
Iron	0.22	1.2
Manganese	0.010	0.063
Zinc	<0.005	0.005

Salty Pool	2025	2024
Barium	0.11	0.09
Boron	<0.05	0.06
Cobalt	0.001	0.001
Copper	0.002	<0.001
Iron	0.29	0.53
Lithium	0.006	0.004
Manganese	0.22	0.22
Nickel	0.003	0.002
Zinc	<0.005	0.005

Craignish	2025	2024
Aluminium	0.06	0.70
Barium	0.03	0.05
Boron	<0.05	0.08
Chromium	<0.001	0.002
Cobalt	<0.001	0.002
Copper	<0.001	0.002
Iron	0.78	6.0
Lead	<0.001	0.001
Manganese	0.053	0.16
Titanium	<0.005	0.020
Vanadium	0.006	0.007
Zinc	0.006	<0.005

Rocky Pool	2025	2024
Aluminium	0.09	0.06
Barium	0.03	0.03
Iron	0.10	0.16
Manganese	0.010	0.008
Zinc	0.005	<0.005

Beraking Yarra	2025	2024
Aluminium	0.15	0.18
Barium	0.02	0.02
Cobalt	0.001	0.002
Copper	0.005	0.001
Cyanide	<0.005	0.007
Iron	0.63	3.0
Lead	<0.001	0.001
Manganese	0.240	0.46
Vanadium	0.007	<0.005
Zinc	0.007	0.006

LPD	2025	2024
Barium	0.04	0.04
Boron	<0.05	0.13
Iron	1.2	3.4
Manganese	0.12	0.28
Vanadium	0.006	<0.005
Zinc	0.011	<0.005

Piesse Culvert	2025	2024
Aluminium	<0.05	0.09
Barium	0.03	0.04
Copper	0.003	0.003
Iron	0.01	0.06
Manganese	0.011	0.011
Zinc	0.010	0.007

Default Guideline	Freshwater Ecosystem			Human Health				Primary Industries		
	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Aluminium	0.027[#H7]			20[#B]	0.2[#A]	0.2[#C]	0.2[#D]	5[#F1]	20[#F2]	3.6[#J1]
Barium				2[#A]		20[#C]	1[#D]			2[#E1]
Boron	0.09[#G]			4[#A]		40[#C]	1[#D]	0.5[#F1]	0.5[#F2]	5[#J]
Chromium	0.00095[#H2]			0.05[#A2]			0.05[#D]	0.1[#F1]	1[#F2]	0.05[#J]
Chromium (III)	0.00095[#H5]			22[#B]						0.05[#J]
Cobalt	0.0014[#H3]			0.006[#B]				0.05[#F1]	0.1[#F2]	1[#J]
Copper	0.001[#H]			2[#A]	1[#A]	20[#C]	1[#D]	0.2[#F1]	5[#F2]	0.5[#J2]
Cyanide	0.004[#G1]			0.08[#A3]		0.8[#C]	0.1[#D]			0.08[#E1]
Iron	0.14[#H5]			14[#B]	0.3[#A]	0.3[#C]	0.3[#D]	0.2[#F1]	10[#F2]	NST
Lead	0.001[#H]			0.01[#A]		0.1[#C]	0.05[#D]	2[#F1]	5[#F2]	0.1[#J]
Lithium				0.04[#B]						0.04[#E1]
Manganese	1.2[#H]			0.5[#A]	0.1[#A]	5[#C]	0.1[#D]	0.2[#F1]	10[#F2]	10[#J]
Nickel	0.008[#H]			0.02[#A]		0.2[#C]	0.1[#D]	0.2[#F1]	2[#F2]	1[#J]
Selenium	0.005[#H]			0.01[#A]		0.1[#C]	0.01[#D]	0.02[#F1]	0.05[#F2]	0.02[#J]
Uranium	0.0005[#H3]			0.02[#A]		0.2[#C]	0.2[#C]	0.01[#F1]	0.1[#F2]	0.2[#J]
Vanadium	0.006[#H3]			0.086[#B]				0.1[#F1]	0.5[#F2]	0.1[#J]
Zinc	0.0024[#H]			6[#B]	3[#A]	3[#C]	5[#D]	2[#F1]	5[#F2]	20[#J]

Legend

Metals in Water 2025

- Exceeds Human Health and Primary Industries and/or Freshwater Ecosystem DGV
- Exceeds Primary Industries and Freshwater Ecosystem DGV
- Exceeds Freshwater Ecosystem DGV

Metals in Water 2024

- Exceeds Human Health and Primary Industries and/or Freshwater Ecosystem DGV
- Exceeds Freshwater Ecosystem DGV

Metals analysis differed between 2025 and 2024, so the results cannot be directly compared.

- 2025 analysis: Dissolved metal concentrations from field filtered samples.
- 2024 analysis: Total metal concentrations from unfiltered field samples.

Dissolved metals analysis undertaken in 2025 to assess bioavailability - a better metric for risk assessment.

Detectable concentrations are shown for each location. The following metals were not detected at any location in 2025 or 2024: antimony, arsenic, beryllium, cadmium, mercury, molybdenum, silver, thallium, thorium, tin and zirconium.
All units in mg/L.

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
A2: NHMRC (2011) Cr VI guideline used for screening.
A3: NHMRC (2011) Guideline is for total cyanide.
B: US EPA (2024) Tap Water Regional Screening Level (TR1E-06; THQ0.1) used in absence of Australian DGV.
C: DOH (2014) Guidelines for Non-Potable Use (NPUG) e.g. watering gardens/parks, edible garden produce.
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3.
E: ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality.
E1: ANZECC (2000) Insufficient data, drinking water guideline recommended for screening.
F: ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use.
F1: ANZECC (2000) Long Term Trigger Value, non-domestic irrigation for <100 years, Table 4.2.10.
F2: ANZECC (2000) Short Term Trigger Value.
G: ANZECC (2000) Trigger Values for Freshwater Ecosystems at 99% level of species protection (LOSP).
G1: ANZECC (2000) Unionised cyanide DGV used for screening.
H: ANZG (2026) Australian Water Quality Guidelines for Toxicants in Freshwater Ecosystems at 99% LOSP.
H2: ANZG (2026) Guideline for chromium III applied in the absence of detectable chromium VI.
H3: ANZG (2026) Unknown LOSP.
#H5 ANZG (2026) Guideline for 99% LOSP, applies to total concentrations, rather than filtered/dissolved concentrations, but applied for screening purposes in the absence of any other guidelines.
J: ANZG (2023) Draft Livestock Drinking Water Guidelines.
J1: ANZG (2023) 3.6 mg/L chickens, 5 mg/L general livestock.
J2: ANZG (2023) 0.5 mg/L sheep, 1 mg/L cattle, 5 mg/L pigs and poultry.
NST: Not Sufficiently Toxic, ANZG (2023).

Samson St and Nyaania Pool sampled in 2025 only.

Figure 11 Water Sampling Results: Metals and Other Inorganics

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment) Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-011
Date: 24 May 2026

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.

Helena Swan	2025	2024
Aluminium	1.4	7,300
Boron	0.32	<10
Chromium (T)	0.001	11
Chromium (III)	<0.002	11
Copper	0.003	11
Iron	1.6	19,000
Lead	0.004	33
Zinc	0.022	48

Samson St	2025
Aluminium	14
Boron	0.26
Chromium (T)	0.014
Chromium (III)	0.014
Cobalt	0.007
Copper	0.015
Iron	15
Lead	0.013
Manganese	0.15
Vanadium	0.028
Zinc	0.12

Nyaania	2025
Aluminium	9.3
Boron	0.56
Chromium (T)	0.043
Chromium (III)	0.043
Cobalt	0.012
Copper	0.032
Iron	47
Lead	0.038
Manganese	0.17
Nickel	0.025
Vanadium	0.084
Zinc	0.31

Craignish	2025	2024
Aluminium	0.98	7,600
Boron	0.24	<10
Cobalt	0.01	7.9
Copper	0.08	16
Iron	2.0	16,000
Lead	0.001	11
Zinc	0.025	23

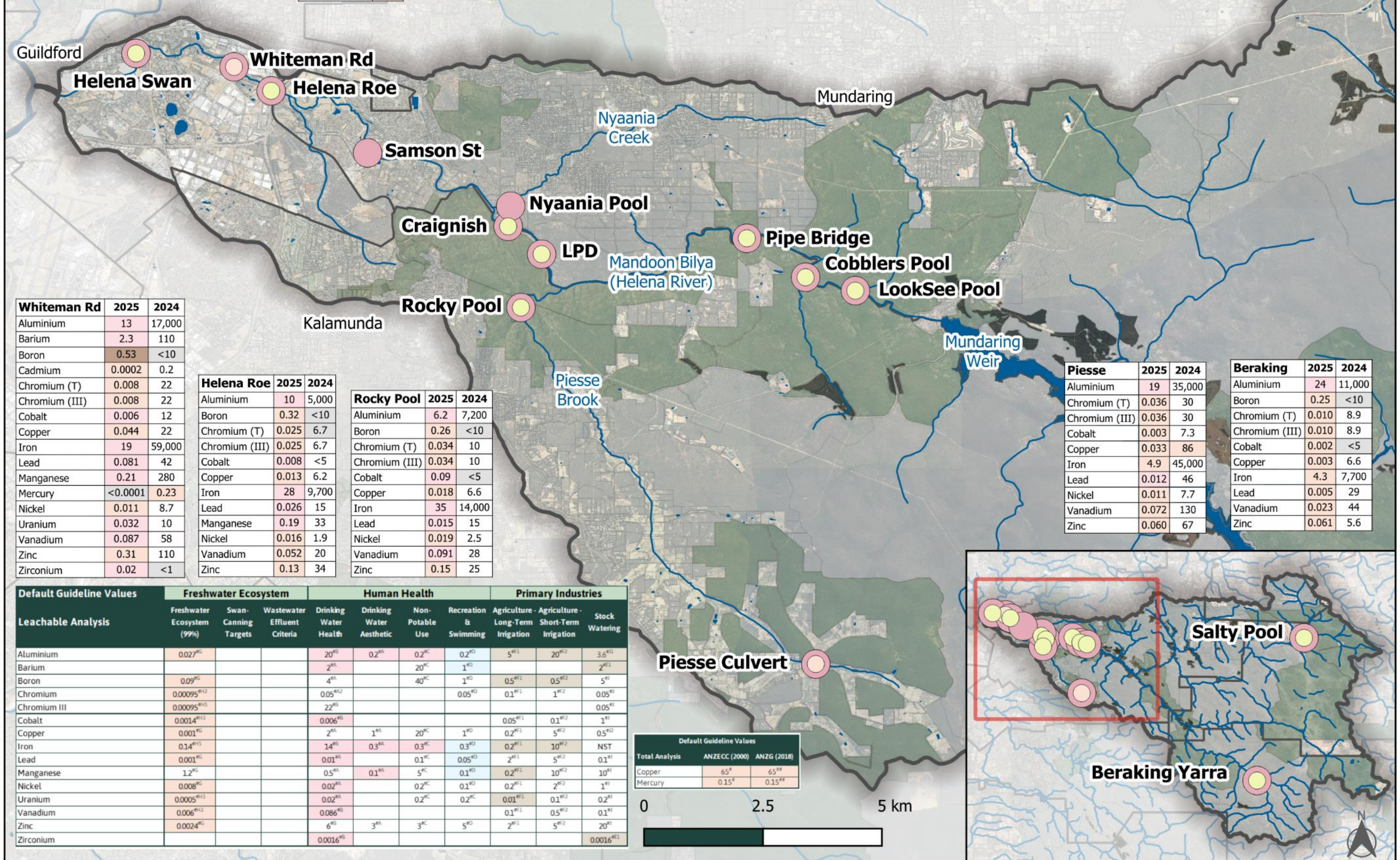
LPD	2025	2024
Aluminium	13	5,000
Boron	0.33	<10
Chromium (T)	0.005	9.8
Chromium (III)	0.005	9.8
Copper	0.005	5.8
Iron	3.1	15,000
Lead	0.002	14
Vanadium	0.007	26
Zinc	0.059	17

Pipe Bridge	2025	2024
Aluminium	45	17,000
Boron	0.20	<10
Chromium (T)	0.026	17
Chromium (III)	0.026	17
Copper	0.003	7.1
Iron	18	12,000
Lead	0.005	17
Vanadium	0.052	51
Zinc	0.11	190

Cobblers Pool	2025	2024
Aluminium	2.7	13,000
Boron	0.23	<10
Chromium (T)	0.002	9.7
Chromium (III)	0.002	9.7
Copper	0.003	8.2
Iron	4.0	13,000
Lead	0.001	17
Zinc	0.050	27

LookSee Pool	2025	2024
Aluminium	18	14,000
Boron	0.21	<10
Chromium (T)	0.012	11
Chromium (III)	0.012	11
Copper	0.003	7.3
Iron	7.4	11,000
Lead	0.003	14
Vanadium	0.030	35
Zinc	0.054	25

Salty Pool	2025	2024
Aluminium	14	8,500
Boron	0.46	<10
Chromium (T)	0.028	14
Chromium (III)	0.0285	14
Cobalt	0.006	<5
Copper	0.010	7.1
Iron	27	17,000
Lead	0.012	15
Nickel	0.016	5.0
Vanadium	0.056	42
Zinc	0.21	15



Whiteman Rd	2025	2024
Aluminium	13	17,000
Barium	2.3	110
Boron	0.53	<10
Cadmium	0.0002	0.2
Chromium (T)	0.008	22
Chromium (III)	0.008	22
Cobalt	0.006	12
Copper	0.044	22
Iron	19	59,000
Lead	0.081	42
Manganese	0.21	280
Mercury	<0.0001	0.23
Nickel	0.011	8.7
Uranium	0.032	10
Vanadium	0.087	58
Zinc	0.31	110
Zirconium	0.02	<1

Helena Roe	2025	2024
Aluminium	10	5,000
Boron	0.32	<10
Chromium (T)	0.025	6.7
Chromium (III)	0.025	6.7
Cobalt	0.008	<5
Copper	0.013	6.2
Iron	28	9,700
Lead	0.026	15
Manganese	0.19	33
Nickel	0.016	1.9
Vanadium	0.052	20
Zinc	0.13	34

Rocky Pool	2025	2024
Aluminium	6.2	7,200
Boron	0.26	<10
Chromium (T)	0.034	10
Chromium (III)	0.034	10
Cobalt	0.09	<5
Copper	0.018	6.6
Iron	35	14,000
Lead	0.015	15
Nickel	0.019	2.5
Vanadium	0.091	28
Zinc	0.15	25

Piesse	2025	2024
Aluminium	19	35,000
Chromium (T)	0.036	30
Chromium (III)	0.036	30
Cobalt	0.003	7.3
Copper	0.033	86
Iron	4.9	45,000
Lead	0.012	46
Nickel	0.011	7.7
Vanadium	0.072	130
Zinc	0.060	67

Beraking	2025	2024
Aluminium	24	11,000
Boron	0.25	<10
Chromium (T)	0.010	8.9
Chromium (III)	0.010	8.9
Cobalt	0.002	<5
Copper	0.003	6.6
Iron	4.3	7,700
Lead	0.005	29
Vanadium	0.023	44
Zinc	0.061	5.6

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Leachable Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Aluminium	0.027[#G]			20[#B]	0.2[#A]	0.2[#C]	0.2[#D]	5[#F1]	20[#F2]	3.6[#J1]
Barium				2[#A]		20[#C]	1[#D]			2[#E1]
Boron	0.09[#G]			4[#A]		40[#C]	1[#D]	0.5[#F1]	0.5[#F2]	5[#J]
Chromium	0.00095[#H2]			0.05[#A2]			0.05[#D]	0.1[#F1]	1[#F2]	0.05[#J]
Chromium III	0.00095[#H5]			22[#B]						0.05[#J]
Cobalt	0.0014[#H3]			0.006[#B]				0.05[#F1]	0.1[#F2]	1[#J]
Copper	0.001[#G]			2[#A]	1[#A]	20[#C]	1[#D]	0.2[#F1]	5[#F2]	0.5[#J2]
Iron	0.14[#H5]			14[#B]	0.3[#A]	0.3[#C]	0.3[#D]	0.2[#F1]	10[#F2]	NST
Lead	0.001[#G]			0.01[#A]		0.1[#C]	0.05[#D]	2[#F1]	5[#F2]	0.1[#J]
Manganese	1.2[#G]			0.5[#A]	0.1[#A]	5[#C]	0.1[#D]	0.2[#F1]	10[#F2]	10[#J]
Nickel	0.008[#G]			0.02[#A]		0.2[#C]	0.1[#D]	0.2[#F1]	2[#F2]	1[#J]
Uranium	0.0005[#H3]			0.02[#A]		0.2[#C]	0.2[#C]	0.01[#F1]	0.1[#F2]	0.2[#J]
Vanadium	0.006[#H3]			0.086[#B]				0.1[#F1]	0.5[#F2]	0.1[#J]
Zinc	0.0024[#G]			6[#B]	3[#A]	3[#C]	5[#D]	2[#F1]	5[#F2]	20[#J]
Zirconium				0.0016[#B]						0.0016[#E1]

Default Guideline Values		
Total Analysis	ANZECC (2000)	ANZG (2018)
Copper	65[#]	65[##]
Mercury	0.15[#]	0.15[##]

Legend

Metals in Sediment 2025

Exceeds Human Health and Primary Industries and/or Freshwater Ecosystem DGV

Metals in Sediment 2024

Exceeds Freshwater Ecosystem DGV

Detected Below DGV or No DGV Exist

Sediment analysis differed between 2025 and 2024, so the results cannot be directly compared.
a liquid (mg/L).
- 2024 analysis: Total concentrations in sediment as a solid (mg/kg).
Leachable analysis was undertaken in 2025 as a better metric for risk assessment.

Units: 2025 = mg/L; 2024 = mg/kg.

Metals analysis differed between 2025 and 2024, so the results cannot be directly compared.

- 2025 analysis: Dissolved metal concentrations from field filtered samples.
- 2024 analysis: Total metal concentrations from unfiltered field samples.

Dissolved metals analysis undertaken in 2025 to assess bioavailability - a better metric for risk assessment.

Only DGV exceedances are shown.

Metals detected below the DGV at all sites: arsenic, beryllium, lithium, selenium.
Metals not detected at any site: antimony, chromium VI, cyanide molybdenum, silver, thallium and tin.

DGVs do not exist for thorium and titanium.
Limited DGVs exist for total metals concentrations.

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
A2: NHMRC (2011) Cr VI guideline used for screening.
B: US EPA (2024) Tap Water Regional Screening Level (TR1E-06; THQ0.1) used in absence of Australian DGV.
C: DOH (2014) Guidelines for Non-Potable Use (NPUG).
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3.
E: ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality.
E1: ANZECC (2000) Insufficient data, drinking water guideline recommended for screening.
F: ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use.
F1: ANZECC (2000) Long Term Trigger Value, non-domestic irrigation for <100 years, Table 4.2.10.
F2: ANZECC (2000) Short Term Trigger Value.
G: ANZECC (2000) Trigger Values for Freshwater Aquatic Ecosystems at 99% level of species protection (LOSP).
H: ANZG (2026) Australian Water Quality Guidelines for Toxicants in Freshwater Ecosystems at 99% LOSP.
H2: ANZG (2026) Guideline for chromium III applied in the absence of detectable chromium VI.
H3: ANZG (2026) Unknown LOSP.
H5: ANZG (2026) Guideline for 99% LOSP, applies to tota concentrations, rather than filtered/dissolved concentrations, but applied for screening purposes in the absence of any other guidelines.
J: ANZG (2023) Draft Livestock Drinking Water Guidelines.
J1: ANZG (2023) 3.6mg/L chickens, 5mg/L general livestock.
J2: ANZG (2023) 0.5mg/L sheep, 1mg/L cattle, 5mg/L poultry.
NST: Not sufficiently toxic, ANZG (2023).
#: ANZECC (2000) Sediment quality guidelines - ISQG-Low (Trigger Value), Table 3.5.1.
##: ANZG (2018) DGV for toxicants in sediment, Table 1.

Samson St and Nyaania Pool sampled in 2025 only.

Figure 12 Sediment Sampling Results: Metals and Other Inorganics

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-012
Date: 24 May 2026

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.

Microbes

Aquatic ecosystems contain a diverse and essential community of microbes, including bacteria, algae, fungi, protozoa, and viruses. These microbes play key roles in nutrient cycling, decomposition of organic matter, and maintaining overall water quality. While many are beneficial and form the foundation of healthy river ecosystems, others can be harmful and pose risks to human and animal health.

Escherichia coli (E. coli) and *Enterococci* are bacteria from the intestinal tract of warm-blooded animals including humans, livestock and wildlife. They are indicators of faecal contamination and can enter waterways through wastewater discharge, stormwater, agricultural and urban runoff and animal scat.

Thermophilic amoebae are unicellular organisms that thrive in warm water. Their presence indicates that environmental conditions are favourable for the growth of *Naegleria fowleri*, an amoeba capable of causing a rare but potentially fatal brain infection.

DGV Exceedances – Water

Microbes were analysed in all water samples in 2025 and 2024 (refer **Figure 13** and **Tables T2a-T2b** appended to the back of this report).

There were several exceedances of the default guideline values (DGVs). Human health DGV exceedances were widespread and primarily associated with *E. coli* and *Enterococci* concentrations above the drinking water DGVs at all sites, and *Enterococci* above the recreation DGV at around half of the sites. A broad screen of free-living, heat-loving protozoa detected thermophilic amoebae at three sites in 2024 (Pipe Bridge, Salty Pool and Beraking Yarra), with all detections exceeding the drinking water DGV.

Primary industries DGV exceedances were also widespread, occurring at all sites in both years and typically associated with *E. coli* concentrations. *Enterococci* also exceeded the livestock watering DGV in 2024.

Freshwater ecosystem DGVs do not exist for microbes, with the exception of wastewater effluent criteria for on-site disposal in Mandoon catchment. *E. coli* concentrations exceeded the criteria at all sites in both years. A summary of the DGV exceedances is presented in **Table 9** below.

DGVs	September 2025	September 2024
Freshwater Ecosystem DGVs	Exceedances at all 14 sites: – ***E. coli*** (10–460 CFU/100ml) above the wastewater effluent criteria DGV (10) at all sites. No other DGVs exist.	Exceedances at all 12 sites: – ***E. coli*** (12–240 CFU/100ml) above the wastewater effluent criteria DGV (10) at all sites. No other DGVs exist.
Human Health DGVs	Exceedances at all 14 sites: – ***E. coli*** (10–460 CFU/100ml) equal to or above the drinking water (detection) and non-potable and recreation (1) DGVs at all sites. – ***Enterococci*** (4–79 CFU/100ml) above the drinking water DGV (detection) at all sites. – ***Enterococci*** (61–79 CFU/100ml) above the recreation DGV (60-100) at Helena Swan, Helena Roe and Samson St.	Exceedances at all 12 sites: – ***E. coli*** (12–240 CFU/100ml) above the drinking water (detection) and non-potable and recreation (1) DGVs at all sites. – ***Enterococci*** (7–160 CFU/100ml) above the drinking water DGV (detection) at all sites. – ***Enterococci*** (63–160 CFU/100ml) above the recreation DGV (60-100) at Helena Swan, Helena Roe, Craignish, Lower Dam, Piesse Culvert and Salty Pool. Concentrations at Rocky Pool (59 CFU/100ml) are also noted as it is a known swimming spot. – **Thermophilic amoebae** detected above the drinking water DGV (detection in 250 ml) at Pipe Bridge, Salty Pool and Beraking Yarra.
Primary Industries DGVs	Exceedances at all 14 sites: – ***E. coli*** (10–460 CFU/100ml) equal to or above the agricultural irrigation DGV (10) at all sites. – ***E. coli*** (120–460 CFU/100ml) above the livestock watering DGV (100) at Helena Swan, Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Rocky Pool, Piesse Culvert and Beraking Yarra.	Exceedances at all 12 sites: – ***E. coli*** (12–240 CFU/100ml) above the agricultural irrigation DGV (10) at all sites. – ***E. coli*** (100–240 CFU/100ml) equal to or above the livestock watering DGV (100) at Helena Swan, Whiteman Rd, Helena Roe, Craignish and Lower Dam. – ***Enterococci*** (120–160 CFU/100ml) above the livestock watering DGV (100) at Helena Swan and Helena Roe.

Table 9 Microbes - DGV Exceedances in Water

DGV Exceedances – Sediment

Microbial analysis is not applicable to sediment samples.

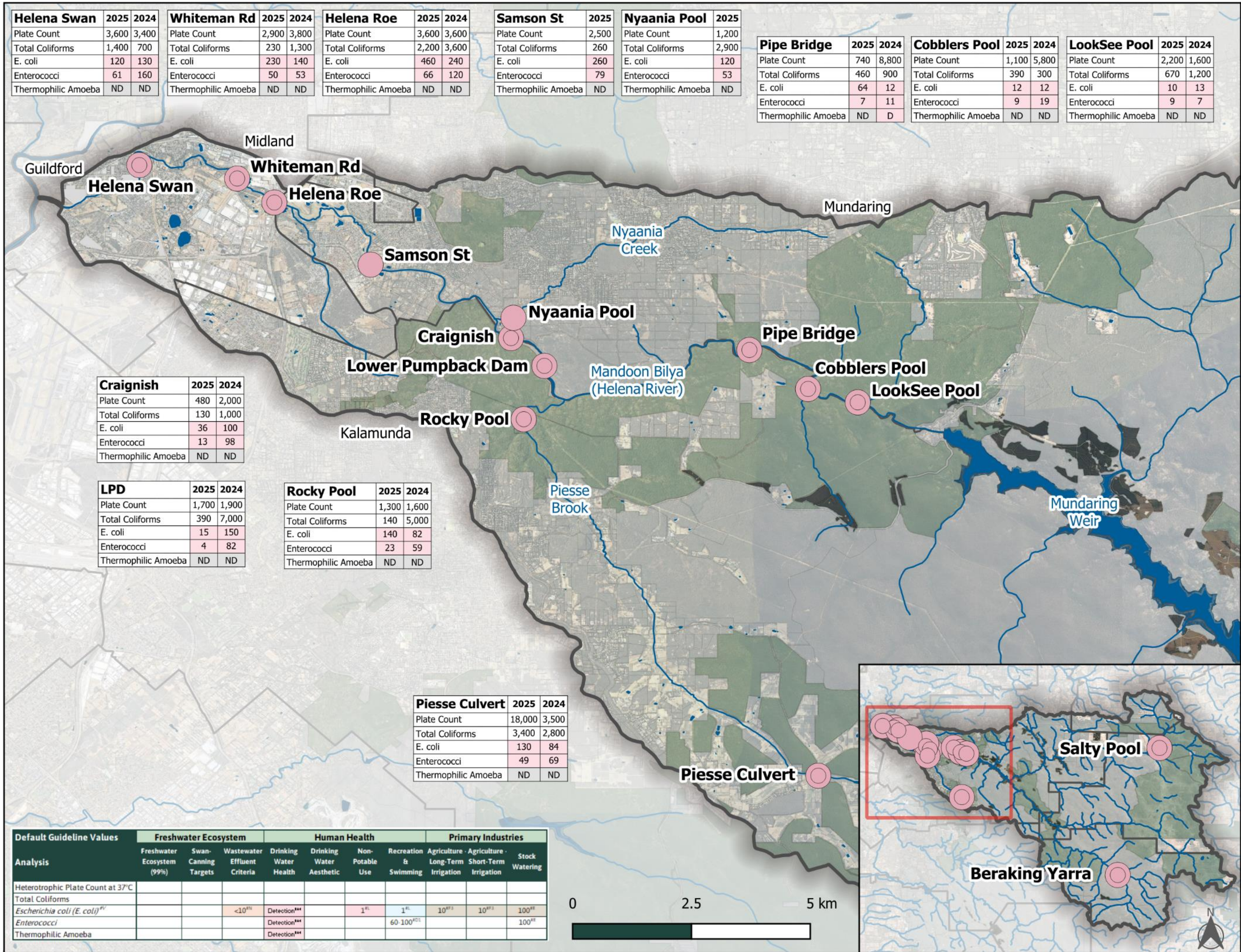
Summary

Consistent with most aquatic ecosystems, microbes in the form of faecal bacteria were present across the catchment. Elevated levels of *E. coli* and *Enterococci* were detected at all sites in both 2025 and 2024.

Thermophilic amoebae were detected at three sites in 2024 (Pipe Bridge, Salty Pool and Beraking Yarra) but were not detected at any site in 2025. Thermophilic *Naegleria* species and *Naegleria fowleri* were not detected at any site in either year. Water temperatures were similar across both years, ranging from 12.2–17.4 °C in 2025 and 12.8–17.2 °C in 2024, with cooler conditions recorded in the upper catchment.

Total coliforms showed substantial variability across the catchment and between years, likely reflecting natural fluctuations in localised inputs. For example, concentrations at Rocky Pool increased from 140 CFU/100 mL in 2024 to 5,000 CFU/100 mL in 2025, although this increase did not align with the comparatively smaller increase in *E. coli* (from 82 CFU/100 mL to 140 CFU/100 mL).

Mandoon Bilya BioBlitz sampling in the lower catchment



Helena Swan	2025	2024
Plate Count	3,600	3,400
Total Coliforms	1,400	700
E. coli	120	130
Enterococci	61	160
Thermophilic Amoeba	ND	ND

Whiteman Rd	2025	2024
Plate Count	2,900	3,800
Total Coliforms	230	1,300
E. coli	230	140
Enterococci	50	53
Thermophilic Amoeba	ND	ND

Helena Roe	2025	2024
Plate Count	3,600	3,600
Total Coliforms	2,200	3,600
E. coli	460	240
Enterococci	66	120
Thermophilic Amoeba	ND	ND

Samson St	2025
Plate Count	2,500
Total Coliforms	260
E. coli	260
Enterococci	79
Thermophilic Amoeba	ND

Nyaania Pool	2025
Plate Count	1,200
Total Coliforms	2,900
E. coli	120
Enterococci	53
Thermophilic Amoeba	ND

Pipe Bridge	2025	2024
Plate Count	740	8,800
Total Coliforms	460	900
E. coli	64	12
Enterococci	7	11
Thermophilic Amoeba	ND	D

Cobblers Pool	2025	2024
Plate Count	1,100	5,800
Total Coliforms	390	300
E. coli	12	12
Enterococci	9	19
Thermophilic Amoeba	ND	ND

LookSee Pool	2025	2024
Plate Count	2,200	1,600
Total Coliforms	670	1,200
E. coli	10	13
Enterococci	9	7
Thermophilic Amoeba	ND	ND

Craignish	2025	2024
Plate Count	480	2,000
Total Coliforms	130	1,000
E. coli	36	100
Enterococci	13	98
Thermophilic Amoeba	ND	ND

LPD	2025	2024
Plate Count	1,700	1,900
Total Coliforms	390	7,000
E. coli	15	150
Enterococci	4	82
Thermophilic Amoeba	ND	ND

Rocky Pool	2025	2024
Plate Count	1,300	1,600
Total Coliforms	140	5,000
E. coli	140	82
Enterococci	23	59
Thermophilic Amoeba	ND	ND

Piesse Culvert	2025	2024
Plate Count	18,000	3,500
Total Coliforms	3,400	2,800
E. coli	130	84
Enterococci	49	69
Thermophilic Amoeba	ND	ND

Salty Pool	2025	2024
Plate Count	1,800	1,600
Total Coliforms	2,100	1,800
E. coli	35	24
Enterococci	58	63
Thermophilic Amoeba	ND	D

Beraking Yarra	2025	2024
Plate Count	2,300	1,900
Total Coliforms	4,100	2,000
E. coli	130	21
Enterococci	59	56
Thermophilic Amoeba	ND	D

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Heterotrophic Plate Count at 37°C										
Total Coliforms										
Escherichia coli (E. coli)[#V]			<10[#N]	Detection[#A4]		1[#L]	1[#L]	10[#F3]	10[#F3]	100[#E]
Enterococci				Detection[#A4]			60-100[#D1]			100[#E]
Thermophilic Amoeba				Detection[#A4]						

Legend

Forestry Plantation

National Park

Microbes in Water 2025

Exceeds Human Health and Primary Industries and Wastewater Effluent DGV

Microbes in Water 2024

Exceeds Human Health and Primary Industries and Wastewater Effluent DGV

Thermophilic Naegleria sp. and Naegleria fowleri were not detected at any location in 2024 or 2025.

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
A4: NHMRC (2011) E. coli, enterococci and thermotolerant coliforms should not be detected in a minimum 100 mL sample of drinking water.
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3 (general chemicals).
D1: ANZECC (2000) For primary contact (e.g. swimming), the median bacterial content in freshwaters taken over the bathing season should not exceed 150 faecal coliform organisms/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month, with 4 of 5 samples containing <4,000 organisms/100 mL) and 35 enterococci organisms/100 mL (maximum number in any one sample: 60–100 organisms/100 mL), Table 5.2.2.
E: ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality.
F: ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use.
F3: ANZECC (2000) Trigger values for thermotolerant coliforms in irrigation waters for raw human food crops in direct contact with irrigation water, Table 4.2.2.
L: DWER (2021) Microbial assessment levels (MAL) for water in urban recreational areas, open spaces, parks and gardens with unrestricted application, Table D2.
N: COK (2020) Common wastewater effluent criteria for on-site disposal in the Mandoon-Helena Catchment.

All units in CFU/ml.

CFU = Colony Forming Unit
D = Detected
ND = Not Detected

Samson St and Nyaania Pool sampled in 2025 only.

Figure 13 Water Sampling Results: Microbes

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment) Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-013
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.

Herbicides and Pesticides

Herbicides and pesticides can contaminate waterways through multiple pathways, including runoff from agricultural land, industrial processes, wastewater discharge, and direct application for weed and pest control. These chemicals can be toxic to aquatic animals and may disrupt aquatic ecosystems, while also posing potential risks to human health. Many herbicides and pesticides are persistent and can bioaccumulate in aquatic organisms, leading to higher concentrations in larger predators and ultimately, potential exposure to humans through consumption. Long term exposure to low levels of pesticides has been associated with a range of health concerns, including hormonal disruption and reproductive effects.

DGV Exceedances – Water

Herbicides and pesticides were analysed in all water samples in 2025 and 2024 (refer **Figure 14** and **Tables T2a-T2b** appended to the back of this report).

There were no exceedances of the default guideline values (DGVs). Dieldrin was the only pesticide detected in water samples, occurring at Cobblers Pool, LookSee Pool and Beraking Yarra in 2025, and at Piesse Culvert in 2024. All detections were only marginally above the analytical detection limit and remained below the DGVs for freshwater ecosystems, human health and primary industries.

DGV Exceedances – Sediment

Herbicides and pesticides were analysed in all sediment samples in 2025 and 2024 (refer **Figure 15** and **Tables T3a-T3b** appended to the back of this report). The sediment analysis method differed between 2025 and 2024, so the results cannot be directly compared:

- 2025 analysis: leachable concentrations in sediment (liquid phase)
- 2024 analysis: total concentrations in sediment (solid phase)

Leachable concentrations were analysed in 2025 to provide a better metric for risk assessment.

Freshwater ecosystem DGV exceedances were associated with elevated dieldrin in leachable sediment at Craignish in 2025, and elevated DDE and DDT in solid sediment at Piesse Culvert in 2024. There were no exceedances of the human health and primary industries DGVs. A summary of the DGV exceedances is presented in **Table 10** below.

DGVs	September 2025 (leachable)	September 2024 (solid)
Freshwater Ecosystem DGVs	Exceedance at 1 of 14 sites: – **Dieldrin** (0.01 ug/L) at the DGV (0.01) at Craignish.	Exceedances at 2 of 12 sites: – **DDE** (0.05 mg/kg) above the DGV (0.0014-0.0022) at Piesse Culvert – **DDT** (0.03 mg/kg) above the DGV (0.0012-0.0016) at Piesse Culvert

Table 10 Herbicides and Pesticides - DGV Exceedances in Sediment

Summary

Herbicides and pesticides were not typically detected at most sites across the catchment.

In water, dieldrin was the only pesticide detected, occurring at low concentrations marginally above the analytical detection limit at four sites (Cobblers Pool, LookSee Pool, Piesse Culvert and Beraking Yarra). These detections are likely linked to historical pest control practices, including possible termite treatment of the wooden road bridge spanning Beraking Brook at the Beraking Yarra site. Dieldrin is a synthetic organochlorine insecticide that was formerly used in agriculture and termite control until its ban in Australia in 1994. It is highly persistent in the environment and is classified as a potential carcinogen.

In sediment, several pesticides were detected. Elevated dieldrin was recorded in leachable sediment at Craignish in 2025, while elevated DDE and DDT were detected in solid sediment at Piesse Culvert in 2024. Detectable concentrations of bifenthrin were also reported at Whiteman Rd in 2024, although no DGVs exist to assess this result. Except for dieldrin, none of these pesticides were detected in water samples.

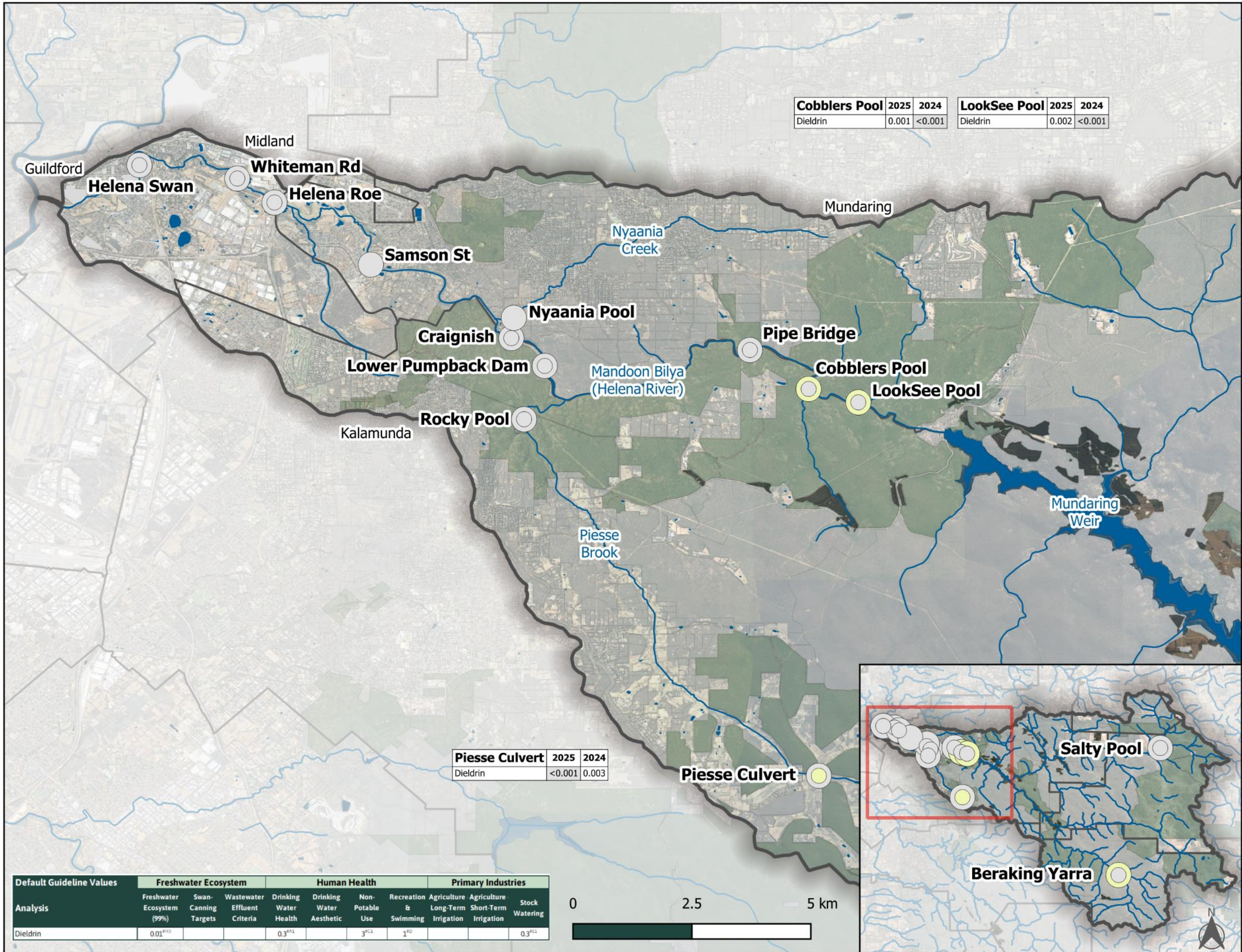
DDT is a synthetic, highly persistent pesticide that was widely used until its ban in Australia in 1987. It is toxic and bioaccumulative, with the potential to build up in animals, humans and the environment. DDE is a breakdown product of DDT. Bifenthrin is a current-use pesticide in Australia, applied for the control of termites, borers, aphids, mites, spiders, ants, fleas and mosquitoes.

Dieldrin concentrations in water were similar in magnitude to those reported in passive sampling at one location on the lower river in 2007[35]. However, the 2007 study also detected a range of other pesticides that were not observed in the current assessment, including chlordane trans, chlorpyrifos, diazinon, heptachlor epoxide, methidathion, metolachlor, oxadiazon, phosphate tri-n-butyl, piperonyl butoxide, propiconazole, terbutryn and trifluralin[35].

Herbicides were not detected at any site in the current assessment, although low levels were reported during the 2007 passive sampling, including ametryn, atrazine, dimethyl tetrachloroterephthalate/DCPA, desisopropyl atrazine, diuron, glyphosate, hexazinone, simazine, tebuthiuron and 2,4-dichlorophenoxyacetic acid/2-4-D[32,35].

The 2007 study demonstrated that passive sampling is a practicable and effective method for detecting low concentrations of organic contaminants in waterways, although it's use was not feasible within the scope of the current assessment. Similar findings were reported in an unpublished Water Corporation field trial along Piesse Brook in 2003, which showed that passive sampling could detect low-level organic contaminants at sites where herbicides and pesticides had not been identified using earlier conventional grab sampling methods (as applied in this assessment).

Craignish Weir site, downstream of the Lower Pumpback Dam



Cobblers Pool	2025	2024
Dieldrin	0.001	<0.001

LookSee Pool	2025	2024
Dieldrin	0.002	<0.001

Piesse Culvert	2025	2024
Dieldrin	<0.001	0.003

Beraking Yarra	2025	2024
Dieldrin	0.001	<0.001

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture Long-Term Irrigation	Agriculture Short-Term Irrigation	Stock Watering
Dieldrin	0.01 [#H3]			0.3 [#A1]		3 [#C1]	1 [#D]			0.3 [#E1]

Legend

Forestry Plantation

National Park

Herbicides and Pesticides in Water 2025

Detected Below DGV

Not Detected

Herbicides and Pesticides in Water 2024

Detected Below DGV

Not Detected

Only detectable concentrations are shown.

Dieldrin was the only Organochloride & Organophosphate Pesticide (OCP/OPP) detected in 2025 and 2024.

Base Neutral Pesticides and Acidic Herbicides were not detected at any location in 2025 or 2024.

Refer laboratory documentation for a full list of herbicides and pesticides that were analysed.

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
A1: NHMRC (2011) Guideline is for aldrin + dieldrin.
C: DOH (2014) Guidelines for Non-Potable Use (NPUG) e.g. watering gardens/parks and edible garden produce.
C1: DOH (2014) Guideline is for aldrin + dieldrin.
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3 (general chemicals).
E: ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality.
E1: ANZECC (2000) Insufficient data, drinking water guideline recommended for screening.
H3: ANZG (2026) Unknown LOSP.

All units in ug/L.

Samson St and Nyaania Pool sampled in 2025 only.

Figure 14 Water Sampling Results: Herbicides and Pesticides

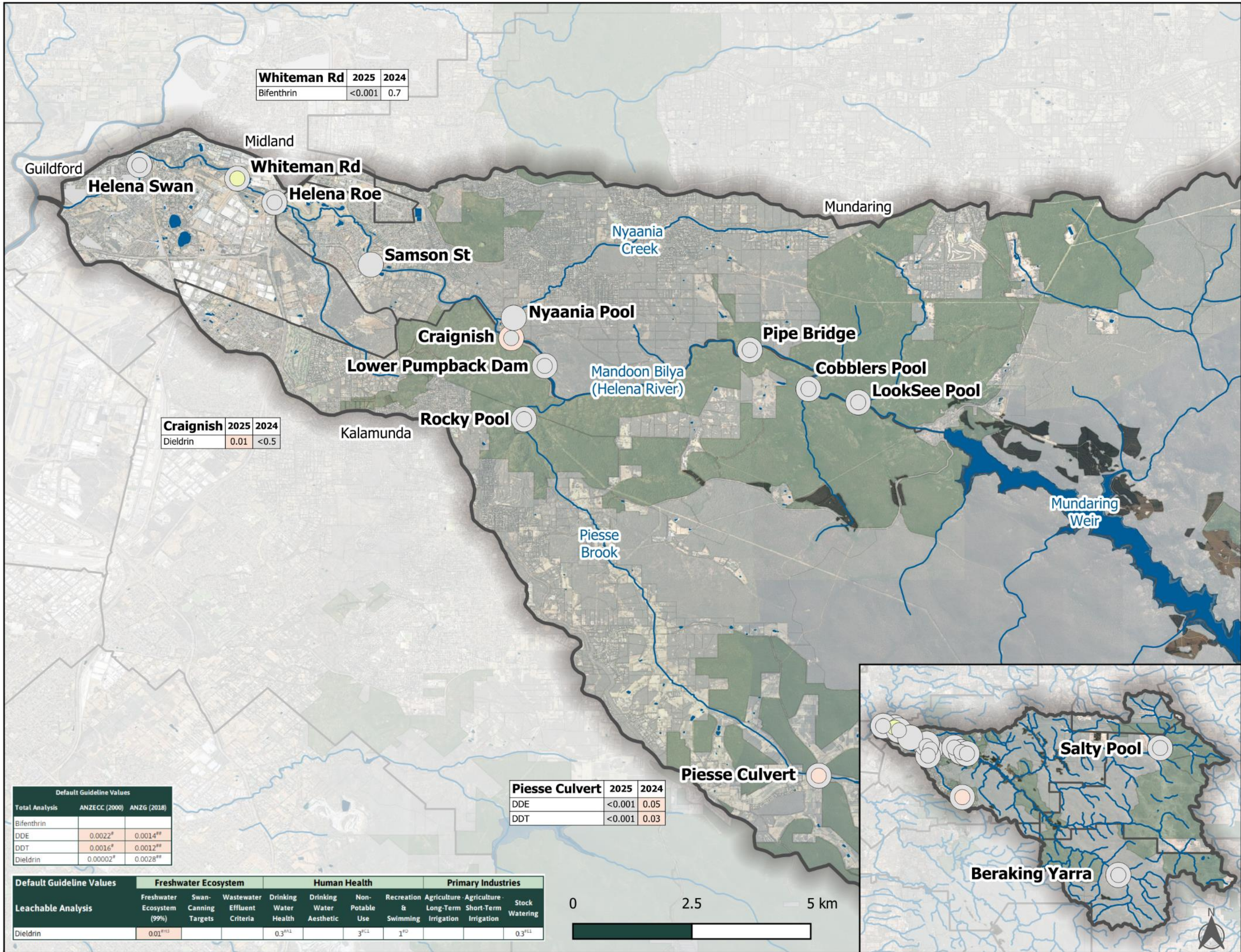
BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-014
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.



Whiteman Rd	2025	2024
Bifenthrin	<0.001	0.7

Craignish	2025	2024
Dieldrin	0.01	<0.5

Piesse Culvert	2025	2024
DDE	<0.001	0.05
DDT	<0.001	0.03

Default Guideline Values		
Total Analysis	ANZECC (2000)	ANZG (2018)
Bifenthrin		
DDE	0.0022[#]	0.0014[##]
DDT	0.0016[#]	0.0012[##]
Dieldrin	0.00002[#]	0.0028[##]

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Leachable Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Dieldrin	0.01[#H3]			0.3[#A1]		3[#C1]	1[#D]			0.3[#E1]

Legend

Forestry Plantation

National Park

Herbicides and Pesticides in Sediment 2025

Exceeds Freshwater Ecosystem DGV

Not Detected

Herbicides and Pesticides in Sediment 2024

Exceeds Freshwater Ecosystem DGV

Detected - No DGV Exists

Not Detected

Sediment analysis differed between 2025 and 2024, so the results cannot be directly compared.

- 2025 analysis: Leachable concentrations in sediment as a liquid (ug/L).
- 2024 analysis: Total concentrations in sediment as a solid (mg/kg).

Leachable analysis was undertaken in 2025 as a better metric for risk assessment.

Units: 2025 = ug/L; 2024 = mg/kg.

Only detectable concentrations are shown.

Only Organochloride & Organophosphate Pesticides (OCP/OPP) were detected during the sampling.

Base Neutral Pesticides and Acidic Herbicides were not detected at any location in 2025 or 2024.

Refer laboratory documentation for a full list of herbicides and pesticides that were analysed.

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
A1: NHMRC (2011) Guideline is for aldrin + dieldrin.
C: DOH (2014) Guidelines for Non-Potable Use (NPUG) e.g. watering gardens/parks and edible garden produce.
C1: DOH (2014) Guideline is for aldrin + dieldrin.
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3 (general chemicals).
E: ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality.
E1: ANZECC (2000) Insufficient data, drinking water guideline recommended for screening.
H3: ANZG (2026) Unknown LOSP.
#: ANZECC (2000) Sediment quality guidelines - ISQG-Low (Trigger Value), Table 3.5.1.
##: ANZG (2018) DGV for toxicants in sediment Table 1.

Samson St and Nyaania Pool sampled in 2025 only.

Figure 15 Sediment Sampling Results: Herbicides and Pesticides

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-015
Date: 12 December 2025

BOORYUL BAH BILYA
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Hydrocarbons

Total recoverable hydrocarbons (TRH) is a measure of all organic compounds made up of hydrogen and carbon atoms in various combinations. These hydrocarbons can occur naturally, such as those produced during the decomposition of organic matter and through microbial activity. They can also enter the environment through human activities, including petroleum hydrocarbons from fossil fuels and non-petroleum hydrocarbons like fatty acids and cholesterols from sewage.

TRH results represent a mixture of compounds that are measured against aliphatic hydrocarbon standards across different carbon (C) number ranges. Semi-volatile TRH cover the >C10-C40 range. Volatile TRH cover carbon range C6-C10 range and include BTEX compounds (benzene, toluene, ethylbenzene and xylene).

Polycyclic aromatic hydrocarbons (PAHs) are another class of organic compounds found in coal, oil, and gas, and are also produced during incomplete combustion of fuels and other organic materials. They are known for their persistence in the environment and their potential health impacts. More than 100 PAHs have been identified, although studies typically focus on 16 priority PAHs. These include naphthalene, which is toxic to aquatic life and commonly enters waterways after forest fires or through road runoff and urban or agricultural drainage.

DGV Exceedances – Water

Hydrocarbons were analysed in all water samples in 2025 and 2024 (refer **Figure 16** and **Tables T2a-T2b** appended to the back of this report).

There were no exceedances of the default guideline values (DGVs). Volatile hydrocarbons in the TRH C6-C9 and C6-C10 ranges were the only hydrocarbons detected in water, occurring at Cobblers Pool in 2024 only. Detectable hydrocarbons were not reported at any site in 2025. All detections were only marginally above the analytical detection limit and remained below the DGVs for drinking water (no other DGVs exist).

BTEX and PAH were not detected in any water sample in either year.

DGV Exceedances – Sediment

Hydrocarbons were analysed in all sediment samples in 2025 and 2024 (refer **Figure 17** and **Tables T3a-T3b** appended to the back of this report). The sediment analysis method differed between 2025 and 2024, so the results cannot be directly compared:

- 2025 analysis: leachable concentrations in sediment (liquid phase)
- 2024 analysis: total concentrations in sediment (solid phase)

Leachable concentrations were analysed in 2025 to provide a better metric for risk assessment.

Freshwater ecosystem DGV exceedances in 2024 were associated with elevated TRH C10-C40 concentrations in solid sediment at five sites across the catchment, as well as elevated naphthalene at two sites in the lower catchment. Detectable hydrocarbons were not reported in any leachable sediment sample collected in 2025. A summary of the DGV exceedances is presented in **Table 11** below.

DGVs	September 2025 (leachable)	September 2024 (solid)
Freshwater Ecosystem DGVs	Hydrocarbons not detected.	Exceedances at 5 of 12 sites: – **TRH C10-C40** (335–1,310 mg/kg) above the DGV (280) at Whiteman Rd, Pipe Bridge, Cobblers Pool, LookSee Pool and Salty Pool. – **Naphthalene** (0.7–0.8 mg/kg) above the DGV (0.16) at Whiteman Rd and Helena Roe.

Table 11 Hydrocarbons - DGV Exceedances in Sediment

Summary

Hydrocarbons were not typically detected in water across the catchment. Low levels of volatile hydrocarbons (C6-C9) were detected at a single site, Cobblers Pool, in 2024 only.

In contrast, hydrocarbons were detected in sediment throughout the catchment, although they occurred only as total concentrations. Leachable hydrocarbons were not reported in sediment, indicating that the hydrocarbons remain bound to the solid phase and have not partitioned into porewater.

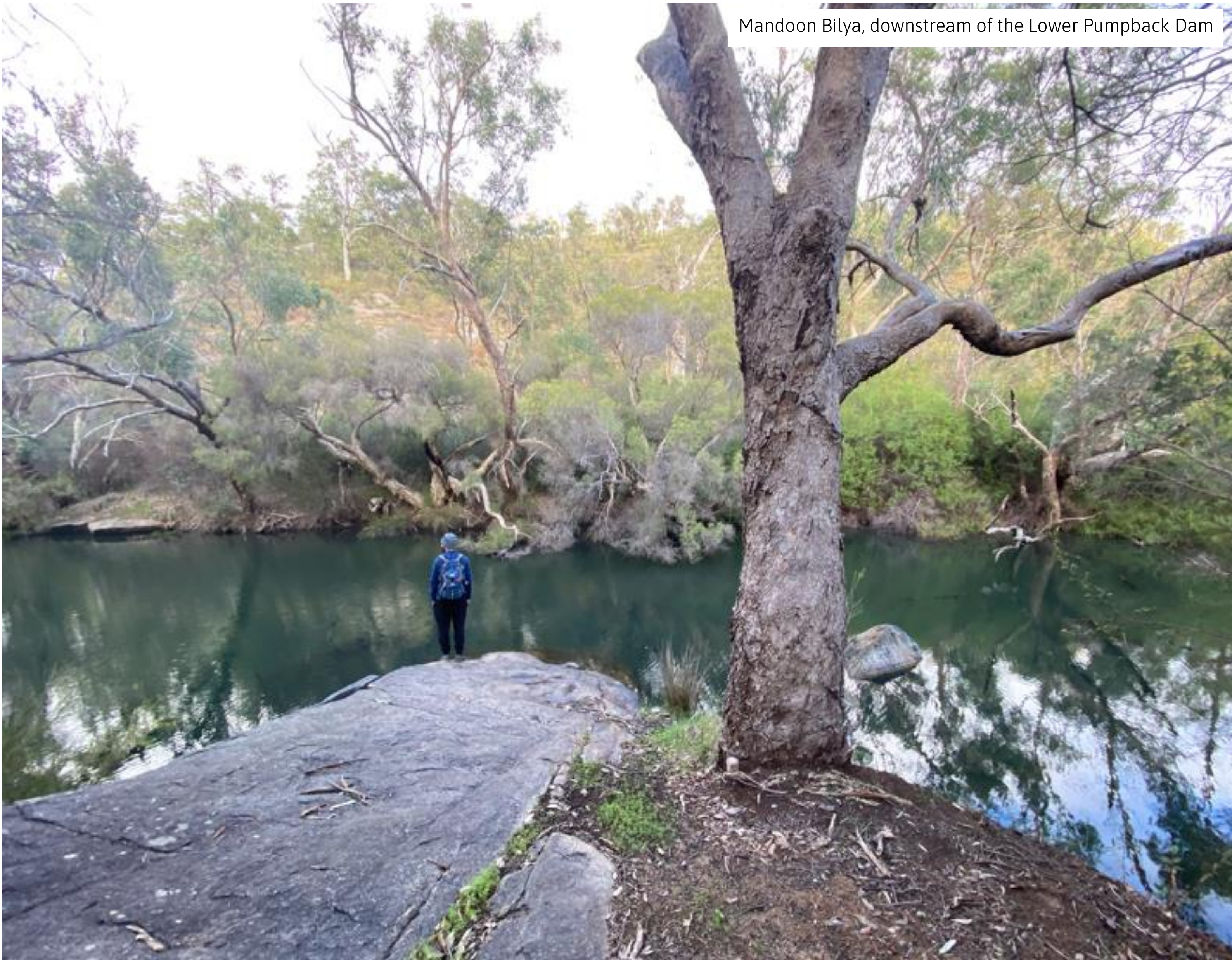
Solid-phase hydrocarbons were mostly semi-volatile hydrocarbons (C10-C40), with concentrations exceeding the sediment quality DGVs at five sites across the catchment. Naphthalene, a polycyclic aromatic hydrocarbon (PAH), was detected at Whiteman Rd and Helena Roe in the lower catchment, with concentrations also above the DGV.

Volatile hydrocarbons (C6-C9) were also detected at Whiteman Rd and Helena Roe; however, DGVs are not available for assessing these concentrations.

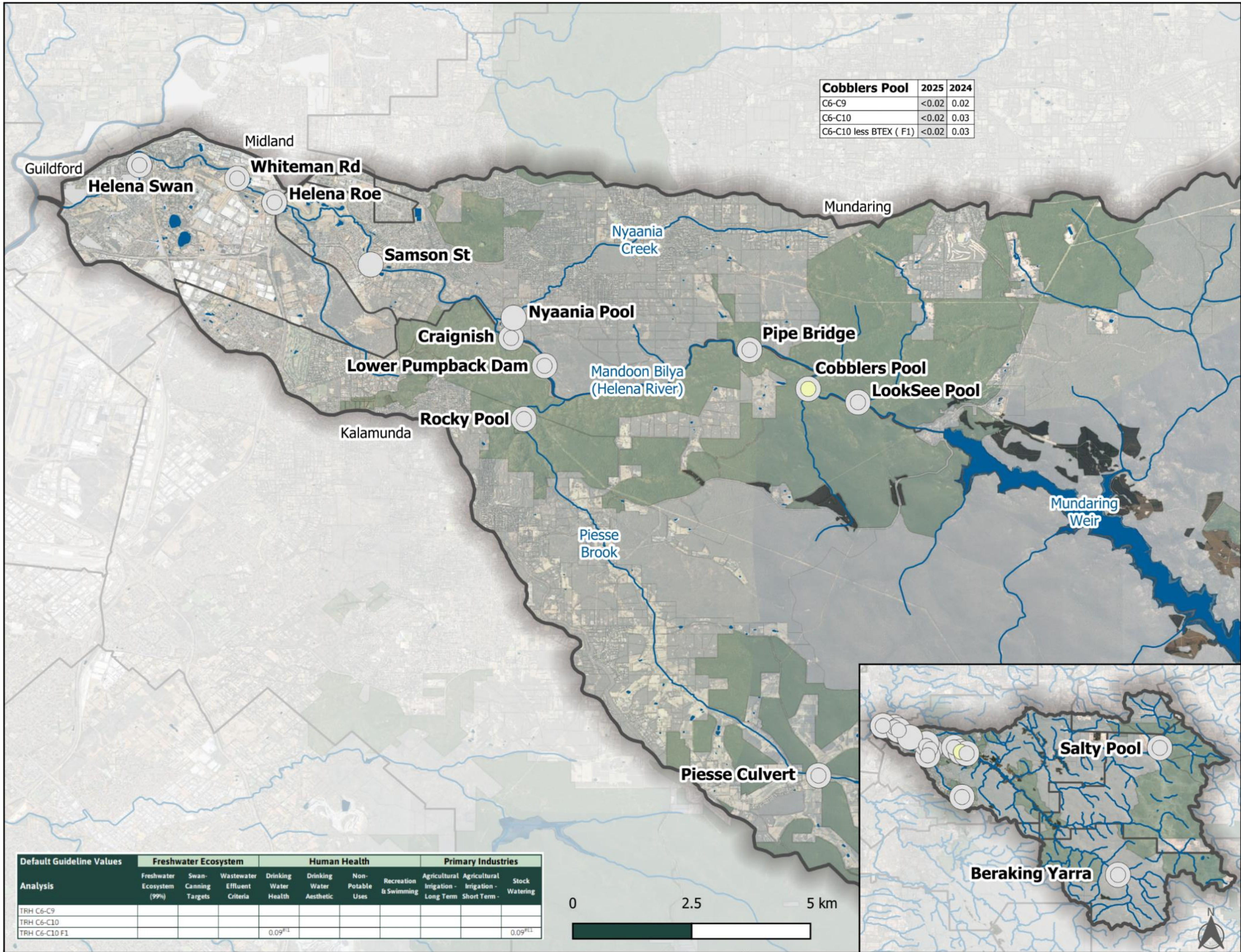
It is unclear whether the detectable hydrocarbons are naturally occurring. In 2025, provision was made to undertake silica gel clean up on any detectable hydrocarbons to help distinguish natural from petroleum sources; however, hydrocarbons were not detected in any sample, so this analysis was not required.

BTEX and other PAH were not detected in any sample in either year.

These findings are somewhat similar to those reported in the 2014 *Helping the Helena* study[32] which also did not detect petroleum hydrocarbons in water. TRH concentrations in sediment were of a similar magnitude to petroleum hydrocarbons reported in 2014; however, total PAH results differed markedly. Total PAH concentrations in 2014 were significantly higher, up to 34 mg/kg compared to 0.5-0.8 mg/kg in the current study, and included a wider range of PAH such as benzo(a)pyrene, chrysene, fluoranthene, naphthalene and pyrene, whereas only naphthalene was detected in the current assessment.



Mandoon Bilya, downstream of the Lower Pumpback Dam



Cobblers Pool	2025	2024
C6-C9	<0.02	0.02
C6-C10	<0.02	0.03
C6-C10 less BTEX (F1)	<0.02	0.03

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Uses	Recreation & Swimming	Agricultural Irrigation - Long Term	Agricultural Irrigation - Short Term -	Stock Watering
TRH C6-C9										
TRH C6-C10										
TRH C6-C10 F1				0.09[#I1]						0.09[#E1]

Legend

Forestry Plantation

National Park

Hydrocarbons in Water 2025

Not Detected

Hydrocarbons in Water 2024

Detected below DGV or No DGV Exist

Not Detected

Only detectable hydrocarbon concentrations are shown.

Hydrocarbons were not detected at any location in 2025.

Hydrocarbons were only detected in water samples at one sampling location in 2024 (Cobblers Pool), in the form of Total Recoverable Hydrocarbons (TRH).

BTEX compounds (Benzene, Toluene, Ethylbenzene and Xylenes) and PAH (Polycyclic Aromatic Hydrocarbons) were not detected at any location in 2025 or 2024.

Refer laboratory documentation for a full list of hydrocarbon compounds that were analysed.

F1 = C6-C10 less BTEX compounds
F2 = C10-C16 less naphthalene

Default Guideline Value (DGV) Notes:
E: ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality.
E1: ANZECC (2000) Insufficient data, drinking water guideline recommended for screening.
I: WHO (2008) Petroleum Products in Drinking Water.
I1: WHO (2008) Lowest derived guideline for aliphatic and aromatic fractions in this range.

All units in ug/L.

Samson St and Nyaania Pool sampled in 2025 only.

Figure 16 Water Sampling Results: Hydrocarbons

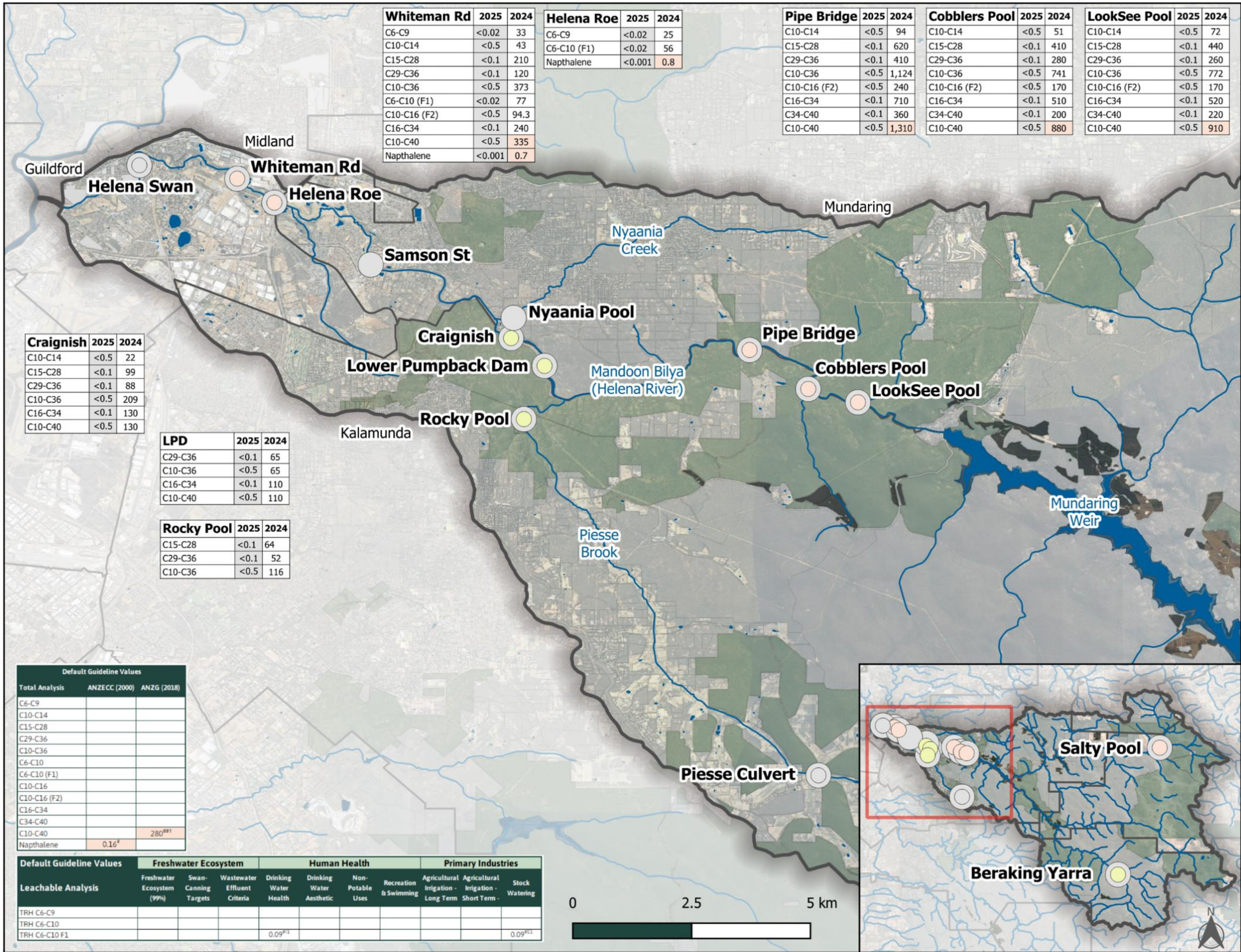
BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-016
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.



Whiteman Rd	2025	2024
C6-C9	<0.02	33
C10-C14	<0.5	43
C15-C28	<0.1	210
C29-C36	<0.1	120
C10-C36	<0.5	373
C6-C10 (F1)	<0.02	77
C10-C16 (F2)	<0.5	94.3
C16-C34	<0.1	240
C10-C40	<0.5	335
Napthalene	<0.001	0.7

Helena Roe	2025	2024
C6-C9	<0.02	25
C6-C10 (F1)	<0.02	56
Napthalene	<0.001	0.8

Pipe Bridge	2025	2024
C10-C14	<0.5	94
C15-C28	<0.1	620
C29-C36	<0.1	410
C10-C36	<0.5	1,124
C10-C16 (F2)	<0.5	240
C16-C34	<0.1	710
C34-C40	<0.1	360
C10-C40	<0.5	1,310

Cobblers Pool	2025	2024
C10-C14	<0.5	51
C15-C28	<0.1	410
C29-C36	<0.1	280
C10-C36	<0.5	741
C10-C16 (F2)	<0.5	170
C16-C34	<0.1	510
C34-C40	<0.1	200
C10-C40	<0.5	880

LookSee Pool	2025	2024
C10-C14	<0.5	72
C15-C28	<0.1	440
C29-C36	<0.1	260
C10-C36	<0.5	772
C10-C16 (F2)	<0.5	170
C16-C34	<0.1	520
C34-C40	<0.1	220
C10-C40	<0.5	910

Craignish	2025	2024
C10-C14	<0.5	22
C15-C28	<0.1	99
C29-C36	<0.1	88
C10-C36	<0.5	209
C16-C34	<0.1	130
C10-C40	<0.5	130

LPD	2025	2024
C29-C36	<0.1	65
C10-C36	<0.5	65
C16-C34	<0.1	110
C10-C40	<0.5	110

Rocky Pool	2025	2024
C15-C28	<0.1	64
C29-C36	<0.1	52
C10-C36	<0.5	116

Default Guideline Values		
Total Analysis	ANZECC (2000)	ANZG (2018)
C6-C9		
C10-C14		
C15-C28		
C29-C36		
C10-C36		
C6-C10		
C6-C10 (F1)		
C10-C16		
C10-C16 (F2)		
C16-C34		
C34-C40		
C10-C40		280##1
Napthalene	0.16#	

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Leachable Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Uses	Recreation & Swimming	Agricultural Irrigation - Long Term	Agricultural Irrigation - Short Term -	Stock Watering
TRH C6-C9										
TRH C6-C10										
TRH C6-C10 F1				0.09#I1						0.09#E1

Legend

Hydrocarbons in Sediment 2025

- Not Detected

Hydrocarbons in Sediment 2024

- Exceeds Freshwater Ecosystem DGV
- Detected Below DGV or No DGV Exists
- Not Detected

Sediment analysis differed between 2025 and 2024, so the results cannot be directly compared.

- 2025 analysis: Leachable concentrations in sediment as a liquid (mg/L).
- 2024 analysis: Total concentrations in sediment as a solid (mg/kg).

Leachable analysis was undertaken in 2025 as a better metric for risk assessment.

Units: 2025 = mg/L; 2024 = mg/kg.

Only detectable hydrocarbon concentrations are shown. Hydrocarbons were not detected at any location in 2025. BTEX compounds (Benzene, Toluene, Ethylbenzene and Xylenes) and PAH (Polycyclic Aromatic Hydrocarbons) were not detected at any location in 2025 or 2024. Refer laboratory documentation for a full list of hydrocarbon compounds that were analysed.

F1 = C6-C10 less BTEX compounds
F2 = C10-C16 less naphthalene
TRH = Total Recoverable Hydrocarbons

Default Guideline Value (DGV) Notes:
E: ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality.
E1: ANZECC (2000) Insufficient data, drinking water guideline recommended for screening.
I: WHO (2008) Petroleum Products in Drinking Water.
I1: WHO (2008) Lowest derived guideline for aliphatic and aromatic fractions in this range.
#: ANZECC (2000) Sediment quality guidelines - ISQG-Low (Trigger Value), Table 3.5.1.
##: ANZG (2018) DGV for toxicants in sediment Table 1.
##1: ANZG (2018) Origin described in Appendix A5 of Simpson SL, Batley GE & Chariton AA (2013) Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines, CSIRO Land and Water Report 8/07

Samson St and Nyaania Pool sampled in 2025 only.

Salty Pool	2025	2024
C10-C14	<0.5	80
C15-C28	<0.1	510
C29-C36	<0.1	380
C10-C36	<0.5	970
C10-C16 (F2)	<0.5	170
C16-C34	<0.1	680
C34-C40	<0.1	140
C10-C40	<0.5	990

Beraking Yarra	2025	2024
C10-C14	<0.5	24
C15-C28	<0.1	100
C29-C36	<0.1	70
C10-C36	<0.5	194
C16-C34	<0.1	130
C10-C40	<0.5	130

Figure 17 Sediment Sampling Results: Hydrocarbons

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-017
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.

Per- and Polyfluoroalkyl Substances

Per- and polyfluoroalkyl substances (PFAS), often referred to as 'forever chemicals', are synthetic compounds known for their toxicity, persistence and ability to bioaccumulate in animals, humans and the environment. They have been widely used to manufacture products that resist stains, grease, soil and water, including firefighting foams, protective coatings, hydraulic fluids and food or beverage containers.

PFAS manufacturing processes, along with the way these chemicals break down, can produce complex mixtures of both intentionally created and unintentionally generated compounds. The most widely studied include PFOS (perfluorooctanesulfonic acid), PFOA (perfluorooctanoic acid) and PFHxS (perfluorohexanesulfonic acid), along with their precursors. The Australian Government banned the import, use and manufacture of several prominent PFAS types from 1 July 2025, including PFOS, PFOA and PFHxS.

Because PFAS do not readily degrade, they can remain in the environment for long periods. Their extensive use and persistence mean that many PFAS compounds may be present at low levels in soil and water. PFAS also bioaccumulate in living organisms, allowing concentrations to increase with repeated exposure.

DGV Exceedances – Water

PFAS were analysed in all water samples collected in 2024 and 2025 (refer **Figure 18** and **Tables T2a-T2b** appended to the back of this report).

There were several exceedances of the default guideline values (DGVs). Freshwater ecosystem DGV exceedances were widespread across the catchment, and related to elevated PFOS concentrations at most sites. Human health DGV exceedances occurred at four sites in the lower catchment, where PFOS concentrations were above both the drinking water and non-potable use guidelines. These same four sites also exceeded the primary industries DGVs for livestock watering. PFAS DGVs are limited; they are only available for a small number of PFAS compounds and do not exist for agricultural irrigation.

A summary of the DGV exceedances is presented in **Table 12** below. Note: the drinking water DGVs for several PFAS compounds and the freshwater DGVs for PFOS have been updated since the 2024 sampling, as described in **Appendix 3**. The 2024 results have been rescreened against the revised guidelines to ensure consistency in interpretation.

DGVs	September 2025	September 2024
Freshwater Ecosystem DGVs	Exceedances at 11 of 14 sites: – PFOS (0.039–0.045 ug/L) above the DGV (0.02) for protection of aquatic animals at Helena Swan, Whiteman Rd and Helena Roe. – PFOS (0.0006–0.045 ug/L) above the DGV (0.0005) for protection of air-breathing animals at all sites except Piesse Culvert, Salty Pool and Beraking Yarra.	Exceedances at 7 of 12 sites: – PFOS (0.041–0.048 ug/L) above the DGV (0.02) for protection of aquatic animals at Whiteman Rd and Helena Roe. – PFOS (0.0005–0.048 ug/L) equal to or above the DGV (0.0005) for protection of air-breathing animals at Whiteman Rd, Helena Roe, Craignish, Lower Pumpback Dam, Rocky Pool, Pipe Bridge and Cobblers Pool.
Human Health DGVs	Exceedances at 4 of 14 sites: – PFOS (0.0083–0.045 ug/L) above the drinking water and non-potable DGVs (0.008) at Helena Swan, Whiteman Rd, Helena Roe and Nyaania Pool.	Exceedances at 2 of 12 sites: – PFOS (0.041–0.048 ug/L) above the drinking water and non-potable DGVs (0.008 ug/L) at Whiteman Rd and Helena Roe.
Primary Industries DGVs	Exceedances at 4 of 14 sites: – PFOS (0.0083–0.045 ug/L) above the livestock watering DGV (0.008) at Helena Swan, Whiteman Rd, Helena Roe and Nyaania Pool.	Exceedances at 2 of 12 sites: – PFOS (0.041–0.048 ug/L) above the livestock watering DGV (0.008 ug/L) at Whiteman Rd and Helena Roe.

Table 12 PFAS - DGV Exceedances in Water

DGV Exceedances – Sediment

PFAS were analysed in all sediment samples in 2025 and 2024 (refer **Figure 19** and **Tables T3a-T3b** appended to the back of this report). The sediment analysis method differed between 2025 and 2024, so the results cannot be directly compared:

- 2025 analysis: leachable concentrations in sediment (liquid phase)

- 2024 analysis: total concentrations in sediment (solid phase)

Leachable concentrations were analysed in 2025 to provide a better metric for risk assessment.

Freshwater ecosystem DGV exceedances were associated with elevated PFOS concentrations at all sites in the lower catchment except Craignish. Human health DGV exceedances occurred at a single site in the lower catchment, Nyaania Pool, where leachable PFOS concentrations were above both the drinking water and non-potable use guidelines. Leachable PFOS concentrations at Nyaania Pool also exceeded the primary industries DGV for livestock watering. A summary of the DGV exceedances is presented in **Table 13** below.

DGVs	September 2025 (leachable)	September 2024 (solid)
Freshwater Ecosystem DGVs	Exceedances at 6 of 14 sites: PFOS (0.0025–0.0093 ug/L) above the DGV (0.0005) for protection of air-breathing animals at Helena Swan, Whiteman Rd, Helena Roe, Samson St, Nyaania Pool and Lower Dam.	PFAS not detected.
Human Health DGVs	Exceedance at 1 of 14 sites: PFOS (0.0093 ug/L) above the drinking water and non-potable DGVs (0.008) at Nyaania Pool.	PFAS not detected.
Primary Industries DGVs	Exceedance at 1 of 14 sites: PFOS (0.0093 ug/L) above the livestock watering DGV (0.008) at Nyaania Pool.	PFAS not detected.

Table 13 PFAS - DGV Exceedances in Sediment

Summary

Low concentrations of PFAS were detected in water at all sites, with the notable exception of Helena Swan in 2024. The absence is unexpected and inconsistent with the widespread presence of PFAS throughout the Swan Canning catchment[38].

The most frequently detected compound was PFOS, which was detected at concentrations of up to 0.048 ug/L in water samples. PFOS was potentially detected more often than other PFAS because it's laboratory detection limit (0.0001 ug/L) is an order of magnitude lower than that of other compounds (0.001 ug/L). PFOS exceeded the freshwater ecosystem DGV at almost all sites, with the exception of those in the upper reaches of the catchment.

PFAS levels were highest in the lower catchment, with four sites reporting PFOS concentrations above the human health DGV for non-potable use (Helena Roe, Whiteman Rd, Helena Swan and Nyaania Pool).

The greatest concentrations were detected at Helena Roe, Whiteman Road and Helena Swan (2025 only). Eleven PFAS compounds were detected at these sites, comprising PFOS, PFHxS, PFOA, PFBA, PFBS, PFHxA, PFHpA, PFHpS. PFPeA, PFPeS and PFPrS. Helena Roe is located adjacent to the former Bellevue Waste Facility site, where PFAS may have been stored or released to the environment during the 2001 hazardous waste fire. Whiteman Road lies just 1 km downstream of Helena Roe.

Further upstream in the lower catchment, elevated concentrations were also observed at Samson St and Nyaania Pool. Six PFAS compounds were detected at these sites: PFOS, PFHxS, PFHxA, PFOA, PFBS and PFPeS.

PFAS levels were substantially lower in the middle catchment. At several sites (Craignish, Pipe Bridge and Piesse Culvert), PFOS was the only compound detected in both 2025 and 2024. At other sites (Lower Pumpback Dam, Rocky Pool, Cobblers Pool and LookSee Pool), only PFOS and PFHxS were detected. In the upper catchment, both sites (Salty Pool and Beraking Yarra) reported PFOS in 2025 and 2024, and PFBA in 2024 only.

Leachable PFAS concentrations in sediment were also elevated in the lower catchment. PFOS was the most commonly detected compound, present at all sites in the lower catchment except Craignish, with concentrations of up to 0.0093 ug/L. The highest leachable concentration occurred at Nyaania Pool, exceeding the human health DGVs for non-potable use. This site also had the greatest number of PFAS compounds detected in sediment, including PFOS, PFHxS, PFOA and PFHxA.

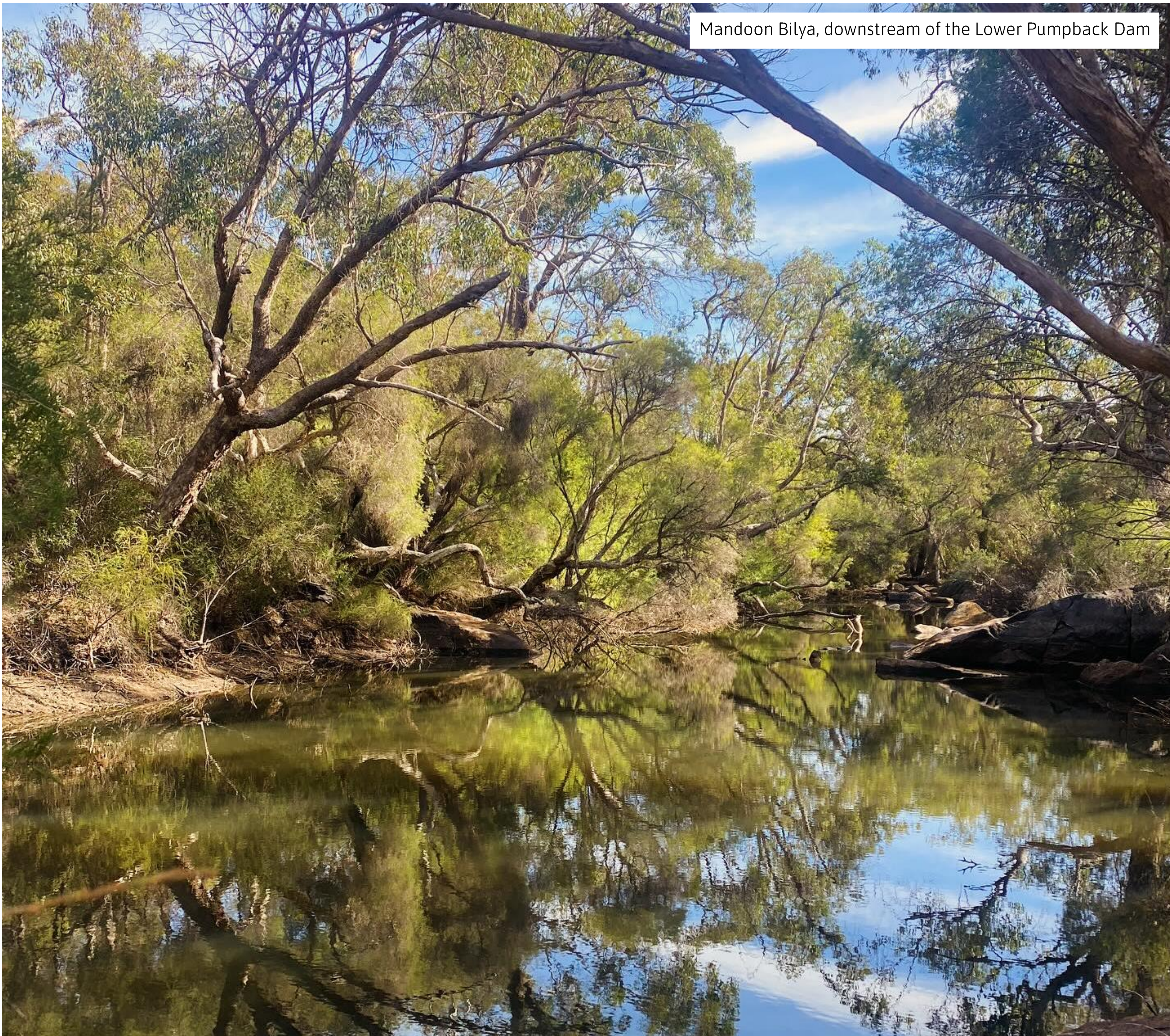
Leachable PFOS and PFHxS were detected at Samson St, whilst PFOS was the only compound detected in sediment at Helena Swan and Whiteman Rd. Leachable PFAS concentrations were not reported in sediment samples from the middle or upper catchment.

PFAS were not detected in sediment samples in 2024; however, the detection limit for solid sediment analysis (5 ug/kg) is several orders of magnitude higher than that for leachable analysis (0.0001–0.005 ug/L). As a result, PFAS may have been present at concentrations too low to be detected using the solid-phase method.

Given the widespread prevalence of PFAS compounds and their detection in previous studies of the Swan Canning catchment, their presence in the river was expected. PFAS concentrations were similar to those reported in the 2022 DBCA study of the Swan-Canning catchment conducted between December 2016 and June 2018[38]: For comparison:

- PFOS concentrations of 0.0001–0.048 ug/L in 2024–2025 compared to 0.0041–0.120 ug/L in 2016-2018.
- PFHxS concentrations of 0.001-0.024 ug/L in 2024–2025 compared to 0.0022–0.0510 ug/L in 2016-2018.

BNAA will provide these findings to the Department of Health (DOH) and DWER so they can consider notifying users of water abstractions in the area and undertaking additional sampling to verify these results.


Mandoon Bilya, downstream of the Lower Pumpback Dam

Helena Swan	2025	2024
PFBA	0.012	<0.005
PFPeA	0.023	<0.001
PFHxA	0.017	<0.001
PFHpA	0.007	<0.005
PFOA	0.012	<0.001
PFBS	0.005	<0.001
PFOS	0.039	<0.0001
PFPrS	0.001	<0.001
PFPeS	0.004	<0.001
PFHxS	0.024	<0.001
PFHpS	0.001	<0.001

Whiteman Rd	2025	2024
PFBA	0.012	0.017
PFPeA	0.023	0.037
PFHxA	0.015	0.016
PFHpA	0.007	0.007
PFOA	0.013	0.011
PFBS	0.006	0.004
PFOS	0.040	0.041
PFPrS	0.001	<0.001
PFPeS	0.005	0.004
PFHxS	0.023	0.021
PFHpS	0.001	0.001

Helena Roe	2025	2024
PFBA	0.010	0.016
PFPeA	0.015	0.023
PFHxA	0.010	0.013
PFHpA	0.006	0.006
PFOA	0.013	0.0013
PFBS	0.005	0.006
PFOS	0.045	0.048
PFPrS	0.001	0.002
PFPeS	0.004	0.004
PFHxS	0.022	0.024
PFHpS	0.001	0.001

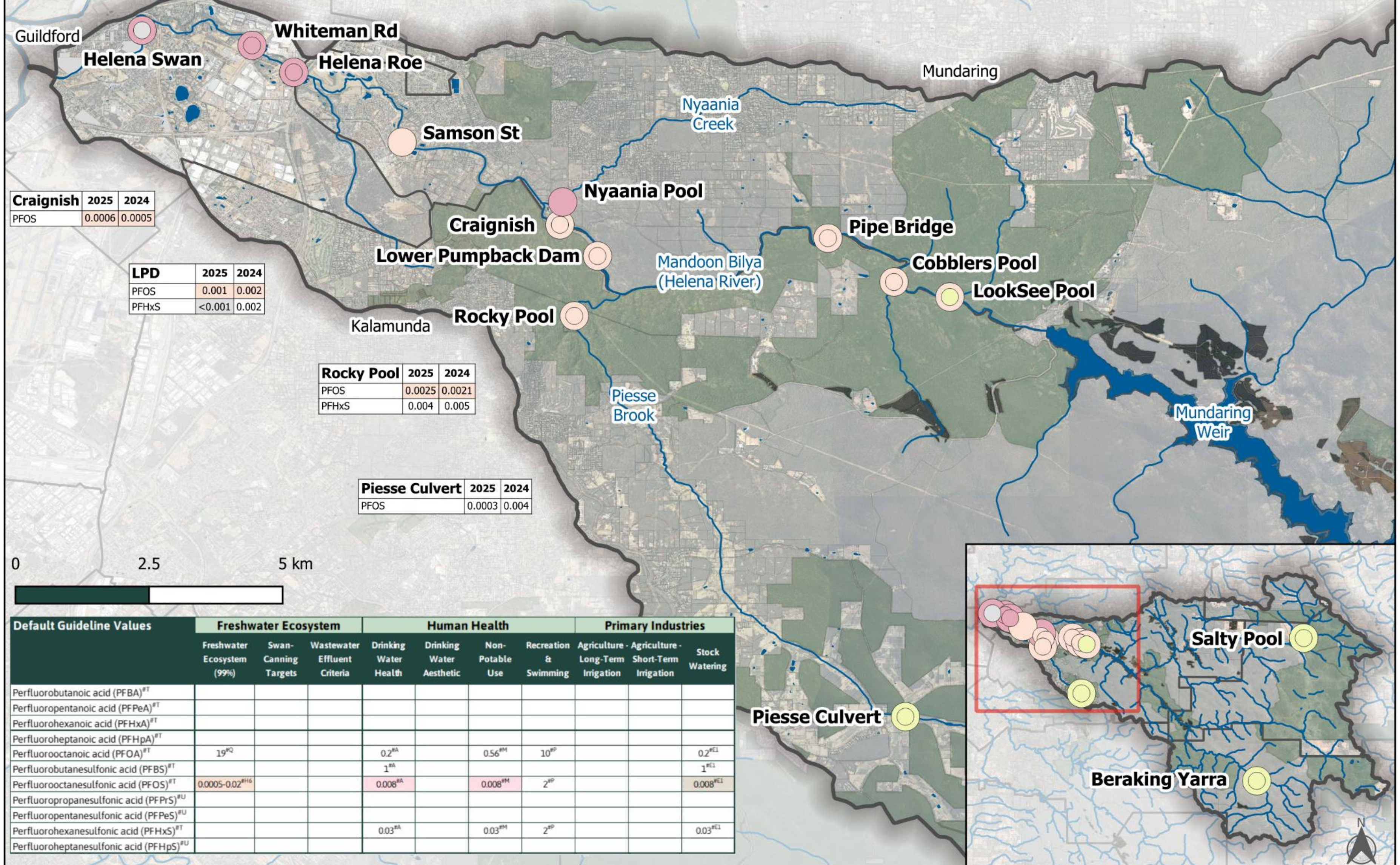
Samson St	2025
PFHxA	0.002
PFOA	0.003
PFBS	0.003
PFOS	0.0070
PFPeS	0.001
PFHxS	0.009

Nyaania Pool	2025
PFHxA	0.003
PFOA	0.003
PFBS	0.003
PFOS	0.0083
PFPeS	0.002
PFHxS	0.010

Pipe Bridge	2025	2024
PFOS	0.0007	0.0006

Cobblers Pool	2025	2024
PFOS	0.0013	0.001
PFHxS	0.001	<0.001

LookSee Pool	2025	2024
PFOS	0.0012	0.0003
PFHxS	0.001	<0.001



Craignish	2025	2024
PFOS	0.0006	0.0005

LPD	2025	2024
PFOS	0.001	0.002
PFHxS	<0.001	0.002

Rocky Pool	2025	2024
PFOS	0.0025	0.0021
PFHxS	0.004	0.005

Piesse Culvert	2025	2024
PFOS	0.0003	0.004

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Perfluorobutanoic acid (PFBA)[#T]										
Perfluoropentanoic acid (PFPeA)[#T]										
Perfluorohexanoic acid (PFHxA)[#T]										
Perfluoroheptanoic acid (PFHpA)[#T]										
Perfluorooctanoic acid (PFOA)[#T]	19[#Q]			0.2[#A]		0.56[#M]	10[#P]			0.2[#E1]
Perfluorobutanesulfonic acid (PFBS)[#T]				1[#A]						1[#E1]
Perfluorooctanesulfonic acid (PFOS)[#T]	0.0005-0.02[#H6]			0.008[#A]		0.008[#M]	2[#P]			0.008[#E1]
Perfluoropropanesulfonic acid (PFPrS)[#U]										
Perfluoropentanesulfonic acid (PFPeS)[#U]										
Perfluorohexanesulfonic acid (PFHxS)[#T]				0.03[#A]		0.03[#M]	2[#P]			0.03[#E1]
Perfluoroheptanesulfonic acid (PFHpS)[#U]										

Legend

PFAS in Water 2025

- Exceeds Human Health and Primary Industries and Freshwater Ecosystem DGV
- Exceeds Freshwater Ecosystem DGV
- Detected Below DGV or no DGV exist

PFAS in Water 2024

- Exceeds Human Health and Primary Industries and Freshwater Ecosystem DGV
- Exceeds Freshwater Ecosystem DGV
- Detected Below DGV or no DGV Exist

Only detectable PFAS compounds are shown. Other PFAS compounds were not detected at any location in 2025 or 2024, including various Perfluoroalkyl carboxylic acids (PFCAs), Perfluoroalkyl sulfonic acids (PFSAs), n:2 Fluorotelomer sulfonic acids (n:2 FTSAs) and Perfluoroalkyl sulfonamido substances.

Refer laboratory documentation for a full list of PFAS compounds that were analysed.

All units in ug/L.

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
E: ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality.
E1: ANZECC (2000) Insufficient data, drinking water guideline recommended for screening.
H6: ANZG (2026) Guidelines of 0.02 ug/L for 99% LOSP to aquatic species (including plants, invertebrates and fish), both via direct toxicity and bioaccumulation pathways, and 0.0005 ug/L for 99% LOSP to air-breathing animals that live in aquatic ecosystems or prey on aquatic organisms.
M: DWER (2021) For PFAS, drinking water guidelines are appropriate screening levels for non-potable uses.
P: NHMRC (2019) Australian recreational water Health Based Guideline Value (HBGV), not protective of a pathway of PFAS accumulation in fish/shellfish, and subsequent human consumption (e.g. by recreational fishers or Noongar people sourcing traditional foods).
Q: HEPA (2025) PFAS National Environmental Management Plan (NEMP), Version 3.0, interim guideline for 99% level of species protection used for high conservation value systems - this approach is generally adopted for chemicals that bioaccumulate and biomagnify in wildlife. Interim guidelines do not account for bioaccumulation and biomagnification effects of toxicants in air-breathing animals or in animals which prey on aquatic organisms.

Samson St and Nyaania Pool sampled in 2025 only.

Salty Pool	2025	2024
PFBA	<0.005	0.015
PFOS	0.0003	0.0004

Beraking Yarra	2025	2024
PFBA	<0.005	0.009
PFOS	0.0004	0.0001

Figure 18 Water Sampling Results: Per- and Polyfluoroalkyl Substances (PFAS)

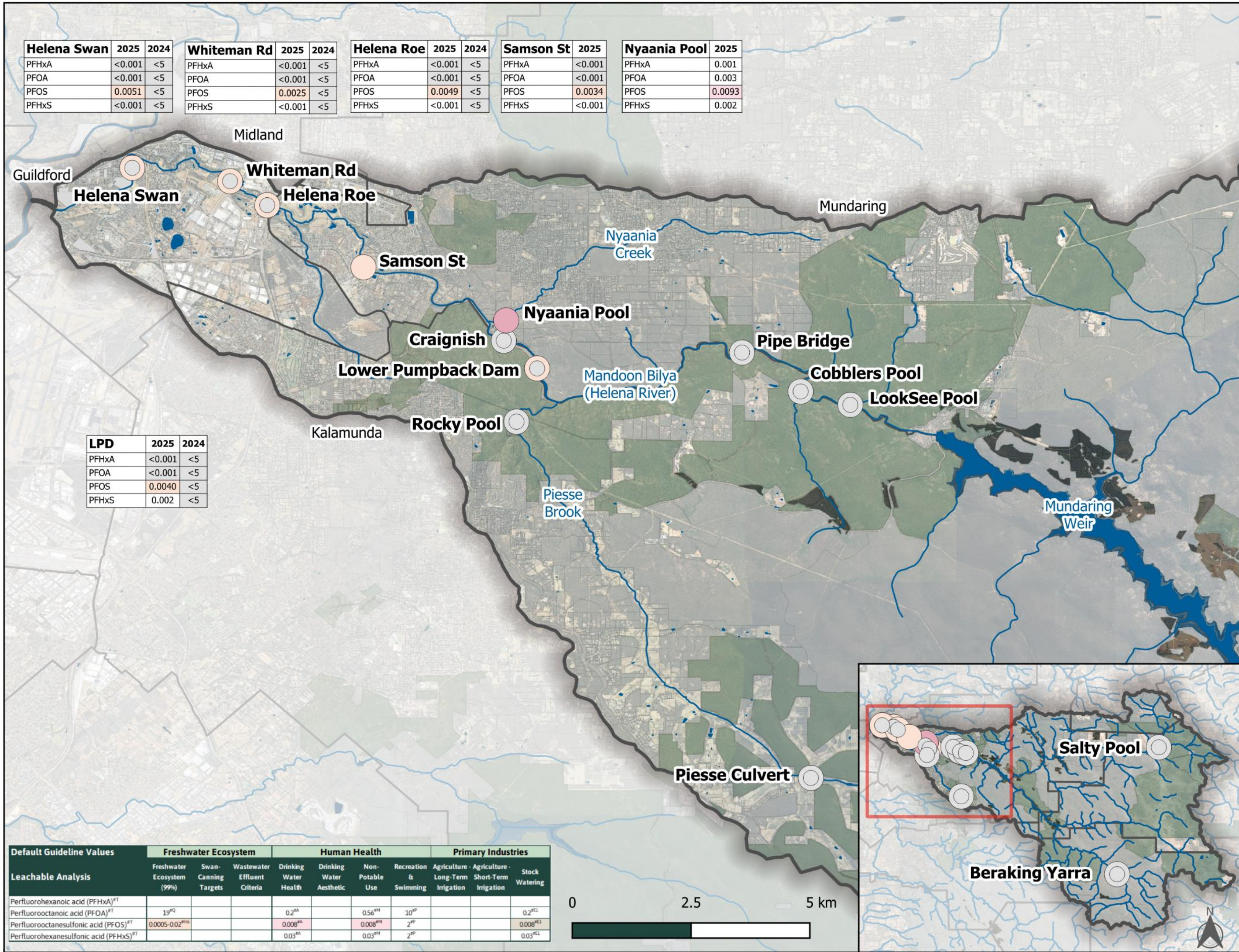
Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-018
Date: 24 May 2026

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.



Helena Swan	2025	2024
PFHxA	<0.001	<5
PFOA	<0.001	<5
PFOS	0.0051	<5
PFHxS	<0.001	<5

Whiteman Rd	2025	2024
PFHxA	<0.001	<5
PFOA	<0.001	<5
PFOS	0.0025	<5
PFHxS	<0.001	<5

Helena Roe	2025	2024
PFHxA	<0.001	<5
PFOA	<0.001	<5
PFOS	0.0049	<5
PFHxS	<0.001	<5

Samson St	2025
PFHxA	<0.001
PFOA	<0.001
PFOS	0.0034
PFHxS	<0.001

Nyaania Pool	2025
PFHxA	0.001
PFOA	0.003
PFOS	0.0093
PFHxS	0.002

LPD	2025	2024
PFHxA	<0.001	<5
PFOA	<0.001	<5
PFOS	0.0040	<5
PFHxS	0.002	<5

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Leachable Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Perfluorohexanoic acid (PFHxA)[#T]										
Perfluorooctanoic acid (PFOA)[#T]	19[#Q]			0.2[#A]		0.56[#M]	10[#P]			0.2[#E1]
Perfluorooctanesulfonic acid (PFOS)[#T]	0.0005-0.02[#H6]			0.008[#A]		0.008[#M]	2[#P]			0.008[#E1]
Perfluorohexanesulfonic acid (PFHxS)[#T]				0.03[#A]		0.03[#M]	2[#P]			0.03[#E1]

Legend

Forestry Plantation

National Park

PFAS in Sediment 2025

Exceeds Human Health and Primary Industries and Freshwater Ecosystem DGV

Exceeds Freshwater Ecosystem DGV

Not Detected

PFAS in Sediment 2024

Not Detected

Sediment analysis differed between 2025 and 2024, so the results cannot be directly compared.

- 2025 analysis: Leachable concentrations in sediment as a liquid (ug/L).
- 2024 analysis: Total concentrations in sediment as a solid (ug/kg).

Leachable analysis was undertaken in 2025 as a better metric for risk assessment.

Units: 2025 = ug/L; 2024 = ug/kg.

Only detectable PFAS compounds are shown. Other PFAS compounds were not detected at any location in 2025 or 2024, including various Perfluoroalkyl carboxylic acids (PFCAs), Perfluoroalkyl sulfonic acids (PFSAs), n:2 Fluorotelomer sulfonic acids (n:2 FTSAs) and Perfluoroalkyl sulfonamido substances.

Refer laboratory documentation for a full list of PFAS compounds that were analysed.

PFAS was not detected in any sediment sample collected in 2024, however, the detection limit (<5 ug/kg) is several orders of magnitude higher than the detection limit for water samples and leachable sediment concentrations (<0.0001–0.005 ug/L).

Default Guideline Value (DGV) Notes:
A: NHMRC (2011) Australian Drinking Water Guidelines.
E: ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality.
E1: ANZECC (2000) Insufficient data, drinking water guideline recommended for screening.
H6: ANZG (2026) Guidelines of 0.02 ug/L for 99% LOSP to aquatic species (including plants, invertebrates and fish), both via direct toxicity and bioaccumulation pathways, and 0.0005 ug/L for 99% LOSP to air-breathing animals that live in aquatic ecosystems or prey on aquatic organisms.
M: DWER (2021) For PFAS, drinking water guidelines are appropriate screening levels for non-potable uses where consumption of home-grown produce is a plausible exposure pathway e.g. watering gardens.
P: NHMRC (2019) Australian recreational water Health Based Guideline Value (HBGV), not protective of a pathway of PFAS accumulation in fish/shellfish, and subsequent human consumption (e.g. by recreational fishers or Noongar people sourcing traditional foods).
Q: HEPA (2025) PFAS National Environmental Management Plan (NEMP), Version 3.0, interim guideline for 99% LOSP used for high conservation value systems. Interim guidelines do not account for bioaccumulation and biomagnification of toxicants in air-breathing animals or in animals which prey on aquatic organisms.

Samson St and Nyaania Pool sampled in 2025 only.

Figure 19 Sediment Sampling Results: Per- and Polyfluoroalkyl Substances (PFAS)

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment) Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-019
Date: 24 May 2026

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.

Methylene Blue Active Substances

Methylene blue active substances (MBAS) are commonly used as a screening tool to indicate presence of anionic surfactants such as detergents and foaming agents. While MBAS analysis does not identify specific surfactants, it provides an measure of their overall concentration. Anionic surfactants are typically present in wastewater and industrial runoff, and also occur naturally from the decomposition of organic matter and from saponins, detergent-like compounds produced by many plants. They are also used to enhance the effectiveness of active ingredients in herbicides and pesticides. The toxicity of anionic surfactants varies, but their presence in aquatic environments can increase the mobility and bioavailability of other contaminants[32].

DGV Exceedances – Water

MBAS were analysed in all water samples collected in 2024 and 2025 (refer **Figure 20** and **Tables T2a-T2b** appended to the back of this report).

Human health default guideline value (DGV) exceedances were widespread, with concentrations above the recreation DGVs at almost all sites. MBAS DGVs do not exist for drinking water, non-potable uses, primary industries or freshwater ecosystems. A summary of the DGV exceedances is presented in **Table 14** below.

DGVs	September 2025	September 2024
Human Health DGVs	Exceedances at 13 of 14 sites: – MBAS (0.20–0.84 mg/L) above the recreation DGV (0.2) at all sites except Nyaania Pool.	Exceedances at 10 of 12 sites: – MBAS (0.2–1.4 mg/L) above the recreation DGV (0.2) at all sites except Lower Dam and Rocky Pool.

Table 14 MBAS - DGV Exceedances in Water

DGV Exceedances – Sediment

MBAS were analysed in all sediment samples in 2025 and 2024 (refer **Figure 21** and **Tables T3a-T3b** appended at the back of this report). The sediment analysis method differed between 2025 and 2024, so the results cannot be directly compared:

- 2025 analysis: leachable concentrations in sediment (liquid phase)
- 2024 analysis: total concentrations in sediment (solid phase)

Leachable concentrations were analysed in 2025 to provide a better metric for risk assessment.

There were no exceedances of the DGVs. Leachable MBAS concentrations were not detected in any sediment sample in 2025. Solid MBAS concentrations were only detected in two samples in 2024, Piesse Culvert and Whiteman Rd, although there are no DGVs available to assess these concentrations.

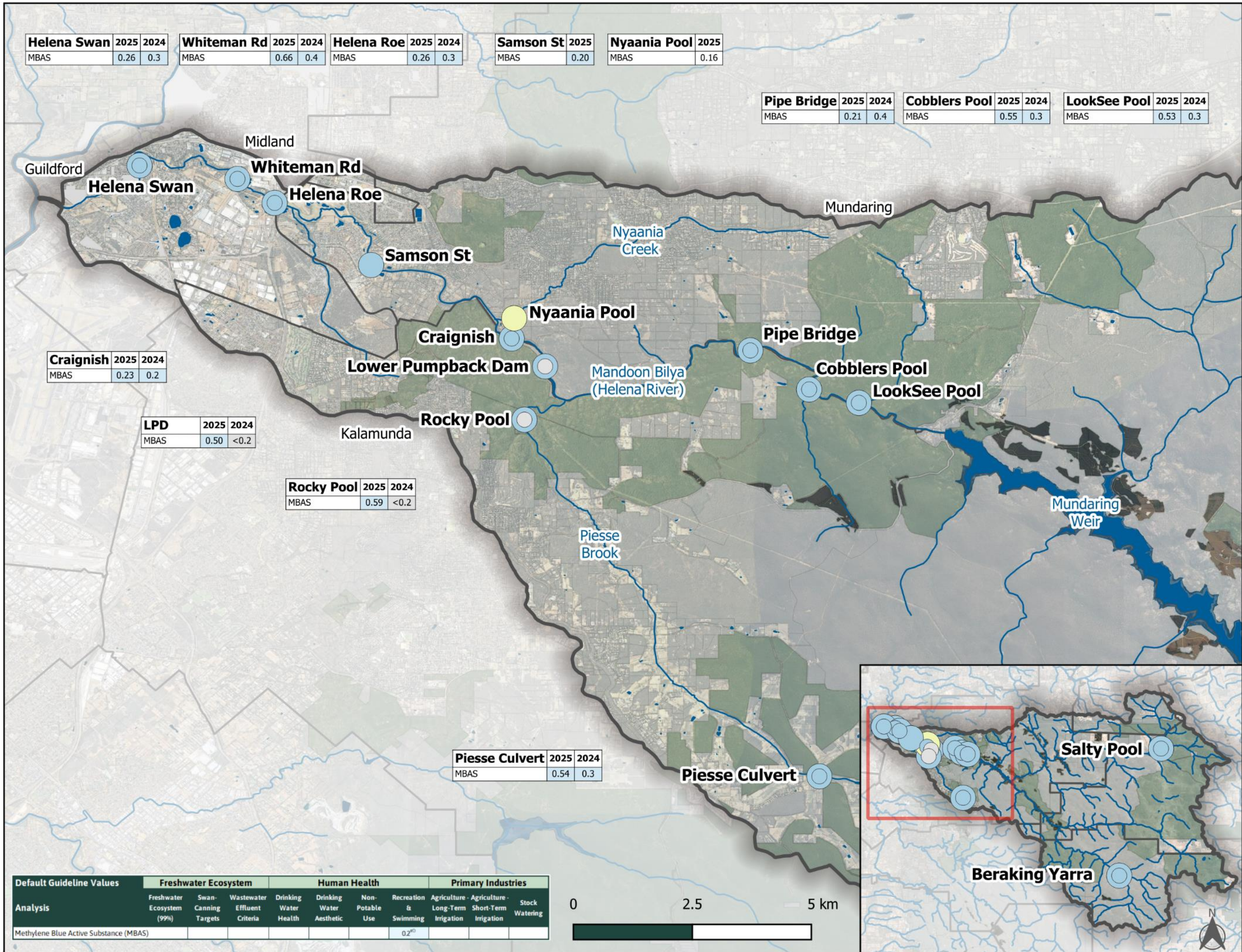
Summary

Elevated MBAS were widespread in surface water, indicating the presence of anionic surfactants from unknown sources. The highest concentrations occurred at Salty Pool, a site with elevated salinity resulting from historical land clearing. MBAS concentrations can be strongly influenced by dissolved salts, particularly chloride ions, which were also elevated at Salty Pool.

The detection of MBAS throughout the catchment, including at Beraking Yarra in the river's headwaters suggests that at least some of the measured surfactants originate from natural sources. Soap bush (*Trymalium odoratissimum*), which is prolific in the lower and middle catchment, produces a soap-like lather when its leaves are rubbed with water due to naturally occurring saponins. It is unclear whether the elevated MBAS concentrations are linked to the presence of this plant.

MBAS were rarely detected in sediment, occurring as solid-phase concentrations in only two samples. Concentrations at Whiteman Rd (32 mg/kg) were an order of magnitude higher than those at Piesse Culvert (3.6 mg/kg). Leachable MBAS was not detected in any sediment sample.

Overall, MBAS concentrations were comparable to those reported in the 2014 *Helping the Helena* study[32], with maximum concentrations of 1.4 mg/L in the current assessment compared with up to 0.85 mg/L in 2014.



Helena Swan	2025	2024
MBAS	0.26	0.3

Whiteman Rd	2025	2024
MBAS	0.66	0.4

Helena Roe	2025	2024
MBAS	0.26	0.3

Samson St	2025
MBAS	0.20

Nyaania Pool	2025
MBAS	0.16

Pipe Bridge	2025	2024
MBAS	0.21	0.4

Cobblers Pool	2025	2024
MBAS	0.55	0.3

LookSee Pool	2025	2024
MBAS	0.53	0.3

Craignish	2025	2024
MBAS	0.23	0.2

LPD	2025	2024
MBAS	0.50	<0.2

Rocky Pool	2025	2024
MBAS	0.59	<0.2

Piesse Culvert	2025	2024
MBAS	0.54	0.3

Salty Pool	2025	2024
MBAS	0.84	1.4

Beraking Yarra	2025	2024
MBAS	0.69	0.4

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Methylene Blue Active Substance (MBAS)							0.2[#D]			

Legend

Forestry Plantation

National Park

MBAS in Water 2025

Exceeds Recreation DGV

Detected Below DGV

MBAS in Water 2024

Exceeds Recreation DGV

Not Detected

DGVs do not exist for MBAS in drinking water, non-potable water, primary industries water and freshwater ecosystems.

Default Guideline Value (DGV) Notes:
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3 (general chemicals).

All units in mg/L.

Samson St and Nyaania Pool sampled in 2025 only.

Figure 20 Water Sampling Results: Methylene Blue Active Substances

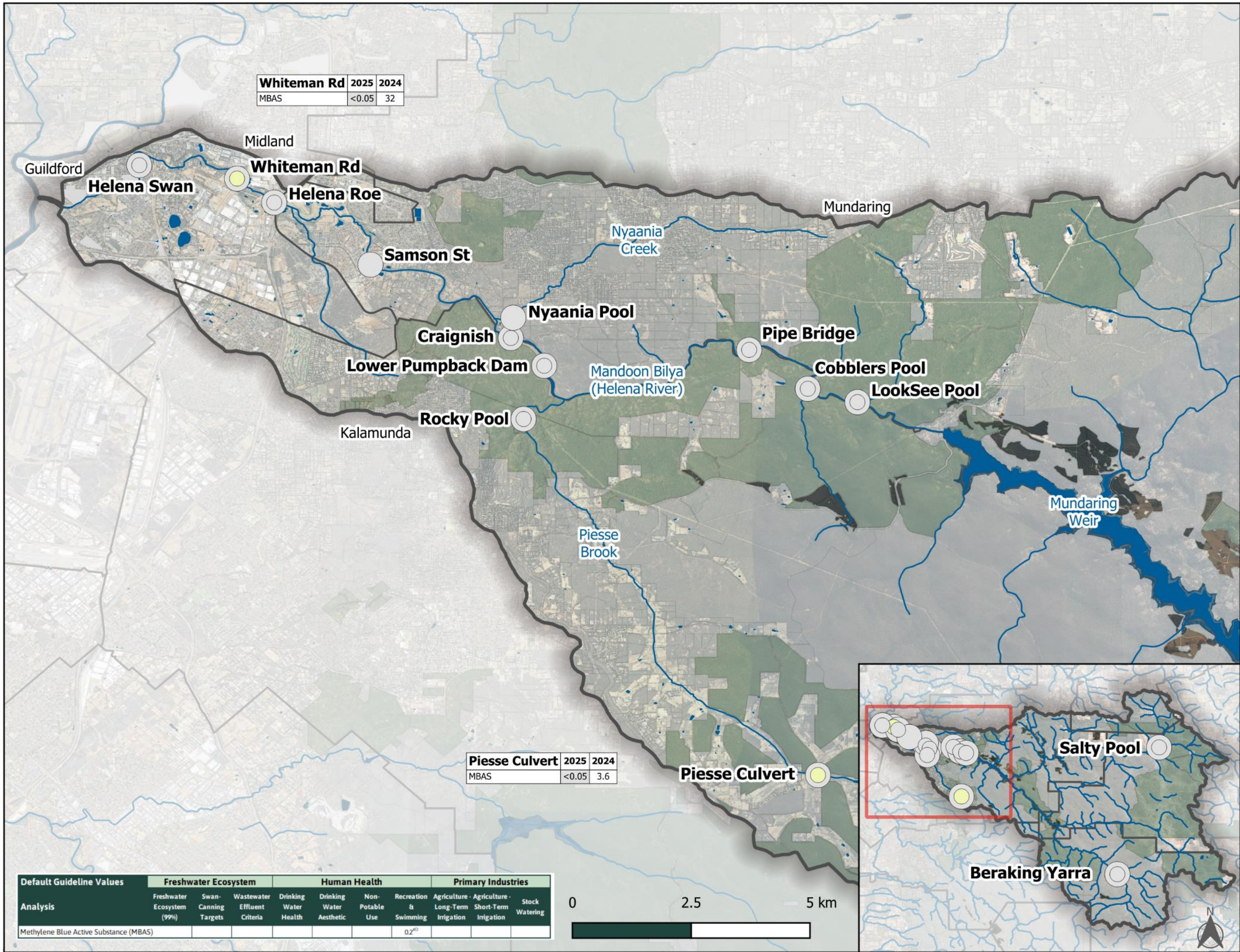
Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-020
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.



Whiteman Rd	2025	2024
MBAS	<0.05	32

Piesse Culvert	2025	2024
MBAS	<0.05	3.6

Default Guideline Values	Freshwater Ecosystem			Human Health				Primary Industries		
Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Stock Watering
Methylene Blue Active Substance (MBAS)							0.2[#D]			

Legend

Forestry Plantation

National Park

MBAS in Sediment 2025

Not Detected

MBAS in Sediment 2024

Detected - No DGV Exist

Not Detected

Sediment analysis differed between 2025 and 2024, so the results cannot be directly compared.

- 2025 analysis: Leachable concentrations in sediment as a liquid (mg/L).
- 2024 analysis: Total concentrations in sediment as a solid (mg/kg).

Leachable analysis was undertaken in 2025 as a better metric for risk assessment.

Units: 2025 = mg/L; 2024 = mg/kg.

Only detectable concentrations are shown.

DGV do not exist for MBAS in drinking water, non-potable water, primary industries water and freshwater ecosystems.
DGV do not exist for MBAS in solid sediment.

Default Guideline Value (DGV) Notes:
D: ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, Table 5.2.3 (general chemicals).

Samson St and Nyaania Pool sampled in 2025 only.

Figure 21 Sediment Sampling Results: Methylene Blue Active Substances

Bibbul Ngarma Aboriginal Association Incorporated
Prepared by: Francesca Flynn

BoorYul-Bah-Bilya (Mandoon Bilya - Helena River Catchment)
Baseline Surface Water and Sediment Sampling 2024-2025, Conservation Audit

Data: Landgate, Department of Water and Environmental Regulation, Shire of Mundaring, City of Kalamunda, City of Swan, Google Satellite

Ref: BBB-MBHR-BWQS-021
Date: 12 December 2025

BOORYUL BAH BILYA
BIBBUL NGARMA ABORIGINAL ASSOCIATION INC.

Quality Control

Duplicate water samples were collected to check for replicability and sampling errors.

In 2024, one duplicate sample was collected from Piesse Culvert and analysed for TRH and BTEX. Hydrocarbons were not detected at that site, meaning relative percentage differences (RPDs) could not be calculated. At the time, it was recommended that future duplicate analysis be undertaken on metals to ensure detectable concentrations and subsequent calculation of RPDs.

In 2025, one duplicate sample was collected from Piesse Culvert and analysed for metals. The RPDs between detectable metals in the primary and duplicate samples are presented in **Table 15** below. All other metals were detected below the laboratory limit of reporting (LOR).

All RPDs were within the acceptable limit (<30%).

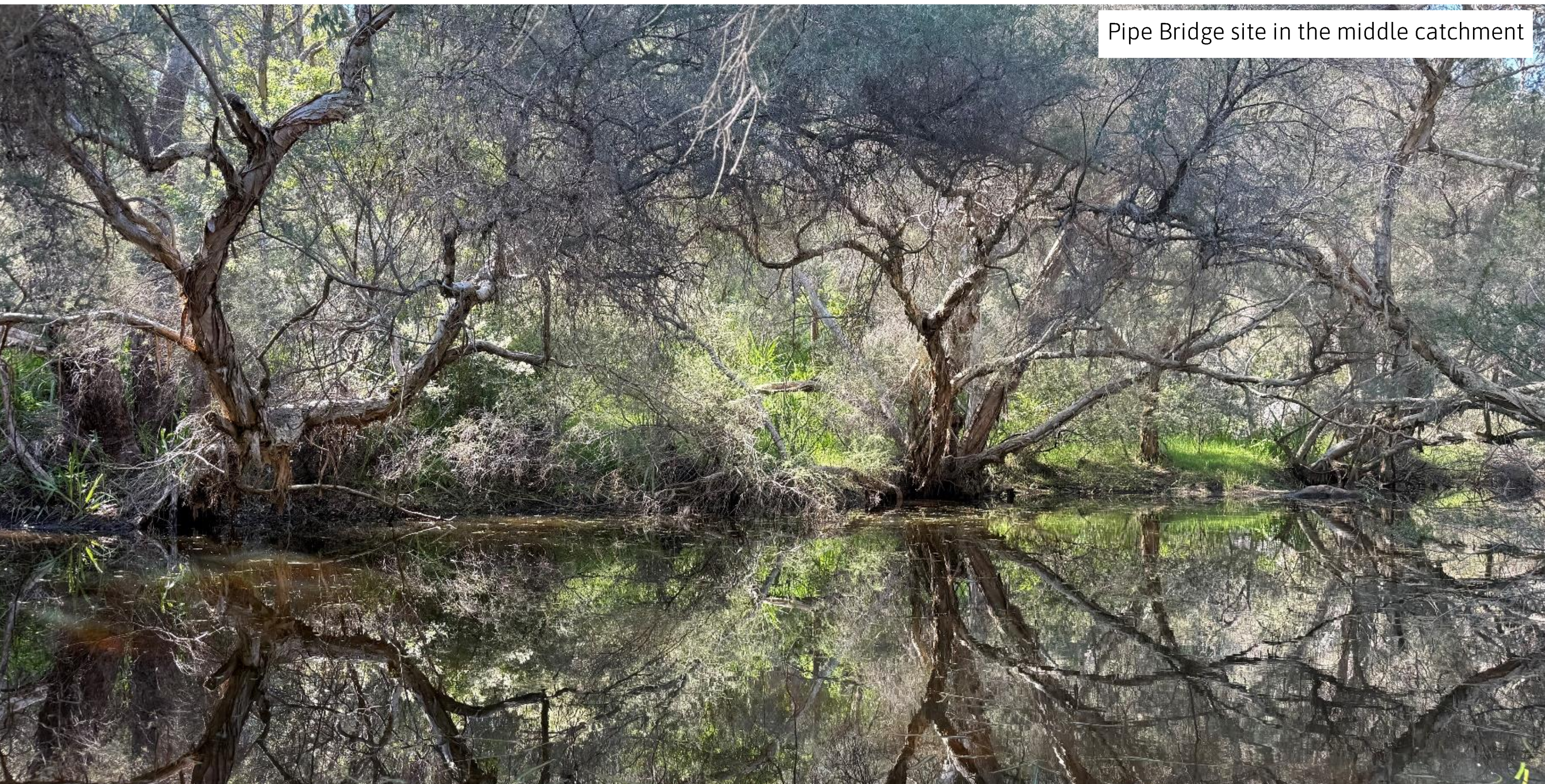
Group	Analysis	Piesse Culvert Primary	Piesse Culvert Duplicate	RPD
Metals (Filtered)	Barium	0.03	0.03	0%
	Copper	0.003	0.003	0%
	Iron	0.01	0.01	0%
	Manganese	0.011	0.012	8%
	Zinc	0.010	0.010	0%

Table 15 Primary and duplicate water sample comparison

Quality control analysis was undertaken by the laboratory including duplicate samples, method blanks, recovery control samples and matrix spikes. All results were within the required acceptance limits.

The following sample integrity comments were provided by the laboratory:

- Attempt to chill samples was evident
- Samples were correctly preserved
- Appropriate sample containers were used
- Sample containers for volatile analysis were received with minimal headspace
- Samples were received within the required holding time



Pipe Bridge site in the middle catchment

Discussion of Potential Risks

Potential risks to the river's freshwater ecosystem and to water users are discussed below in the context of exceedances of the default guideline values (DGVs).

DGV exceedances do not automatically indicate an impact to ecosystems or water user, instead they indicate that further investigation is required to determine whether an impact is present. Assessing actual impacts requires a detailed risk assessment, which is outside the scope of the current assessment. These assessments need to consider exposure pathways for different receptors, ecotoxicological effects and catchment-specific conditions. They should also account for exposure pathways that are specific to Noongar people, including direct contact with the river during cultural practices such as water ceremonies.

DGVs are limited for some contaminants and for sediment quality. The absence of a DGV does not mean there is no potential risk, instead it means that a guideline is yet to be developed. As the BBB program progresses, BNAA hope to develop catchment-specific guidelines for water and sediment quality that can be incorporated into an overarching plan with management targets to measure progress.

Potential Risks to Freshwater Ecosystems

Potential risks to freshwater ecosystems may exist based on the following exceedances of DGVs in water and leachable sediment:

- Low dissolved oxygen at all sites except Nyaania Pool and Rocky Pool.
- Elevated conductivity at all sites except Beraking Yarra.
- Elevated PFOS at eleven sites: all except Piesse Culvert, Salty Pool and Beraking Yarra.
- Elevated nutrients at all sites, including:
  - Total phosphorus at all sites.
  - Total nitrogen at all sites except Helena Roe, Lower Dam, Cobblers Pool and LookSee Pool.
  - Oxidised nitrogen at six sites: Helena Swan, Whiteman Rd, Helena Roe, Nyaania Pool, Rocky Pool and Piesse Culvert.
  - Nitrate at Rocky Pool and Piesse Culvert
  - Reactive phosphorus at Helena Swan and Salty Pool.
- Elevated dissolved metals at all sites, including:
  - Aluminium, copper, iron and zinc at all sites.
  - Lead at all sites (leachable sediment only).
  - Boron at all sites except Piesse Culvert (leachable sediment only).
  - Vanadium at all sites except Helena Swan and Cobblers Pool.
  - Chromium at all sites except Helena Swan and Craignish (leachable sediment only).
  - Cobalt at nine sites: Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Craignish, Rocky Pool, Piesse Culvert, Salty Pool and Beraking Yarra (leachable sediment only).
  - Nickel at six sites: Whiteman Rd, Helena Roe, Nyaania Pool, Rocky Pool, Piesse Culvert and Salty Pool (leachable sediment only).
  - Cadmium and uranium at Whiteman Rd (leachable sediment only).
- Elevated fluoride at seven sites: Helena Swan, Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Salty Pool and Beraking Yarra.
- Slightly acidic conditions at Craignish, Lower Pumpback Dam, Cobblers Pool and Salty Pool.
- Elevated pesticides (dieldrin) at Craignish (leachable sediment only).
- Elevated turbidity at Craignish.

Some metal exceedances relate to leachable concentrations in sediment only, including boron, cadmium, chromium, cobalt lead, nickel and uranium. These exceedances were not observed in the corresponding water results, indicating that the metals are largely confined to sediments and potentially sediment porewaters. Risks to plants and animals that live in the sediment cannot be excluded. However, due to dilution in surface water, risks to aquatic receptors living in the water column are likely to be low.

Potential risks may also exist due to isolated exceedances of total metal concentrations in water samples collected in 2024, involving cyanide at Beraking Yarra, and uranium at Helena Swan and Helena Roe. These exceedances were not observed in the dissolved or leachable metal results from 2025, suggesting that the elevated total concentrations may not reflect bioavailable forms that are accessible to aquatic organisms.

Risks may also exist based on the following exceedances of DGVs in solid sediment:

- Elevated total recoverable hydrocarbons (TRH) at Whiteman Rd, Pipe Bridge, Cobblers Pool, LookSee Pool and Salty Pool.
- Elevated naphthalene at Whiteman Rd and Helena Roe
- Elevated pesticides (DDT and DDE) at Piesse Culvert.
- Elevated mercury at Whiteman Rd.

Contaminants in solid sediment must first partition into porewater before they can affect aquatic ecosystems. The exceedances noted above were not reflected in any water or leachable sediment results, suggesting that the elevated solid concentrations in solid sediment may not represent bioavailable forms accessible to aquatic organisms.

Assessment of potential risks to freshwater ecosystems requires consideration of ecotoxicology and catchment-specific conditions. Ecotoxicology examines the effects of substances in water, soils and sediment on organisms within an ecosystem. For example, many freshwater fish have a degree of tolerance to salinity, so unless salinity reaches levels capable of causing sickness or mortality, its ecological impact cannot be determined without ecotoxicity testing.

Some metals occur naturally at elevated in the catchment, particularly aluminium and iron, meaning that local aquatic organisms are likely adapted to higher background concentrations. In addition, some of the DGVs used in this assessment were applied as screening criteria in the absence of more appropriate guidelines. For instance, the DGV for iron is intended for total concentrations, but was applied to dissolved concentrations due to the lack of an alternative DGV. Consequently, catchment-specific DGVs would provide a more accurate basis for assessing potential risks.

While DGVs are not currently available to assess potential risks to freshwater ecosystems posed by elevated microbes, it is noted that *E. coli* concentrations at all sites exceeded the wastewater effluent criteria for on-site disposal in the Mandoon catchment.

Based on current findings, potential risks to freshwater ecosystems may exist due to elevated PFOS, nutrients and various dissolved metals at all sites, elevated fluoride at approximately half of the sites, and elevated dieldrin at one site. Poor water quality may also pose risks, with low dissolved oxygen and elevated conductivity observed at most sites, slightly acidic conditions at three sites, and elevated turbidity at one site. Of particular concern are the consistently elevated PFOS concentrations across most sites and the elevated nutrient levels, specifically nitrogen and nitrate, recorded in Piesse Brook.

Potential Risks to Human Health

Drinking Water

Potential risks to human health via drinking water may exist based on the following exceedances of DGVs in water and leachable sediment:

- Elevated *E. coli* and *Enterococci* at all sites.

- Elevated thermophilic amoebae at Pipe Bridge, Salty Pool and Beraking Yarra.
- Elevated PFOS at Helena Swan, Whiteman Rd, Helena Roe and Nyaania Pool.
- Slightly acidic conditions at Craignish, Lower Pumpback Dam, Cobblers Pool and Salty Pool.
- Elevated dissolved metals at nine sites, including:
  - Cobalt at seven sites: Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Craignish, Rocky Pool and Salty Pool (leachable sediment only).
  - Iron at seven sites: Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Rocky Pool, Pipe Bridge and Salty Pool (leachable sediment only).
  - Lead at seven sites: Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Rocky Pool, Piesse Culvert and Salty Pool (leachable sediment only).
  - Vanadium at Whiteman Rd and Rocky Pool (leachable sediment only).
  - Barium, uranium and zirconium at Whiteman Rd (leachable sediment only).
  - Aluminium at Pipe Bridge (leachable sediment only).
  - Nickel at Nyaania Pool (leachable sediment only).

All metals exceedances relate to leachable concentrations in sediment. These exceedances were not observed in the corresponding dissolved metal results, indicating that the metals are largely confined to solid phase and have not partitioned into porewater at levels that pose a risk to drinking water.

Exceedances of the drinking water aesthetic DGVs were reported at most sites, predominantly due to elevated hardness, turbidity, total dissolved solids (TDS) and naturally occurring metals (aluminium, iron and manganese), as well as elevated chloride and sodium at brackish Salty Pool. Whilst these concentrations do not pose a health risk, they would make water undesirable to drink due to taste, odour or appearance.

Assessment of potential risks to drinking water requires consideration of the likelihood of the water being used for drinking as well as any treatment prior to consumption. In the Mandoon catchment, water from the dams is treated at the 165 ML/day treatment plant at Mundaring Weir before it is distributed as potable water in the Integrated Water Supply Scheme (IWSS) to Perth, the Goldfields and Agricultural Region, and parts of southwest WA. Treatment includes filtration, disinfection and compliance with Australian drinking water guidelines, effectively reducing microbial contamination and neutralising acidic water.

PFOS concentrations exceeded the drinking water DGV at several sites in the lower catchment only. These sites are located downstream of the two water supply dams, where water is not used for drinking.

Based on current findings, potential risks to human health via drinking water are unlikely.

Non-Potable Uses

Potential risks to human health via non-potable uses may exist based on the following exceedances of DGVs in water and leachable sediment:

- Elevated *E. coli* at all sites.
- Elevated PFOS at Helena Swan, Whiteman Rd, Helena Roe and Nyaania Pool.
- Elevated turbidity at ten sites: Helena Swan, Whiteman Rd, Helena Roe, Samson St, Craignish, Lower Pumpback Dam, Pipe Bridge, Cobblers Pool, LookSee Pool and Beraking Yarra.
- Slightly acidic conditions at Craignish, Lower Pumpback Dam, Cobblers Pool and Salty Pool.
- Elevated biochemical oxygen demand (BOD) at Samson St and Rocky Pool.
- Elevated total suspended solids (TSS) at Helena Roe, Craignish and Salty Pool.
- Elevated chloride at Salty Pool.
- Elevated dissolved metals at all sites, including:

- Iron at all sites.
- Aluminium at all sites (all leachable sediment only except Nyaania Pool).

Assessment of potential risks to non-potable users of the river's water requires consideration of both the likelihood of the water being used for various purposes and the ways in which people may come into contact with the water. For example, several properties downstream of the Lower Pumpback Dam and along Piesse Brook abstract water from the river for growing produce, irrigating gardens and other uses under 'riparian rights'. It is unknown whether the water is used for other non-potable purposes, such as washing or filling swimming pools, or if any treatment is undertaken on the water following abstraction, such as filtration.

A review of DWER's Water Information Register (https://maps.water.wa.gov.au/#/webmap/register) does not identify many privately licensed surface water abstractions in the lower catchment. However, private abstractions are known to occur, based on observation of pumps in the river channel and discussions with local residents. Because the lower catchment is located within an unproclaimed surface water area, these abstractions are not required to be registered or licensed.

Based on current findings, potential risks to non-potable uses may exist due to elevated microbes and naturally occurring metals (iron and aluminium) at all sites, as well as elevated PFOS in the lower catchment. Poor water quality may also pose risks, including elevated turbidity at most sites, and isolated occurrences of elevated suspended solids, biochemical oxygen demand, chloride and slightly acidic conditions.

Of particular concern are the elevated PFOS concentrations in the lower catchment and the potential impacts for nearby surface water abstractions. BNAA will report these findings to the Department of Health and DWER so they can consider notifying any users of water abstractions in the area and undertaking additional PFAS sampling in the short term to verify these results.

Recreation

Potential risks to human health via recreation may exist based on the following exceedances of DGVs in water and leachable sediment:

- Elevated *E. coli* at all sites.
- Elevated surfactants at all sites except Nyaania Pool.
- Elevated ammonia at all sites except Cobblers Pool, LookSee Pool and Piesse Culvert.
- Elevated *Enterococci* at seven sites: Helena Swan, Helena Roe, Samson St, Craignish, Lower Pumpback Dam, Piesse Culvert and Salty Pool.
- Slightly acidic conditions at Craignish, Lower Pumpback Dam, Cobblers Pool and Salty Pool.
- Elevated chloride, sodium, hardness and total dissolved solids (TDS) at Salty Pool.
- Elevated dissolved metals at all sites, including:
  - Iron at all sites.
  - Aluminium at all sites (all leachable sediment only except Nyaania Pool).
  - Manganese at eight sites: Helena Swan, Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Lower Pumpback Dam, Salty Pool and Beraking Yarra (NB: elevated total manganese in water at Craignish was not reflected in the dissolved or leachable metal results, suggesting that concentrations may not reflect bioavailable forms at that site).
  - Barium and lead at Whiteman Rd (leachable sediment only).

Assessment of potential risks to recreational users of the river requires consideration of both the likelihood of the water being used for different types of recreation and the ways in which people may come into contact with the water. For instance:

- Swimming (classified as 'primary contact') is known to occur at Rocky Pool and Nyaania Pool, but is less likely at other sites, particularly in the lower catchment. It is noted that swimming is prohibited at Rocky Pool under the *Country Areas Water Supply (CAWS)* Act By-Laws 1957.
- Kayaking (classified as 'secondary contact') is possible near the river's confluence with the Derbarl Yerrigan (Swan River); however, kayaks cannot travel much further upstream because of obstructions.

Based on current findings, potential risks to human health via recreation may exist due to elevated microbes and dissolved metals at all sites, as well as elevated ammonia and surfactants at most sites. Additional risks may arise from slightly acidic conditions at four sites and isolated elevated chloride, sodium, hardness and total dissolved solids (TDS) at Salty Pool.

Of particular concern are the potentials risks to swimmers at Rocky Pool and Nyaania Pool due to elevated *E. coli*, *Enterococci* and ammonia. BNAA will report these findings to DBCA so they can consider notifying swimmers in the area of the potential risk, for example through signage.

It is noted that the recreational DGVs are currently in the process of being updated, with draft guidance released by NHMRC in January 2026[116]. The DGVs adopted in the current assessment remain valid until the updated version is finalised and published, as NHMRC advice might change depending on input from the public consultation and any potential new information that becomes available before final publication. However, it is noted that the draft guidelines reference more stringent toxicity data for PFAS than was incorporated in the current recreational guidelines. While no exceedances of the recreational DGVs for PFAS have currently been identified, review of the data against the new guidelines (when finalised) may be warranted in the future, and conclusions may change.

Other Exposure Pathways

Although fishing is prohibited in drinking water catchments, anecdotal evidence indicates that some people may still consume fish and crustaceans from the Mandoon catchment, including recreational fishers and Noongar people sourcing traditional foods. Given the widespread prevalence of PFOS, there is a potential human health risk associated with PFAS accumulation in aquatic animals that are subsequently consumed. There are currently no guidelines to address PFAS exposure through consumption of fish or shellfish, although Food Standards Australia New Zealand has set trigger points for PFAS concentrations in fish to indicate when further investigation or dietary restrictions may be required. Further assessment is warranted wherever PFAS is present and fishing or harvesting may occur.

Potential Risks to Primary Industries

Agricultural Irrigation

Potential risks to primary industries via agricultural irrigation may exist based on the following exceedances of DGVs in water and leachable sediment:

- Elevated *E. coli* at all sites.
- Elevated dissolved metals at all sites, including:
  - Iron at all sites (long-term DGV) (NB: seven sites exceeded the short-term DGV in leachable sediment: Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Rocky Pool, Pipe Bridge and Salty Pool).
  - Aluminium at all sites except Helena Swan, Craignish and Cobblers Pool (long-term DGV, leachable sediment only) (NB: one site exceeded the short-term DGV in leachable sediment: Pipe Bridge).
  - Manganese at Whiteman Rd, Lower Pumpback Dam, Salty Pool and Beraking Yarra (long-term DGV).
  - Boron at Whiteman Rd and Nyaania Pool (leachable sediment only).
  - Uranium at Whiteman Rd (long-term DGV, leachable sediment only).
- Elevated nutrients at twelve sites, including:
  - Total phosphorus at all sites (long-term DGV).

  - Total nitrogen at eight sites: Helena Swan, Whiteman Rd, Samson St, Nyaania Pool, Craignish, Piesse Culvert, Salty Pool and Beraking Yarra (long-term DGV).
- Elevated major ions at five sites, including:
  - Chloride at Helena Swan, Whiteman Rd, Helena Roe, Samson St and Salty Pool.
  - Sodium at Helena Swan, Whiteman Rd, Helena Roe and Salty Pool.

Livestock Drinking Water

Potential risks to primary industries via livestock drinking water may exist based on the following exceedances of DGVs in water and leachable sediment:

- Elevated dissolved metals at eleven sites, including:
  - Aluminium at all sites except Helena Swan, Craignish and Cobblers Pool (leachable sediment only).
  - Barium and zirconium at Whiteman Rd (leachable sediment only).
- Elevated microbes at ten sites, including:
  - *E. coli* at ten sites: Helena Swan, Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Craignish, Lower Pumpback Dam, Rocky Pool, Piesse Culvert and Beraking Yarra.
  - *Enterococci* at two sites: Helena Swan and Helena Roe.
- Elevated PFOS at Helena Swan, Whiteman Rd, Helena Roe and Nyaania Pool.
- Elevated total dissolved solids (TDS) at Helena Swan, Whiteman Rd, Helena Roe and Salty Pool.
- Elevated magnesium at Salty Pool.

Assessment of potential risks to primary industries requires consideration of both the likelihood of the water being used for agriculture or livestock, and the manner in which it is used (e.g. frequency, volume and point of extraction). For example, Piesse Brook flows through orchards and wineries in Bickley Valley and Pickering Brook, where it may be used to irrigate crops. Similarly, several semi-rural properties in the lower catchment are used to graze cattle, sheep and goats and may rely on the river as a source of livestock drinking water.

Assessment of potential risks also requires consideration of the applicability of the DGVs. For instance:

- Livestock drinking water DGVs are not available for a number of COPC, including PFOS, barium and zirconium. Concentrations have been compared with human health drinking water DGV, which is the recommended approach when a livestock-specific guideline is unavailable, although these DGV are likely to be overly conservative. This approach also does not consider the uptake of bioaccumulative contaminants (such as PFOS) into livestock tissues, and the risks to human consumers of meat and dairy. As such, exceedances of the DGVs do not necessarily mean risk is posed to livestock or consumers of livestock products. Instead, risk assessment which specifically looks at these pathways may be warranted, for example, through the development of DGVs for specific exposure pathways.
- Long-term DGVs apply to agricultural irrigation over periods of up to 100 years, while short-term DGVs apply to shorter durations. However, because long-term water quality datasets are not available to support a 100-year assessment, short-term DGVs have also been applied in this assessment.

Consequently, catchment-specific DGVs would provide a more accurate basis for assessing potential risks.

Based on current findings, potential risks to primary industries may exist due to elevated E. coli and various dissolved metals at all sites, elevated nutrients at almost all sites, and elevated PFOS at four sites in the lower catchment. Additional risks may also arise from elevated major ions (chloride, magnesium and/or sodium) at five sites, and elevated total dissolved solids (TDS) at four sites.

Of particular concern are the elevated PFOS concentrations in the lower catchment near properties used for grazing cattle, sheep and goats. The livestock drinking water DGVs applied in this assessment do not account for bioaccumulation in animals or subsequent human consumption. Furthermore, DGVs are not currently available to assess PFOS in agricultural irrigation water, including potential uptake into food crops.

eDNA Findings

Environmental DNA (eDNA) enables detection of animals, plants and microbes through traces of genetic material shed into the environment. It has significant potential to transform biodiversity monitoring by providing broadscale, non-invasive detection of a wide range of organisms, especially those that are rare or difficult to detect using more traditional methods.

As an emerging technology, eDNA also has some limitations. These include environmental degradation of DNA, particularly in warm shallow water, gaps in DNA reference libraries, and the current inability to reliably quantify population size or abundance. Detection uncertainties can also occur, such as false positives (e.g. from scat, predator transport or downstream drift) and false negatives (e.g. when DNA concentrations are very low). In addition, gaps remain in ecological understanding of how DNA moves through the environment, and technical challenges can arise when samples are inhibited by substances such as tannins or when filtration is difficult due to turbid or high particle water.

Nonetheless, eDNA remains a valuable line of evidence because it can detect a wide range of species non-invasively and provide broad spatial coverage in a short timeframe.

Between 9-11 October 2025, water samples were collected from each site for environmental DNA (eDNA) analysis as part of a broader eDNA study of the Mandoon catchment. Three samples were collected from each site in laboratory supplied kits using the methodology presented in **Appendix 4**. Two of the samples were submitted to Wilderlab for comprehensive freshwater analysis, which includes:

- Vertebrates including fish, mammals, reptiles, amphibians and birds
- Crustaceans including crayfish, crabs, prawns and other arthropods
- Plants including land and aquatic plants
- Microbes and microeukaryotes including bacteria, algae and zooplankton
- Fungi

While the full eDNA results will be reported separately, key findings from the sites included in the current assessment are summarised in this report to provide a more comprehensive picture of river health.

The *South West Index of River Condition* (SWIRC)[88] is a toolkit developed by the Department of Water and Environmental Regulation (DWER) to assess river health in southwest Western Australia (WA). It considers six key indicators: physical form, land use, hydrology (flow), fringing vegetation (nativeness and vegetation extent), water quality (nutrients and water quality parameters), and aquatic biota. The aquatic biota assessment currently includes consideration of:

- Fish and crayfish.
- Macroinvertebrates.

The SWIRC aquatic biota assessment has been used to guide presentation of the current eDNA findings, which are summarised below and presented in **Table T4** appended at the back of this report.

Fish

Three local freshwater fish species were frequently detected in the catchment, comprising nightfish (*Bostockia porosa*), western minnow (*Galaxias occidentalis*) and western pygmy perch (*Nannoperca vittata*):

- Nightfish, western minnow and western pygmy perch at seven sites: Helena Swan, Whiteman Rd, Helena Roe, Samson St and Craignish in the lower catchment, and Cobblers Pool and Looksee Pool in the middle catchment.
- Nightfish and western minnow at Lower Pumpback Dam.
- Western minnow at Salty Pool in the upper catchment.
- Western pygmy perch at Rocky Pool on Piesse Brook.

Large nightfish found in the upper Mandoon Bilya

Two additional local species were detected in the lower catchment:

- Western hardyhead (*Leptatherina wallacei*) at Craignish (and likely Lower Pumpback Dam*).
- Sea mullet (*Mugil cephalus*) at Whiteman Rd (and likely Helena Swan*).

* Although species-level identification was not achieved, detections of the hardyhead genus (*Leptatherina*) at Craignish and Lower Pumpback Dam, and the mullet genus (*Mugil*) at Helena Swan and Whiteman Rd, are likely to correspond with the species listed above. Their presence exclusively in the lower catchment aligns with their classification as estuarine species.

The goby genus (*Pseudogobius*) was detected at seven sites: Helena Swan, Whiteman Rd, Helena Roe, Samson St and Craignish in the lower catchment, as well as Cobblers Pool and LookSee Pool in the middle catchment. Although no species-level detections were recorded, these are likely to represent local species, either the south-western goby (*Afurcagobius suppositus*) or the blue-spot goby (*Pseudogobius olorum*).

The catfish genus (*Siluriformes*) was also detected at Cobblers Pool. This detection is likely to correspond to the local freshwater cobbler (*Tandanus bostocki*), a species historically associated with this location. Its absence from other sites is expected, as this large species typically inhabits deep, permanent water bodies.

Exotic fish species were also detected across the catchment. These were dominated by eastern mosquitofish (*Gambusia holbrooki*), with additional localised detections of common carp (*Cyprinus carpio*) and redfin perch (*Perca fluviatilis*) in large permanent pools within the middle catchment, including:

- Eastern mosquitofish at ten sites: Helena Swan, Whiteman Rd, Helena Roe, Samson St, Craignish and Lower Pumpback Dam in the lower catchment, and at Rocky Pool, Cobblers Pool, Looksee Pool and Piesse Culvert in the middle catchment.
- Redfin perch at Cobblers Pool and LookSee Pool.
- Common carp at Cobblers Pool.

Eastern mosquitofish is the most widespread exotic freshwater fish in Australia, and one of the most widely introduced freshwater fish globally, and can be spread by animals. In contrast, redfin perch and common carp may have been deliberately released for illegal fishing or may represent aquarium escapees.

The results also include a few unexplained or anomalous results, including:

- The Western Australian dhufish (*Glaucosoma buergeri*), an ocean dwelling species, was the only fish detected at Nyaania Pool, suggesting contamination from human food waste or animal scat rather than a true local occurrence.

- The salmonids family (*Salmonidae*) was detected at Rocky Pool. There are no local species, suggesting the possible presence of exotic trout, which were widely introduced in the 1800s for recreational fishing, or potential contamination from human food waste or animal scat.
- The sunfishes order (*Centrarchiformes*) was detected at six sites: Helena Swan, Whiteman Rd, Helena Roe, Craignish and Lower Pumpback Dam in the lower catchment, as well as LookSee Pool in the middle catchment. These detections could be associated with local western pygmy perch or exotic redfin perch, although neither was recorded at Lower Pumpback Dam.

Crayfish

Three local crayfish species, comprising smooth marron (*Cherax cainii*), common koonac (*Cherax preissii*) and freshwater crayfish/gilgie (*Cherax quinquecarinatus*), were detected in the catchment:

- Gilgies at eight sites: Helena Swan, Whiteman Rd, Helena Roe, Samson St, Craignish and Lower Dam in the lower catchment, and at Cobblers Pool and Looksee Pool in the middle catchment.
- Koonacs at 3 sites: Helena Swan, Whiteman Rd and Helena Roe in the lower catchment.
- Marron at 3 sites (locations withheld to protect against trapping).

The exotic common yabby (*Cherax destructor*) was detected at Craignish in the lower catchment and at Rocky Pool on Piesse Brook. This eastern states species is highly invasive and can outcompete local crayfish, especially in degraded or stressed systems. It was the only crayfish recorded to species-level at Rocky Pool.

Macroinvertebrates

Carter's freshwater mussel (*Westralunio carteri*) were detected at three sites: Craignish, Lower Pumpback Dam and LookSee Pool. Additional bivalve molluscs (superorder *Palaeoheterodonta*) were also detected at Whiteman Rd and Helena Roe, although it is unknown if these relate to Carter's mussels.

The Carter's mussel is the only large freshwater bivalve in southwest WA and its range has declined by 49% in less than 50 years, largely due to salinisation and reduced water flows from a drying climate[117]. It is listed as *Vulnerable* under the *Biodiversity Conservation Act 2016*.

The EPT taxon (Ephemeroptera, Plecoptera, Trichoptera) is widely used as an indicator of good water quality due to its sensitivity to pollution, sedimentation and habitat disturbance. EPT detections were as follows:

- Caddisflies (order *Trichoptera*) at eight sites: Helena Swan, Whiteman Rd Helena Roe, Nyaania, Rocky Pool, Cobblers Pool, LookSee Pool and Piesse Culvert.
- Mayflies (order *Ephemeroptera*) at five sites: Nyaania Pool, Rocky Pool, Pipe Bridge, Cobblers Pool, LookSee Pool
- Stoneflies (order *Plecoptera*) at one site: Rocky Pool.

Other notable aquatic macroinvertebrate observations included:

- Dragonflies and damselflies (order *Odonata*) at almost all sites, except Lower Pumpback Dam, Pipe Bridge, Salty Pool and Beraking Pool.
- Predacious diving beetles (family *Dytiscidae*) at almost all sites, except Samson St, Nyaania Pool, Craignish and Pipe Bridge.
- Water boatmen (family *Corixidae*) at LookSee Pool and Piesse Culvert.
- Water scavenger beetle (genus *Berosus*) at Pipe Bridge.
- Australian water moth (*Hygraula nitens*) at Piesse Culvert.
- Freshwater limpets (subfamily *Ancylinae*) at eight sites: Helena Swan, Whiteman Rd, Helena Roe, Samson St, Nyaania Pool, Rocky Pool, LookSee Pool and Beraking Yarra.
- Freshwater snails (superfamilies *Cerithioidea* and *Lymnaeoidea*) at almost all sites except Craignish, Pipe Bridge, Salty Pool and Beraking Yarra.

- Pea mussels (family *Sphaeriidae*) at Piesse Culvert.

Detections of species that are endemic to southwest Western Australia included:

- *Palaemon australis* (south-west glass shrimp) at Craignish, Cobblers Pool and LookSee Pool.
- *Paramphisopus palustris* at Helena Swan, Whiteman Rd, Helena Roe, Samson St and LookSee Pool – an endemic freshwater isopod that is restricted to the Perth region and is often abundant in the groundwater-fed wetlands of the Swan Coastal Plain.
- *Newmanoperla exigua* at Rocky Pool – an endemic species of stonefly that is typically used as an indicator of river health, although it has shown higher tolerance to environmental stressors like low oxygen compared to other stoneflies.

Detections of known introduced species included:

- Indistinct river shrimp (*Caridina indistincta B*) at Whiteman Rd, Helena Roe and Craignish.
- Bladder snail (*Physella acuta*) at seven sites: Helena Swan, Whiteman Rd, Helena Roe, Samson St, Rocky Pool, LookSee Pool and Piesse Culvert (and likely Nyaania Pool and Lower Pumpback Dam*).
- American ribbed fluke snail (*Pseudosuccinea columella*) at Piesse Culvert.
- Ram's horn freshwater snail (*Gyraulus convexiusculus*) at Helena Swan (and likely Samson St*).

* Although species-level identification was not achieved, detections of the *Physella* genus at Nyaania Pool and Lower Dam and the *Gyraulus* genus at Samson St are likely to correspond with the species listed above.

P. columella is a significant pest due to its role as an intermediate host for the liver fluke parasite (Fasciola hepatica), which can cause serious illness in sheep, cattle, horses, and, in rare cases, humans. The establishment of these snails increases the risk of liver fluke spreading in WA. As an introduced species that poses a biosecurity risk to agriculture, *P. columella* is considered a declared animal in Western Australia. This finding has been reported to the Department of Primary Industries and Regional Development (DPIRD).

Other

Other notable detections included:

- Yagyn / snake-necked turtle (*Chelodina oblonga*) at Helena Swan, Whiteman Rd, Helena Roe, Samson St and LookSee Pool.
- Ticking frog (*Geocrinia leai*) at Rocky Pool.
- Western banjo frog (*Limnodynastes dorsalis*) at Craignish and Piesse Culvert.
- Humming frog (*Neobatrachus pelobatoides*) at Salty Pool.
- Crawling toadlet (*Pseudophryne guentheri*) at Whiteman Rd, Helena Roe and Craignish.
- Australian froglets (genus *Crinia*) at Nyaania Pool Rocky Pool, Piesse Culvert and Beraking Yarra.
- Burrowing frogs (genus *Heleioporus*) at Samson St, Salty Pool and Beraking Yarra.
- Likely motorbike frog (*Litoria moorei*) at Helena Swan, Whiteman Rd, Helena Roe, Samson St and Craignish.

Summary

The eDNA results indicated the presence of key indicator species for healthy rivers in southwest WA at most sites at most sites, including several in the lower catchment where water quality is generally poorer.

The widespread detection of local fish and crayfish is a positive sign of habitat condition and suggests that exotic species are not dominating the ecosystem. Local fish and crayfish were not detected at Nyaania Pool, Pipe Bridge, Piesse Culvert or Beraking Yarra, although this does not necessarily confirm their absence.

The *Vulnerable* Carter's freshwater mussel was detected at three sites in the lower and middle catchment, confirming that the river contains to provide critical habitat for this threatened species.

Macroinvertebrate diversity was highest at Rocky Pool, a site characterised by fast-flowing water and high dissolved oxygen. It was where stoneflies (*Plecoptera*) were detected alongside mayflies (Ephemeroptera) and caddisflies (Trichoptera). These taxa are strong indicators of good water quality, high habitat complexity, and intact native riparian vegetation. Mayflies and caddisflies were also detected at Nyaania Pool, consistent with its fast-flowing water and well-oxygenated conditions, as well as at Cobblers Pool and Looksee Pool.

The EPT taxon (Ephemeroptera, Plecoptera, Trichoptera) was not detected at several sites in both the lower catchment and upper catchment, possibly reflecting lower dissolved oxygen levels in these areas.

Macroinvertebrate density was lowest at Salty Pool and Beraking Yarra in the upper catchment, likely due to a combination of low dissolved oxygen, elevated tannins and localised brackish conditions.

Rakali (native water rat) was not detected at any site.


High quality fringing vegetation along the upper Mandoon Bilya

Recommendations

It is recommended to undertake similar sampling in September 2026 to enable comparison of results and to build a three-year baseline. This is particularly important for sites sampled only in 2025 (Samson St and Nyaania Pool) and for analyses introduced for the first time in 2025, especially dissolved metals. It will also help determine whether the variations observed in 2025 represent emerging trends or natural variability.

Consideration should also be given to undertaking the following additional work:

- Additional sampling sites downstream of the Lower Pumpback Dam, to better characterise poor water quality in the lower catchment, as well as along Piesse Brook, to assess nutrient inputs to the Lower Pumpback Dam drinking water source.
- Analysis of total iron and chromium III concentrations, rather than dissolved, to align with new DGVs.
- Analysis of microplastics, trifluoroacetic acid (TFA) and/or other emerging contaminants of concern.
- Additional sampling events during low flow conditions, such as following the first heavy rains after summer (approximately April-June).
- Salinity testing in the upper catchment during both low and high flows, targeting both surface and bottom waters to assess potential stratification.
- Passive sampling to assess the presence of herbicides and pesticides at low concentrations.
- Development of catchment-specific DGVs to improve risk assessment, including consideration of the cultural and spiritual values of the river to Noongar people.
- Detailed risk assessment and/or ecotoxicology testing to determine actual impacts, including exposure pathways that are specific to Noongar people during cultural practices.

Tables

Nyaania Pool site on Nyaania Creek, tributary of the lower river

BoorYul-Bah-Bilya (Mandoon Bilya-Helena River)
LHAAC Water and Sediment Sampling, 2024-2025
Table T1a Field Measured Parameters 2025

Group	Parameter	Default Guideline Values for Freshwater Ecosystems	Helena Swan	Whiteman Rd	Helena Roe	Samson St	Nyaania Pool	Craignish US	Lower Pumpback Dam	Rocky Pool	Pipe Bridge	Cobblers Pool	LookSee Pool	Piesse Culvert	Salty Pool	Beraking Yarra
Location	Altitude (m AHD)		19.9	26.3	27.4	-	-	32.9	40.8	85.9	86.1	92.8	108.0	252.3	257.1	262.0
	Latitude		-31.89708	-31.90006	-31.90540	-31.91924	-31.93108	-31.93560	-31.94179	-31.95366	-31.93825	-31.94693	-31.94991	-32.03306	-31.93913	-32.18171
	Longitude		115.98581	116.00762	116.01589	116.03736	116.06919	116.06864	116.07608	116.07148	116.12176	116.13484	116.14592	116.13711	116.51495	116.43514
Weather	Date		23.9.25	23.9.25	23.9.25	23.9.25	23.9.25	22.9.25	22.9.25	23.9.25	22.9.25	22.9.25	22.9.25	22.9.25	22.9.25	22.9.25
	Time		14:05	12:45	11:20	10:25	9:40	17:10	16:30	8:08	15:20	14:20	13:25	7:35	11:05	9:10
	Description		Sunny, no clouds, still, very warm	Sunny, no clouds, still, warm	Sunny, no cloud, light breeze, warm	Sunny, no cloud, light breeze	Sunny, no cloud, light breeze	Sunny, no cloud, light breeze	Sunny, no cloud, light breeze, warm	Sunny, no clouds, still	Sunny, no cloud, light breeze, warm	Sunny, no cloud, light breeze, warm	Sunny, no cloud, light breeze	Sunny, no clouds, still	Sunny, no cloud, light breeze	Sunny, no cloud, light breeze
	Air Temperature (°C)		27.0	25.9	24.2	23.1	21.7	21.9	24.2	16.4	-	-	23.2	11.3	19.9	14.2
	Humidity (%)		33%	33%	34%	36%	38%	33%	31%	51%	-	-	33%	76%	49%	64%
	Rain (mm)		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Quality Parameters	Water Depth (m)		0.6	0.4	0.8 - 1.0	0.2 - 0.4	1.0*	1.0*	0.15	1.0*	0.6 - 0.7	1.0*	1.0*	0.18	0.6 - 0.8	1.0
	Water Temperature (°C)		17.4	17.4	16.6	16.1	15.0	16.0	15.8	14.7	16.3	14.8	14.7	15.5	13.7	12.2
	Conductivity Field (uS/cm)	>120-300[#A]	938	960	973	690	578.3	483.6	322.3	367.0	391.1	458.5	419.2	397.7	11,194	143.3
	Conductivity Laboratory (uS/cm)	>120-300[#A]	1,000	1,000	1,000	730	620	430	320	390	400	470	560	430	11,000	150
	Dissolved Oxygen Field (%, optical)	<80[#A]	62.8	67.9	56.4	78.9	89.4	49.0	44.9	97.8	64.9	62.9	68.2	75.3	31.9	43.1
	Dissolved Oxygen Field (mg/L, optical)	<4[#B]	6.00	6.49	5.48	7.77	9.00	4.83	4.45	9.91	6.34	6.35	6.90	7.53	3.18	4.82
	pH Field	6.5-8.0[#A]	7.00	7.03	7.02	6.75	7.89	6.31	6.41	7.48	6.66	6.49	6.61	6.60	6.32	6.70
	pH Laboratory*	6.5-8.0[#A]	6.9	6.9	6.9	6.5	6.6	6.3	6.4	6.9	6.3	6.3	6.4	6.2	6.5	6.5
	Salinity Field (ppm)		-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Salinity Laboratory (mg/L)		470	480	480	350	290	200	150	180	190	220	270	200	5,400	70
	Redox (ORP) Field (mV)		103.7	98.2	80.5	80.7	103.1	79.0	57.0	94.0	72.8	73.2	89.3	86.6	41.1	81.2
	Total Dissolved Solids Field (mg/L)		611.0	624.0	630.5	448.5	375.7	314.6	209.3	238.6	254.2	297.7	319.2	258.1	7280.0	93.0
	Total Dissolved Solids Laboratory (mg/L)		600	610	620	440	370	250	180	240	230	250	280	240	5,300	130
	Turbidity Field (NTU)	<10-20[#A]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Turbidity Laboratory (NTU)	<10-20[#A]	15	11	13	12	4	13	9.8	3.9	6.4	7.0	5.6	1.4	3.3	4.1

Notes

123	Concentration is at or above the default guideline value for freshwater ecosystems
-	Weather unable to be recorded without phone signal, water quality meter used in 2025 was unable to measure air pressure, salinity and turbidity.
1.0*	Not possible to measure pool depth, greater than 1 metre

NTU Nephelometric Turbidity Units
ORP Oxidation Reduction Potential

Where available, laboratory measured field parameters are presented for comparison.
* pH recorded in the laboratory differs from that recorded in the field, likely because the laboratory test must begin within 30 minutes of sampling. As such, only DGV exceedances in the field measured pH are highlighted.
Default guideline values (DGV) for freshwater ecosystems are presented for comparison. Refer Tables T2a-b for a full screen against DGVs.
Specific conductance is a conductivity measurement made at or corrected to 25° C. This is the standardized method of reporting conductivity as water temperature affects conductivity.
Total dissolved solids dried at 180°C + 2°C by the laboratory.
Altitude derived from Landgate topography mapping at 5 m contour intervals.

ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1 The Guidelines. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand. October 2000.
#A ANZECC (2000) Default trigger values for base flow in lowland rivers and slightly disturbed ecosystems in south west Australia, refer Table 3.3.6 and 3.3.7.
#A* pH recorded in the laboratory differs from that recorded in the field, likely because the laboratory test must begin within 30 minutes of sampling, which was not possible.
#B DWER (2020) South West Index of River Condition (SWIRC), <4 mg/L is considered to be the lower limit for dissolved oxygen when assessing river condition.

BoorYul-Bah-Bilya (Mandoon Bilya-Helena River)
LHAAC Water and Sediment Sampling, 2024-2025
Table T1b Field Measured Parameters 2024

Group	Parameter	Default Guideline Values for Freshwater Ecosystems	Helena Swan	Whiteman Rd	Helena Roe	Craignish US	Lower Pumpback Dam	Rocky Pool	Pipe Bridge	Cobblers Pool*	LookSee Pool	Piesse Culvert	Salty Pool*	Beraking Yarra
Location	Altitude (m AHD)		19.9	26.3	27.4	32.9	40.8	85.9	86.1	92.8	108.0	252.3	257.1	262.0
	Latitude		-31.89708	-31.89997	-31.90541	-31.93554	-31.94179	-31.95366	-31.93834	-31.94693	-31.94991	-32.03209	-31.93916	-32.18183
	Longitude		115.9858	116.0075	116.0160	116.0687	116.0761	116.0716	116.1217	116.1348	116.1459	116.1370	116.5150	116.4349
Weather	Date		16.09.24	18.09.24	16.09.24	16.09.24	16.09.24	16.09.24	17.09.24	17.09.24	17.09.24	16.09.24	17.09.24	17.09.24
	Time		16:15	10:20	15:15	14:15	13:15	10:35	14:15	15:00	15:30	8:30	10:15	11:45
	Description		Sunny, no clouds, light breeze	Sunny, no clouds, light breeze	Sunny, no clouds, light wind	Sunny, no clouds, light wind	Sunny, no clouds, light wind	Sunny, no clouds, light wind	Sunny, no clouds, still	Sunny, no clouds, still	Sunny, no clouds, still	Sunny, no clouds, light wind	Sunny, no clouds, still	Sunny, no clouds, still
	Air Temperature (°C)		20.7	20.1	22.0	21.3	21.5	19.5	-	-	22.4	14.1	-	23.9
	Humidity (%)		38	51	36	43	37	42	-	-	29	65	-	23
	Rain (mm)		0	0	0	0	0	0	0	0	0	0	0	0
	Wind (kmph)		11-13 E	9-11 SW	15-20 NE	15-24 NE	20-26 NE	26 NE	-	-	13-19 NE	30 NE	-	11-24 NW
Water Quality Parameters	Air Pressure (mmHg)		767.4	765.1	767	766.4	766.7	763.8	756.6	755	754.9	750.1	745	743.6
	Water Depth (m)		0.534	0.518	0.464	0.324	0.321	0.549	0.209	0.794	0.362	0.106	0.292	0.273
	Water Temperature (°C)		16.8	16.5	17.2	17.0	15.6	16.4	17.0	15.4	15.4	16.2	13.4	12.8
	Conductivity Field (uS/cm)	>120-300[#A]	1,095	1,176	1,128	498.3	442.6	415.8	509	591	648	420	8,274	161.7
	Conductivity Laboratory (uS/cm)	>120-300[#A]	1,200	1,300	1,200	520	460	440	540	630	700	450	8,600	170
	Dissolved Oxygen Field (%, optical)	<80[#A]	54.8	56.5	59.1	59.3	27.6	96.9	94.4	69.3	70.5	101.4	46.9	36.4
	Dissolved Oxygen Field (mg/L, optical)	<4[#B]	5.30	5.50	5.67	5.71	2.76	9.47	9.10	6.93	7.04	9.95	4.75	3.85
	pH Field	6.5-8.0[#A]	6.76	6.64	6.73	6.24	6.49	7.43	6.73	6.44	6.52	6.91	6.58	6.91
	pH Laboratory*	6.5-8.0[#A]	7.1	6.8	6.6	6.3	6.6	6.0	6.1	6.3	6.0	5.9	6.3	6.2
	Salinity Field (ppm)		550	590	560	240	210	200	250	290	320	200	4,620	80
	Salinity Laboratory (mg/L)		530	560	540	240	210	200	240	280	310	200	3,900	76
	Redox (ORP) Field (mV)		131.3	158.9	106.4	89.1	83.1	145.2	132.4	171.1	152.0	182.7	218.2	187.9
	Total Dissolved Solids Field (mg/L)		712	764	733	288	325	271	331	384	421	273	5,390	105
	Total Dissolved Solids Laboratory (mg/L)		700	760	710	310	280	270	320	380	420	270	5,200	100
	Turbidity Field (NTU)	<10-20[#A]	17.59	14.70	17.80	28.77	12.24	0.30	1.11	2.24	2.08	0.61	0.69	5.14
	Turbidity Laboratory (NTU)	<10-20[#A]	18	10	19	36	17	2.2	3.7	4.3	3.7	2.1	2.6	6.9

Notes

123	Concentration is at or above the default guideline value for freshwater ecosystems
-	Weather unable to be recorded without phone signal

NTU	Nephelometric Turbidity Units
ORP	Oxidation Reduction Potential

Where available, laboratory measured field parameters are presented for comparison.
* pH recorded in the laboratory differs from that recorded in the field, likely because the laboratory test must begin within 30 minutes of sampling. As such, only DGV exceedances in the field measured pH are highlighted.
Default guideline values (DGV) for freshwater ecosystems are presented for comparison. Refer Tables T2a-b for a full screen against DGVs.
Water quality meter unable to measure air pressure, pH mV, salinity and turbidity in 2025.
Specific conductance is a conductivity measurement made at or corrected to 25° C. This is the standardized method of reporting conductivity as water temperature affects conductivity.
Total dissolved solids dried at 180°C + 2°C by the laboratory.
Altitude derived from Landgate topography mapping at 5 m contour intervals.

* Salty Pool is referred to as Helena Pony in field notes and laboratory documentation.
* Cobblers Pool is referred to as Skeleton Pool in field notes and laboratory documentation.

ANZECC (2000)	Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1 The Guidelines. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand. October 2000.
#A	ANZECC (2000) Default trigger values for base flow in lowland rivers and slightly disturbed ecosystems in south west Australia, refer Table 3.3.6 and 3.3.7.
#A*	pH recorded in the laboratory differs from that recorded in the field, likely because the laboratory test must begin within 30 minutes of sampling, which was not possible.
#B	DWER (2020) South West Index of River Condition (SWIRC), <4 mg/L is considered to be the lower limit for dissolved oxygen when assessing river condition.

BoorYul-Bah-Bilya (Mandoon Bilya-Helena River)
LHAAC Water and Sediment Sampling, 2024-2025
Table T2a Water Sampling Results 2025

		Default Guideline Values (DGVs)																								
		Freshwater Ecosystem			Human Health				Primary Industries																	
Group	Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Livestock Watering	LOR (mg/L)	Helena Swan	Whiteman Rd	Helena Roe	Samson St	Nyaania Pool	Craignish US	Lower Pumpback Dam	Rocky Pool	Pipe Bridge	Cobblers Pool	LookSee Pool	Piesse Culvert	Salty Pool	Beraking Yarra
Major Ions	Calcium										1,000[#E]	< 0.5	30	30	30	13	11	6.8	11	10	4.7	5.6	7.2	12	150	4.9
	Chloride (filtered)					250[#A7]	250[#C]	400[#D]	175[#F1]	175[#F2]		< 5	220	240	240	190	160	110	62	77	88	110	140	67	4,100	26
	Fluoride	0.29[#H]			1.5[#A]		15[#C]	15[#C]	1[#F1]	2[#F2]	2[#J5]	< 0.1	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.5	0.3
	Magnesium										125[#J6]	< 0.5	21	21	21	13	10	8.9	6.2	5.9	6.7	7.8	8.6	6.7	520	2.9
	Potassium											< 0.5	4.4	4.3	3.9	2.7	3.1	2.1	2.8	3.2	1.8	2.0	2.2	4.5	4.8	2.4
	Sodium				NN	180[#A9]		300[#D]	115[#F1]	115[#F2]		< 0.5	110	110	110	79	75	44	38	43	53	59	68	41	1,500	16
	Sulphate (as SO4)					250[#A10]	1,000[#C]	400[#D]			250[#J4]	< 1	62	57	37	27	26	12	17	27	17	20	22	34	190	< 1
Nutrients	Ammonia-N	0.32[#G2]					0.388[#C]	0.01[#D]				< 0.02	0.06	0.11	0.18	0.04	0.04	0.04	0.03	0.04	0.03	< 0.02	< 0.02	< 0.02	0.06	0.04
	Nitrate-N	0.64-1.0[#H4]			11[#A5]		113[#C]	10[#D]			25[#J3]	< 0.01	0.20	0.20	0.14	0.11	0.25	< 0.01	< 0.01	1.3	0.03	0.06	0.04	5.7	< 0.01	< 0.01
	Nitrite-N				0.9[#A6]		9.12[#C]	1[#D]			10[#J3]	< 0.01	0.01	0.02	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Total Oxidised Nitrogen (as NOx-N)	0.15[#G3]										< 0.01	0.21	0.21	0.16	0.12	0.25	< 0.01	< 0.01	1.3	0.03	0.06	0.04	5.7	< 0.01	< 0.01
	Total Kjeldahl Nitrogen											< 0.2	0.4	0.4	0.5	0.4	0.3	0.4	0.2	< 0.2	2.3	0.2	0.3	< 0.2	1.1	1.2
	Nitrogen (organic)											< 0.2	0.3	0.3	0.4	0.3	0.2	0.4	0.2	< 0.2	2.2	0.2	0.3	< 0.2	1.0	1.2
	Nitrogen (total)	1.2[#G3]	1.0[#O1]	<10[#N]					5[#F1]	25[#F2]		< 0.2	0.6	0.6	0.7	0.5	0.5	0.4	0.2	1.3	2.3	0.3	0.3	5.7	1.1	1.2
	Phosphorus (filterable reactive)	0.04[#G3]										< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.07	< 0.01
	Phosphorus (total)	0.065[#G3]	0.1[#O2]	<2[#N]					0.05[#F1]	0.8[#F2]		< 0.01	0.04	0.03	0.04	0.03	0.10	0.07	0.06	0.02	0.05	0.03	0.04	0.03	0.07	0.05
Metals (Filtered / Dissolved)**	Aluminium	0.027[#H7]			20[#B]	0.2[#A]	0.2[#C]	0.2[#D]	5[#F1]	20[#F2]	3.6[#J1]	< 0.05	< 0.05	< 0.05	0.06	0.07	0.20	0.06	< 0.05	0.09	0.12	0.10	0.09	< 0.05	< 0.05	0.15
	Barium				2[#A]		20[#C]	1[#D]			2[#E1]	< 0.01	0.06	0.06	0.06	0.04	0.02	0.03	0.04	0.03	0.02	0.02	0.02	0.03	0.11	0.02
	Boron	0.09[#G]			4[#A]		40[#C]	1[#D]	0.5[#F1]	0.5[#F2]	5[#J]	< 0.05	0.05	0.06	0.06	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
	Cobalt	0.0014[#H3]			0.006[#B]				0.05[#F1]	0.1[#F2]	1[#J]	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	0.001
	Copper	0.001[#H]			2[#A]	1[#A]	20[#C]	1[#D]	0.2[#F1]	5[#F2]	0.5[#J2]	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.003	0.002	0.005
	Iron	0.14[#H5]			14[#B]	0.3[#A]	0.3[#C]	0.3[#D]	0.2[#F1]	10[#F2]	NST	< 0.01	0.95	0.87	0.81	0.54	0.16	0.78	1.2	0.10	0.28	0.32	0.22	0.01	0.29	0.63
	Lithium				0.04[#B]						0.04[#E1]	< 0.001	< 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001
	Manganese	1.2[#H]			0.5[#A]	0.1[#A]	5[#C]	0.1[#D]	0.2[#F1]	10[#F2]	10[#J]	< 0.005	0.10	0.11	0.13	0.057	0.008	0.053	0.12	0.010	0.017	0.012	0.010	0.011	0.220	0.240
	Nickel	0.008[#H]			0.02[#A]		0.2[#C]	0.1[#D]	0.2[#F1]	2[#F2]	1[#J]	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.003	< 0.001
	Titanium											< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.007	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
	Vanadium	0.006[#H3]			0.086[#B]				0.1[#F1]	0.5[#F2]	0.1[#J]	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.006	0.006	< 0.005	0.005	0.005	< 0.005	< 0.005	< 0.005	0.007
	Zinc	0.0024[#H]			6[#B]	3[#A]	3[#C]	5[#D]	2[#F1]	5[#F2]	20[#J]	< 0.005	0.010	< 0.005	0.006	0.010	0.006	0.006	0.011	0.005	< 0.005	0.007	< 0.005	0.010	< 0.005	0.007
Microbes	Heterotrophic Plate Count at 37°C (total)											<20 CFU/ml	3,600	2,900	3,600	2,500	1,200	480	1,700	1,300	740	1,100	2,200	18,000	1,800	2,300
	Total Coliforms											<1 CFU/100ml	1,400	230	2,200	260	2,900	130	390	140	460	390	670	3,400	2,100	4,100
	Escherichia coli (E. coli)[#V]			<10[#N]	Detection[#A4]		1[#L]	1[#L]	10[#F3]	10[#F3]	100[#E]	<1 CFU/100ml	120	230	460	260	120	36	15	140	64	12	10	130	35	130
	Enterococci				Detection[#A4]			60-100[#D1]			100[#E]	<1 CFU/100ml	61	50	66	79	53	13	4	23	7	9	9	49	58	59
	Thermophilic Amoeba				Detection[#A4]							D/ND / 250ml	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Thermophilic *Naegleria sp.*				Detection[#A4]							D/ND / 250ml	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Naegleria fowleri				Detection[#A4]							D/ND / 250ml	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Herbicides & Pesticides**	Acidic Herbicides											Various ug/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Base Neutral Pesticides											Various ug/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Organochloride & Organophosphate Pesticides											Various ug/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	See below	See below	< LOR	< LOR	See below
	Dieldrin	0.01[#H3]			0.3[#A1]		3[#C1]	1[#D]			0.3[#E1]	< 0.001 ug/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	0.002	< 0.001	< 0.001	0.001
Hydrocarbons**	Total Recoverable Hydrocarbons (TRH)											Various	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	BTEX Compounds											Various	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Polycyclic Aromatic Hydrocarbons (PAH)											< 0.001	< 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Per- and Polyfluoroalkyl Substances (PFAS)**	Perfluorobutanoic acid (PFBA)[#T]											< 0.005 ug/L	0.012	0.012	0.010	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
	Perfluoropentanoic acid (PFPeA)[#T]											< 0.001 ug/L	0.023	0.023	0.015	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluorohexanoic acid (PFHxA)[#T]											< 0.001 ug/L	0.017	0.015	0.010	0.002	0.003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluoroheptanoic acid (PFHpA)[#T]											< 0.005 ug/L	0.007	0.007	0.006	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
	Perfluorooctanoic acid (PFOA)[#T]	19[#Q]			0.2[#A]		0.2[#M]	10[#P]			0.2[#E1]	< 0.001 ug/L	0.012	0.013	0.013	0.003	0.003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluorobutanesulfonic acid (PFBS)[#T]				1[#A]		1[#M]				1[#E1]	< 0.001 ug/L	0.005	0.006	0.005	0.003	0.003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluorooctanesulfonic acid (PFOS)[#T]	0.0005-0.02[#H6]			0.008[#A]		0.008[#M]	2[#P]			0.008[#E1]	< 0.0001 ug/L	0.039	0.040	0.045	0.0070	0.0083	0.0006	0.0010	0.0025	0.0007	0.0013	0.0012	0.0003	0.0003	0.0004
	Perfluoropropanesulfonic acid (PFPrS)[#U]											< 0.001 ug/L	0.001	0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluoropentanesulfonic acid (PFPeS)[#U]											< 0.001 ug/L	0.004	0.005	0.004	0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluorohexanesulfonic acid (PFHxS)[#T]				0.03[#A]		0.03[#M]	2[#P]			0.03[#E1]	< 0.001 ug/L	0.024	0.023	0.022	0.009	0.010	< 0.001	< 0.001	0.004	< 0.001	0.001	0.001	< 0.001	< 0.001	< 0.001
	Perfluoroheptanesulfonic acid (PFHpS)[#U]											< 0.001 ug/L	0.001	0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Sum PFAS (n=30)											< 0.005 ug/L	0.15	0.15	0.13	0.025	0.029	< 0.005	< 0.005	0.007	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
	Sum WA DWER PFAS (n=10)											< 0.005 ug/L	0.139	0.139	0.126	0.024	0.0273	< 0.005	< 0.005	0.0065	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Surfactants	Methylene Blue Active Substance (MBAS)							0.2[#D]				< 0.2	0.26	0.66	0.26	0.20	0.16	0.23	0.50	0.59	0.21	0.55	0.53	0.54	0.84	0.69
Water Quality Parameters	Alkalinity - Bicarbonate (as CaCO3)											< 5	74	83	85	39	31	24	33	22	19	22	23	15	36	28
	Alkalinity - Carbonate (as CaCO3)											< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
	Alkalinity - Hydroxide (as CaCO3)											< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
	Alkalinity - Total (as CaCO3)											< 5	74	83	85	39	31	24	33	22	19	22	23	15	36	28
	Biochemical Oxygen Demand			20[#N]			10[#S2]					< 5	< 5	< 5	< 5	12	< 5	< 5	< 5	11	< 5	5.0	< 5	< 5	< 5	< 5
	Colour											< 5 PCU	62	37	39	25	13	22	13	< 5	21	18	15	< 5	43	100
	Conductivity (field measured at 25°C)	>120-300[#G3]										< 10 uS/cm	938	960	973	690	578.3	483.6	322.3	367.0	391.1	458.5	419.2	397.7	11,194	143.3
	Conductivity (lab measured at 25°C)	>120-300[#G3]										< 10 uS/cm	1,000	1,000	1,000	730	620	430	320	390	400	470	560	430	11,000	150
	Dissolved Oxygen (optical)	<80[#G3]										%	62.8	67.9	56.4	78.9	89.4	49.0	44.9	97.8	64.9	62.9	68.2	75.3	31.9	43.1
	Dissolved Oxygen (optical)	<4[#W]										mg/L	6.00	6.49	5.48	7.77	9.00	4.83	4.45	9.91	6.34	6.35	6.90	7.53	3.18	4.82
	Hardness (equivalent CaCO3/L)					200[#A8]		500[#D]				< 5	160	160	160	88	69	54	46	49	40	46	53	57	2,000	24
	pH (field measured)	6.5-8.0[#G3]		6.5-8.5[#N]	6.5-8.5[#A]		6.5-8.5[#S1]	6.5-8.5[#D]	6-8.5[#F]	6-8.5[#F]		< 0.1 pH	7.00	7.03	7.02	6.75	7.89	6.31	6.41	7.48	6.66	6.49	6.61	6.60	6.32	6.70
	pH (lab measured)*	6.5-8.0[#G3]		6.5-8.5[#N]	6.5-8.5[#A]		6.5-8.5[#S1]	6.5-8.5[#D]	6-8.5[#F]	6-8.5[#F]		< 0.1 pH	6.9	6.9	6.9	6.5	6.6	6.3	6.4	6.9	6.3	6.3	6.4	6.2	6.5	6.5
	Salinity at 25°C (lab measured)											< 10	470	480	480	350	290	200	150	180	190	220	270	200	5,400	70
	Total Dissolved Solids (field measured)					600[#A]		1,000[#D]			500[#J]	-	611.0	624.0	630.5	448.5	375.7	314.6	209.3	238.6	254.2	297.7	319.2	258.1	7,280.0	93.0
	Total Dissolved Solids (dried at 180°C + 2°C)					600[#A]		1,000[#D]			500[#J]	< 5	600	610	620	440	370	250	180	240	230	250	280	240	5,300	130
	Total Organic Carbon											< 5	8.9	< 5	7.9	7.3	5.8	6.2	< 5	< 5	6.2	5.4	5.3	< 5	18	25
	Total Suspended Solids (dried at 103-105°C)			30[#N]			10[#S2]					< 5	6.0	<5	24	6.0	<5	<5	6.0	<5	<5	<5	<5	<5	12	7.0
	Turbidity (lab measured)	>10-20[#G3]				5[#A11]	5[#S1]					< 0.1 NTU	15	11	13	12	4	13	9.8	3.9	6.4	7.0	5.6	1.4	3.3	4.1

BoorYul-Bah-Bilya (Mandoon Bilya-Helena River)
LHAAC Water and Sediment Sampling, 2024-2025
Table T2a Water Sampling Results 2025

Notes

123	Concentration is at or above the DGV for primary industries
123	Concentration is at or above the DGV for freshwater ecosystems
123	Concentration is at or above the DGV for freshwater ecosystems and primary industries
123	Concentration is at or above the DGV for recreation & swimming
123	Concentration is at or above the DGV for human health and primary industries and/or freshwater ecosystems
< LOR	Concentration not detected above the laboratory limit of reporting

All units in mg/L unless otherwise specified.

Abbreviations

CFU = Colony Forming Unit
D = Detected
PCU = Platinum-Cobalt Units (measure of colour)
ND = Not Detected
NTU = Nephelometric Turbidity Units

Metals analysis methods differed between 2025 and 2024, so the results cannot be directly compared. 2025 analysis = dissolved metals concentrations from field filtered samples. 2024 analysis = total metal concentrations from unfiltered samples. Dissolved metals analysis was undertaken in 2025 to assess bioavailability - a better metric for risk assessment.

** Only analytes with detectable concentrations are shown. Other contaminants were not detected above the laboratory limit of reporting (< LOR) as detailed below. Refer laboratory documentation for a full list of analytes and limits of reporting.
The following **metals and other inorganics** were not detected at any location: antimony, arsenic, beryllium, cadmium, chromium, chromium III, chromium VI, cyanide, lead, mercury, molybdenum, selenium, silver, thallium, thorium, tin and zirconium.
The following **acidic herbicides** were not detected at any location: 2.4-D, 2.4.5-T, 2.4.6-T, Clopyralid, Dicamba, Fluazifop, MCPA, Metsulfuron Methyl, Picloram and Triclopyr.
The following **base neutral pesticides** were not detected at any location: Amitraz, Atrazine, Azinphos Methyl, Chlorpyrifos, Diclofop Methyl, Dimethoate, Diuron, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Fenamiphos, Fenitrothion, Fluometuron, Hexazinone, Metolachlor, Molinate, Myclobutanil, Prometryn, Propazine, Propiconazole, Simazine, Tebuconazole, Terbutryn and Trifluralin.
The following **organochloride & organophosphate pesticides** were not detected at any location: Aldrin, BHC (HCH), Bifenthrin, Bromophos Ethyl, Chlordane, Chlorothalonil, Chlorpyrifos, Diazinon, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Endrin, Ethion, Fenitrothion, Fipronil, Hexachlorobenzene (HCB), Heptachlor Epoxide, Heptachlor, Lindane, Malathion, Methoxychlor, o.p-DDT, Oxychlordane, p.p-DDD, p.p-DDE, p.p-DDT, Parathion Ethy, Parathion Methy, Trifluralin and Vinclozolin.
The following **total recoverable hydrocarbon (TRH)** fractions were not detected at any location: C6-C9, C10-C14, C15-C28, C29-C36, C10-C36 and C6-C10, C6-C10 (F1) less BTEX, >C10-C16, >C10-C16 (F2) less naphthalene, >C16-C34, >C34-C40, >C10-C40.
The following **BTEX compounds** were not detected at any location: Benzene, Toluene, Ethylbenzene, m&p-Xylenes, o-Xylenes and Xylenes.
The following **polycyclic aromatic hydrocarbons (PAH)** were not detected at any location: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b&j)fluoranthene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a.h)anthracene, Fluoranthene, Fluorene, Indeno(1.2.3-cd)pyrene, Naphthalene, Phenanthrene, Pyrene and Total PAH.
The following **per- and polyfluoroalkyl substances (PFAS)** were not detected at any location:
Perfluoroalkyl carboxylic acids (PFCAs): Perfluorononanoic acid (PFNA), Perfluorodecanoic acid (PFDA), Perfluorotridecanoic acid (PFTrDA), Perfluoroundecanoic acid (PFUnDA), Perfluorododecanoic acid (PFDoDA) and Perfluorotetradecanoic acid (PFTeDA).
Perfluoroalkyl sulfonic acids (PFSAs): Perfluorononanesulfonic acid (PFNS) and Perfluorodecanesulfonic acid (PFDS).
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs): 1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA), 1H.1H.2H.2H-perfluorooctanesulfonic acid(6:2 FTSA), 1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA), 1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)
Perfluoroalkyl sulfonamido substances: Perfluorooctane sulfonamide (FOSA), N-methylperfluoro-1-octane sulfonamide (N-MeFOSA), N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA), 2-(N-methylperfluoro-1-octane sulfonamido)-ethanol(N-MeFOSE), 2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol(N-EtFOSE), N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA) and N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA).
Total polychlorinated biphenyls (PCB) and volatile & semi-volatile organic compounds (VOC & SVOC) were not analysed in 2025.
* pH recorded in the laboratory differs from that recorded in the field, likely because the laboratory test must begin within 30 minutes of sampling. As such, only DGV exceedances in the field measured pH are highlighted.

ANZECC (2000)	Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1 The Guidelines. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand. October 2000. Available at: https://www.waterquality.gov.au/anz-guidelines/resources/previous-guidelines/anzecc-armcanz-2000
ANZG (2026)	Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian State and Territory Governments, created 2018 and updated April 2026. Available at: https://www.waterquality.gov.au/anz-guidelines
ANZG (2023)	Draft Livestock Drinking Water Guidelines. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian State and Territory Governments. November 2023. Available at: https://www.waterquality.gov.au/sites/default/files/documents/livestock-drinking-water-guidelines-draft.pdf
COK (2020)	City of Kalamunda (2020) Notice of Determination on Application for Planning Approval, Lot 3 (415) Mundaring Weir Road, Piesse Brook, Kalamunda
DOH (2014)	Contaminated Sites Groundwater and Surface Water Chemical Screening Guidelines. Government of Western Australia Department of Health. December 2014. Available at: https://www.health.wa.gov.au/-/media/Files/Corporate/general-documents/Environmental-health/Ground-and-Surface-Chemical-Water-Screening-Guidelines.pdf
DOH (2011)	Guidelines for the Non-Potable Uses of Recycled Water in Western Australia. Government of Western Australia Department of Health. 2011. Available at: https://www.health.wa.gov.au/~/media/Files/Corporate/general-documents/water/Recycling/Guidelines-for-the-Non-potable-Uses-of-Recycled-Water-in-WA.pdf
DWER (2021)	Assessment and Management of Contaminated Sites: Guidelines. Government of Western Australia Department of Water and Environmental Regulation. November 2021. Available at: https://www.wa.gov.au/system/files/2023-05/guideline-assessment-and-management-of-contaminated-sites.pdf
DWER (2020)	South West Index of River Condition (SWIRC). Government of Western Australia Department of Water and Environmental Regulation. December 2020. Available at: https://rivers.dwer.wa.gov.au/wp-content/uploads/2023/05/RSTS-1_2020_Storer-et-al_South-West-Index-of-River-Condition-overview.pdf
HEPA (2025)	PFAS National Environmental Management Plan (NEMP), Version 3.1. Heads of EPA Australia and New Zealand. 2025. Available at: https://www.dcceew.gov.au/sites/default/files/documents/pfas-nemp-3-1.pdf
NHMRC (2019)	Guidance on Per and Polyfluoroalkyl (PFAS) in Recreational Water. National Health and Medical Research Council & Natural Resource Management Ministerial Council, Commonwealth of Australia. 2019. Available at: https://www.nhmrc.gov.au/sites/default/files/documents/attachments/guidance-on-PFAS-in-recreational-water.pdf
NHMRC (2011)	Australian Drinking Water Guidelines 6, National Water Quality Management Strategy, Version 4.0 National Health and Medical Research Council & Natural Resource Management Ministerial Council, Commonwealth of Australia. Updated June 2025. Available at: https://www.nhmrc.gov.au/about-us/publications/australian-drinking-water-guidelines
SRT (1999)	Swan-Canning Cleanup Program: Action Plan. Swan River Trust, Government of Western Australia. May 1999. Available at: https://library.dbca.wa.gov.au/static/FullTextFiles/22030.pdf
US EPA (2024)	Regional Screening Levels - Generic Tables. United States Environmental Protection Agency. December 2024. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

#A	NHMRC (2011) Australian Drinking Water Guidelines (ADWG)
#A1	NHMRC (2011) Guideline is for aldrin + dieldrin
#A2	NHMRC (2011) Guideline for Cr (VI) conservatively adopted for comparison to total chromium
#A4	NHMRC (2011) E. coli, enterococci and thermotolerant coliforms should not be detected in a minimum 100mL sample of drinking water
#A5	NHMRC (2011) Converted from guideline for nitrate (as nitrate) - will protect bottle-fed infants under 3 months from methemoglobinemia; adults and children can safely drink up to 100 mg/L
#A6	NHMRC (2011) Converted from guideline for nitrite (as nitrite), rapidly oxidised to nitrate (see above)
#A7	NHMRC (2011) Chloride is derived from natural mineral salts and effluent contamination. High concentrations more common in groundwater and certain catchments. Insufficient data to set a drinking water guideline value based on health considerations.
#A8	NHMRC (2011) Hard water is caused by calcium and magnesium salts and is difficult to lather; <60 mg/L CaCO3 – soft but possibly corrosive; 60-200 mg/L CaCO3 – good quality; 200-500 mg/L CaCO3 – increasing scaling problems; >500 mg/L CaCO3 – severe scaling
#A9	NHMRC (2011) Sodium is a natural component of water - guideline value is a taste threshold
#A10	NHMRC (2011) Sulphate is a natural component of water and may be added via treatment chemicals - guideline value is a taste threshold as insufficient data to set a drinking water guideline value based on health considerations, >500 mg/L can have purgative effects
#A11	NHMRC (2011) 5 NTU is just noticeable in a glass; <0.2 NTU is the target for effective filtration of Cryptosporidium and Giardia; <1 NTU is the target for effective disinfection - insufficient data to set a drinking water guideline value based on health considerations, values are representative of base river flow in lowland rivers
#B	US EPA (2024) Tap Water Regional Screening Level (TR=1E-06; THQ=0.1) used in the absence of Australian Drinking Water Guideline
#C	DOH (2014) Guidelines for Non-Potable Use (NPUG) including watering gardens and edible garden produce, irrigating parks and reserves, and washing cars and clothes
#C1	DOH (2014) Guideline is for aldrin + dieldrin
#D	ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, refer Table 5.2.3 (general chemicals) and Table 5.2.4 (pesticides)
#D1	ANZECC (2000) For primary contact (e.g. swimming), the median bacterial content in freshwaters taken over the bathing season should not exceed 150 faecal coliform organisms/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month, with 4 of 5 samples containing <4,000 organisms/100 mL) and 35 enterococci organisms/100 mL (maximum number in any one sample: 60–100 organisms/100 mL), refer Table 5.2.2
#E	ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality
#E1	ANZECC (2000) Livestock Drinking Water Quality - in the absence of adequate information derived specifically for livestock under Australian and New Zealand conditions, it is recommended that the drinking water guidelines for human health be adopted
#F	ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use
#F1	ANZECC (2000) Primary Industries - Water Quality for Irrigation and General Water Use, Long Term Trigger Values (LTV), Table 4.2.10 - LTV are applicable to irrigation for up to 100 years in a non-domestic setting; for shorter periods, STV may be more appropriate
#F2	ANZECC (2000) Primary Industries - Water Quality for Irrigation and General Water Use, Short Term Trigger Values (STV), Table 4.2.10
#F3	ANZECC (2000) Trigger values for thermotolerant coliforms in irrigation waters for raw human food crops in direct contact with irrigation water, Table 4.2.2
#G	ANZECC (2000) Trigger Values for Freshwater Aquatic Ecosystems for slightly to moderately disturbed systems at 99% level of species protection (LOSP)
#G2	ANZECC (2000) Ammonia as total ammonia (NH3-N) at pH 8 - guideline drops to 2.18 mg/L at pH 7, refer Vol 2, Table 8.3.7
#G3	ANZECC (2000) Default trigger values for lowland rivers and slightly disturbed ecosystems in south-west Australia, values reflect high site-specific and regional variability, Table 3.3.6 and 3.3.7
#H	ANZG (2026) Default Australian Water Quality Guidelines for Toxicants in Freshwater Ecosystems at 99% level of species protection (LOSP)
#H3	ANZG (2026) Unknown level of species protection (LOSP)
#H4	ANZG (2026) Guidelines for 99% LOSP for soft water (<30 mg/L as CaCO3) is 0.64 mg/L, for moderately hard water (30-150 mg/L) is 1.0 mg/L, and for hard water (>150 mg/L) is 18 mg/L, protects against toxicity and not against eutrophication
#H5	ANZG (2026) Guideline for 99% LOSP, applies to total concentrations, rather than filtered/dissolved concentrations, but applied for screening purposes in this assessment in the absence of any other guidelines
#H6	ANZG (2026) Guidelines of 0.02 ug/L for 99% LOSP to aquatic species (including plants, invertebrates and fish), both via direct toxicity and bioaccumulation pathways, and 0.0005 ug/L for 99% LOSP to air-breathing animals that live in aquatic ecosystems or prey on aquatic organisms.
#H7	ANZG (2026) Guidelines for 99% LOSP at pH >6.5
#J	ANZG (2023) Draft Livestock Drinking Water Guidelines
#J1	ANZG (2023) 3.6 mg/L for chickens, 5 mg/L for general livestock
#J2	ANZG (2023) 0.5 mg/L for sheep, 1 mg/L for cattle, 5 mg/L for pigs and poultry
#J3	ANZG (2023) Nitrate = 25 mg/L for poultry, 100 mg/L for general livestock, 400 mg/L for cattle; nitrite = 10 mg/L for general livestock - levels of nitrate tolerance are lowest in poultry, medium in pigs and highest in cattle
#J4	ANZG (2023) 25 mg/L for poultry, 500 mg/L for livestock in general, pigs may tolerate higher levels
#J5	ANZG (2023) If livestock feed also contains fluoride, the guideline value should be reduced to 1.0 mg/L
#J6	ANZG (2023) 125 mg/L for poultry, 250 mg/L for lactating cows and ewes with lambs, 500 mg/L for ruminants in general - also, if sulphate levels are high, poultry performance may be affected at magnesium concentrations >50 mg/L
#L	DWER (2021) Microbial assessment levels (MAL) for water in urban recreational areas, open spaces, parks and gardens with unrestricted access and application, refer Table D2
#M	DWER (2021) For PFAS, values equal to the drinking water guideline values are appropriate Tier 1 screening levels for non-potable uses
#N	COK (2020) Common wastewater effluent criteria for on-site disposal in the Mandoon-Helena Catchment
#O	SRT (1999) Swan-Canning Cleanup Program: Action Plan, water quality targets adopted for screening purposes, compliance is based on combined data from three years
#O1	SRT (1999) Total nitrogen maximum concentrations for short and long-term catchment water quality targets: 1.0 mg/L long term/20 years and 2.0 mg/L short term/5 years. Recommended total nitrogen targets for the Helena River inflow: 1.0 mg/L.
#O2	SRT (1999) Total phosphorus maximum concentrations for short and long-term catchment water quality targets: total phosphorus = 0.1 mg/L long term/20 years and 0.2 mg/L short term/5 years. Recommended total phosphorus targets for the Helena River inflow: 0.1 mg/L.
#P	NHMRC (2019) Australian recreational water Health Based Guideline Value (HBGV), not protective of a pathway of PFAS accumulation in fish/shellfish, and subsequent human consumption (e.g. by recreational fishers or Noongar people sourcing traditional foods)
#Q	HEPA (2025) PFAS National Environmental Management Plan (NEMP), Version 3.1, interim guideline for 99% level of species protection used for high conservation value systems. Interim guidelines do not account for bioaccumulation and biomagnification effects of toxicants in air-breathing animals or in animals which prey on aquatic organisms. Interim guideline to be used until final PFOA guidelines can be set using the nationally agreed process under the ANZG.
#S	DOH (2011) Guidelines for the Non-Potable Uses of Recycled Water in Western Australia, Government of Western Australia Department of Health
#S1	DOH (2011) Compliance value for minimum ongoing monitoring for a high level of exposure risk (i.e. residential and urban use with unrestricted access and application) used for screening purposes, refer Table 8
#S2	DOH (2011) Compliance value for commissioning validation and verification monitoring for a high level of exposure risk (i.e. residential and urban use with unrestricted access and application) used in the absence of ongoing monitoring values, refer Table 7
#T	Isotope dilution is used for calibration of each native compound for which an exact labelled analogue is available (Isotope Dilution Quantitation) - the isotopically labelled analogues allow identification and recovery correction of the concentration of the associated native PFAS compounds
#U	Where the native PFAS compound does not have labelled analogue, then the quantification is made using the Extracted Internal Standard Analyte with the closest retention time to the analyte and no recovery correction has been made (Internal Standard Quantitation)
#V	*E. coli* to be used as a faecal pathogen indicator but where salinity exceeds one per cent (10,000 ppm), *Enterococci* should be substituted for *E. coli*
#W	DWER (2020) South West Index of River Condition (SWIRC), <4 mg/L is considered to be the lower limit for dissolved oxygen when assessing river condition

BoorYul-Bah-Bilya (Mandoon Bilya-Helena River)
LHAAC Water and Sediment Sampling, 2024-2025
Table T2b Water Sampling Results 2024

		Default Guideline Values (DGVs)																						
		Freshwater Ecosystem			Human Health				Primary Industries															
Group	Analysis	Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Livestock Watering	LOR (mg/L)	Helena Swan	Whiteman Rd	Helena Roe	Craignish US	Lower Pumpback Dam	Rocky Pool	Pipe Bridge	Cobblers Pool*	LookSee Pool	Piesse Culvert	Salty Pool*	Beraking Yarra
Major Ions	Calcium										1,000[#E]	< 0.5	32	33	33	10	12	11	7.3	8.0	9.9	15	130	7.2
	Chloride (filtered)					250[#A7]	250[#C]	400[#D]	175[#F1]	175[#F2]		< 5	230	300	250	110	66	68	110	140	150	60	2,500	23
	Fluoride	0.29[#H]			1.5[#A]		15[#C]	15[#C]	1[#F1]	2[#F2]	2[#J5]	< 0.1	0.2	0.3	0.2	0.2	0.2	< 0.1	0.2	0.2	0.2	0.1	0.5	0.2
	Magnesium										125[#J6]	< 0.5	24	27	24	11	8.2	7.2	9.9	10	12	7.8	340	4.7
	Potassium											< 0.5	5.4	5.5	4.6	2.9	3.6	3.7	2.6	2.7	3.2	5.1	4.9	3.1
	Sodium				NN	180[#A9]		300[#D]	115[#F1]	115[#F2]		< 0.5	140	160	140	69	57	52	77	84	98	51	1,000	20
	Sulphate (as SO4)					250[#A10]	1,000[#C]	400[#D]			250[#J4]	< 1	62	34	41	12	4	33	23	29	31	38	150	< 1
Nutrients	Ammonia-N	0.32[#G2]					0.388[#C]	0.01[#D]				< 0.02	0.02	0.13	0.12	0.05	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.03	< 0.02
	Nitrate-N	0.64-1.0[#H4]			11[#A5]		113[#C]	10[#D]			25[#J3]	< 0.01	0.17	0.23	0.12	0.08	< 0.01	1.4	< 0.01	0.02	0.02	6.9	< 0.01	< 0.01
	Nitrite-N				0.9[#A6]		9.12[#C]	1[#D]			10[#J3]	< 0.01	< 0.01	0.05	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Total Oxidised Nitrogen (as NOx-N)	0.15[#G4]										< 0.01	0.18	0.21	0.13	0.1	< 0.01	1.4	< 0.01	0.03	0.02	6.9	< 0.01	< 0.01
	Total Kjeldahl Nitrogen											< 0.2	1.0	0.3	0.5	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.4	0.3
	Nitrogen (organic)											< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Nitrogen (total)	1.2[#G4]	1.0-2.0[#O]	<10[#N]					5[#F1]	25[#F2]		< 0.2	1.2	0.5	0.6	0.3	< 0.2	1.5	< 0.2	< 0.2	< 0.2	6.9	0.4	0.3
	Phosphorus (filterable reactive)	0.04[#G4]										< 0.01	0.01	0.01	< 0.01	< 0.01	< 0.01	0.03	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Phosphorus (total)	0.065[#G4]	0.1-0.2[#O]	<2[#N]					0.05[#F1]	0.8[#F2]		< 0.01	0.06	0.03	0.04	0.05	0.03	0.03	0.06	0.06	0.06	0.04	0.01	0.06
Metals & Other Inorganics (Total)**	Aluminium	0.027[#H7]			20[#B]	0.2[#A]	0.2[#C]	0.2[#D]	5[#F1]	20[#F2]	3.6[#J1]	< 0.05	0.14	< 0.05	0.06	0.70	< 0.05	0.06	0.09	0.23	0.22	0.09	< 0.05	0.18
	Barium				2[#A]		20[#C]	1[#D]			2[#E1]	< 0.01	0.07	0.07	0.07	0.05	0.04	0.03	0.02	0.03	0.03	0.04	0.09	0.02
	Boron	0.09[#G]			4[#A]		40[#C]	1[#D]	0.5[#F1]	0.5[#F2]	5[#J]	< 0.05	0.08	0.09	0.08	0.08	0.13	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.06	< 0.05
	Chromium	0.00095[#H2]			0.05[#A2]			0.05[#D]	0.1[#F1]	1[#F2]	0.05[#J]	< 0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Chromium (III) (filtered)	0.00095[#H5]			22[#B]						0.05[#J]	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
	Chromium (VI)	0.00001[#H]			0.05[#A]		0.5[#C]	0.5[#C]			0.05[#J]	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
	Cobalt	0.0014[#H3]			0.006[#B]				0.05[#F1]	0.1[#F2]	1[#J]	< 0.001	0.001	< 0.001	0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	0.002
	Copper	0.001[#H]			2[#A]	1[#A]	20[#C]	1[#D]	0.2[#F1]	5[#F2]	0.5[#J2]	< 0.001	0.001	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.003	< 0.001	0.001
	Cyanide	0.004[#G1]			0.08[#A3]		0.8[#C]	0.1[#D]			0.08[#E1]	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.007
	Iron	0.14[#H5]			14[#B]	0.3[#A]	0.3[#C]	0.3[#D]	0.2[#F1]	10[#F2]	NST	< 0.01	4.6	3.8	3.8	6.0	3.4	0.16	0.90	1.0	1.2	0.06	0.53	3.0
	Lead	0.001[#H]			0.01[#A]		0.1[#C]	0.05[#D]	2[#F1]	5[#F2]	0.1[#J]	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001
	Lithium				0.04[#B]						0.04[#E1]	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.004	< 0.001
	Manganese	1.2[#H]			0.5[#A]	0.1[#A]	5[#C]	0.1[#D]	0.2[#F1]	10[#F2]	10[#J]	< 0.005	0.13	0.12	0.12	0.16	0.28	0.008	0.03	0.018	0.063	0.011	0.22	0.46
	Nickel	0.008[#H]			0.02[#A]		0.2[#C]	0.1[#D]	0.2[#F1]	2[#F2]	1[#J]	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.003	< 0.001	< 0.001	0.002	< 0.001
	Selenium	0.005[#H]			0.01[#A]		0.1[#C]	0.01[#D]	0.02[#F1]	0.05[#F2]	0.02[#J]	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	0.002	0.002
	Titanium											< 0.005	< 0.005	< 0.005	< 0.005	0.020	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
	Uranium	0.0005[#H3]			0.02[#A]		0.2[#C]	0.2[#C]	0.01[#F1]	0.1[#F2]	0.2[#J]	< 0.001	0.001	0.002	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Vanadium	0.006[#H3]			0.086[#B]				0.1[#F1]	0.5[#F2]	0.1[#J]	< 0.005	< 0.005	< 0.005	< 0.005	0.007	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
	Zinc	0.0024[#H]			6[#B]	3[#A]	3[#C]	5[#D]	2[#F1]	5[#F2]	20[#J]	< 0.005	0.005	0.006	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.005	0.007	0.005	0.006
Microbes	Heterotrophic Plate Count at 37°C (total)											< 20 CFU/ml	3,400	3,800	3,600	2,000	1,900	1,600	8,800	5,800	1,600	3,500	1,600	1,900
	Total Coliforms											< 1 CFU/100ml	700	1,300	3,600	1,000	7,000	5,000	900	300	1,200	2,800	1,800	2,000
	Escherichia coli (E. coli)[#V]			<10[#N]	Detection[#A4]		1[#L]	1[#L]	10[#F3]	10[#F3]	100[#E]	< 1 CFU/100ml	130	140	240	100	150	82	12	12	13	84	24	21
	Enterococci				Detection[#A4]			60-100[#D1]			100[#E]	< 1 CFU/100ml	160	53	120	98	82	59	11	19	7	69	63	56
	Thermophilic Amoeba				Detection[#A4]							D/ND / 250ml	ND	ND	ND	ND	ND	ND	D	ND	ND	ND	D	D
	Thermophilic *Naegleria sp.*				Detection[#A4]							D/ND / 250ml	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Naegleria fowleri				Detection[#A4]							D/ND / 250ml	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Herbicides & Pesticides**	Acidic Herbicides											Various ug/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Base Neutral Pesticides											Various ug/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Organochloride & Organophosphate Pesticides											Various ug/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	See below	< LOR	< LOR
	Dieldrin	0.01[#H3]			0.3[#A1]		3[#C1]	1[#D]			0.3[#E1]	< 0.001 ug/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.003	< 0.001	< 0.001
Hydrocarbons**	TRH C6-C9											< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02
	TRH C6-C10											< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02
	TRH C6-C10 (less BTEX) (F1)				0.09[#I1]						0.09[#E1]	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02
	BTEX Compounds											Various mg/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Total Polycyclic Aromatic Hydrocarbons (PAH)											Various ug/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
Per- and Polyfluoroalkyl Substances (PFAS)**	Perfluorobutanoic acid (PFBA)[#T]											< 0.005 ug/L	< 0.005	0.017	0.016	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.015	0.009
	Perfluoropentanoic acid (PFPeA)[#T]											< 0.001 ug/L	< 0.001	0.037	0.023	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluorohexanoic acid (PFHxA)[#T]											< 0.001 ug/L	< 0.001	0.016	0.013	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluoroheptanoic acid (PFHpA)[#T]											< 0.005 ug/L	< 0.005	0.007	0.006	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
	Perfluorooctanoic acid (PFOA)[#T]	19[#Q]			0.2[#A]		0.56[#M]	10[#P]			0.2[#E1]	< 0.001 ug/L	< 0.001	0.011	0.013	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluorobutanesulfonic acid (PFBS)[#T]				1[#A]						1[#E1]	< 0.001 ug/L	< 0.001	0.004	0.006	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluorooctanesulfonic acid (PFOS)[#T]	0.0005-0.02[#H6]			0.008[#A]		0.008[#M]	2[#P]			0.008[#E1]	< 0.0001 ug/L	< 0.0001	0.041	0.048	0.0005	0.002	0.0021	0.0006	0.001	0.0003	0.0004	0.0004	0.0001
	Perfluoropropanesulfonic acid (PFPrS)[#U]											< 0.001 ug/L	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluoropentanesulfonic acid (PFPeS)[#U]											< 0.001 ug/L	< 0.001	0.004	0.004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluorohexanesulfonic acid (PFHxS)[#T]				0.03[#A]		0.03[#M]	2[#P]			0.03[#E1]	< 0.001 ug/L	< 0.001	0.021	0.024	< 0.001	0.002	0.005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluoroheptanesulfonic acid (PFHpS)[#U]											< 0.001 ug/L	< 0.001	0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Sum PFAS (n=30)											< 0.005 ug/L	< 0.005	0.16	0.16	< 0.005	< 0.005	0.007	< 0.005	< 0.005	< 0.005	< 0.005	0.015	0.009
	Sum WA DWER PFAS (n=10)											< 0.005 ug/L	< 0.005	0.154	0.149	< 0.005	< 0.005	0.0071	< 0.005	< 0.005	< 0.005	< 0.005	0.0154	0.0091
Surfactants	Methylene Blue Active Substance (MBAS)							0.2[#D]				< 0.2	0.3	0.4	0.3	0.2	< 0.2	< 0.2	0.4	0.3	0.3	0.3	1.4	0.4
Volatiles**	Polychlorinated Biphenyls (PCB)	0.00001[#H8]						0.0001[#D]				< 0.05 mg/L	< 0.05	< LOR	< 0.05	< 0.05	< 0.05	< 0.05	< LOR	< LOR	< LOR	< 0.05	< LOR	< LOR
	Semi-Volatile Organic Compounds (SVOC)											Various mg/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Volatile Organic Compounds (VOC)											Various mg/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
Water Quality Parameters	Alkalinity - Bicarbonate (as CaCO3)											< 5	100	110	110	43	78	23	27	30	34	15	47	37
	Alkalinity - Carbonate (as CaCO3)											< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
	Alkalinity - Hydroxide (as CaCO3)											< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
	Alkalinity - Total (as CaCO3)											< 5	100	110	110	43	78	23	27	30	34	15	47	37
	Biochemical Oxygen Demand			<20[#N]			10[#S2]					< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	5.4	< 5	< 5	< 5
	Colour											< 5 PCU	22	< 5	25	9.8	11	7.6	25	24	< 5	11	130	31
	Conductivity (field measured at 25°C)	<120-300[#G4]										< 10 uS/cm	1,095	1,176	1,128	498.3	442.6	415.8	509	591	648	420	8,274	161.7
	Conductivity (lab measured at 25°C)	<120-300[#G4]										< 10 uS/cm	1,200	1,300	1,200	520	460	440	540	630	700	450	8,600	170
	Dissolved Oxygen (optical)	<80[#G4]										%	54.8	56.5	59.1	59.3	27.6	96.9	94.4	69.3	70.5	101.4	46.9	36.4
	Dissolved Oxygen (optical)	<4[#W]										mg/L	5.30	5.50	5.67	5.71	2.76	9.47	9.10	6.93	7.04	9.95	4.75	3.85
	Hardness (equivalent CaCO3/L)					200[#A8]		500[#D]				< 5	180	200	190	69	69	57	59	62	75	68	1,700	38
	pH (field measured)	6.5-8.0[#G4]		6.5-8.5[#N]	6.5-8.5[#A]		6.5-8.5[#S1]	6.5-8.5[#D]	6-8.5[#F]	6-8.5[#F]		< 0.1 pH	6.76	6.64	6.73	6.24	6.49	7.43	6.73	6.44	6.52	6.91	6.58	6.91
	pH (lab measured)*	6.5-8.0[#G4]		6.5-8.5[#N]	6.5-8.5[#A]		6.5-8.5[#S1]	6.5-8.5[#D]	6-8.5[#F]	6-8.5[#F]		< 0.1 pH	7.1	6.8	6.6	6.3	6.6	6.0	6.1	6.3	6.0	5.9	6.3	6.2
	Salinity (field measured) (ppm)											-	550	590	560	240	210	200	250	290	320	200	4,620	80
	Salinity (lab measured) (mg/L)											< 10	530	560	540	240	210	200	240	280	310	200	3,900	76
	Total Dissolved Solids (field measured)					600[#A]		1,000[#D]			500[#J]	-	712	764	733	288	325	271	331	384	421	273	5,390	105
	Total Dissolved Solids (dried at 180°C + 2°C)					600[#A]		1,000[#D]			500[#J]	< 5	700	760	710	310	280	270	320	380	420	270	5,200	100
	Total Organic Carbon											< 5	< 5	< 5	< 5	< 5	< 5	< 5	6.8	5.1	5.2	< 5	21	< 5
	Total Suspended Solids (dried at 103°C to 105°C)			30[#N]			10[#S2]					< 5	< 5	6	< 5	23	6	< 5	< 5	< 5	< 5	6	5	5
	Turbidity (field measured)	<10-20[#G4]				5[#A11]	5[#S1]					< 0.1 NTU	17.59	14.70	17.80	28.77	12.24	0.30	1.11	2.24	2.08	0.61	0.69	5.14
	Turbidity (lab measured)	<10-20[#G4]				5[#A11]	5[#S1]					< 0.1 NTU	18	10	19	36	17	2.2	3.7	4.3	3.7	2.1	2.6	6.9

Notes

123	Concentration is at or above the DGV for primary industries
123	Concentration is at or above the DGV for freshwater ecosystems
123	Concentration is at or above the DGV for freshwater ecosystems and primary industries
123	Concentration is at or above the DGV for recreation & swimming
123	Concentration is at or above the DGV for human health and primary industries and/or freshwater ecosystems
< LOR	Concentration not detected above the laboratory limit of reporting

All units in mg/L unless otherwise specified.
* Salty Pool is named "Helena Pony" in field notes and laboratory documentation.
* Cobblers Pool is named "Skeleton Pool" in field notes and laboratory documentation.
* pH recorded in the laboratory differs from that recorded in the field, likely because the laboratory test must begin within 30 minutes of sampling. As such, only DGV exceedances in the field measured pH are highlighted.

Abbreviations
CFU = Colony Forming Unit
D = Detected
PCU = Platinum-Cobalt Units (measure of colour)
ND = Not Detected
NTU = Nephelometric Turbidity Units

Metals analysis methods differed between 2025 and 2024, so the results cannot be directly compared. 2025 analysis = dissolved metals concentrations from field filtered samples. 2024 analysis = total metal concentrations from unfiltered samples. Dissolved metals analysis was undertaken in 2025 to assess bioavailability - a better metric for risk assessment.

** Only analytes with detectable concentrations are shown. Other contaminants were not detected above the laboratory limit of reporting (< LOR) as detailed below.
The following **metals** were not detected at any location: antimony, arsenic, beryllium, cadmium, chromium III, chromium VI, mercury, molybdenum, silver, thallium, thorium, tin and zirconium.
The following **acidic herbicides** were not detected at any location: 2.4-D, 2.4.5-T, 2.4.6-T, Clopyralid, Dicamba, Fluazifop, MCPA, Metsulfuron Methyl, Picloram and Triclopyr.
The following **base neutral pesticides** were not detected at any location: Amitraz, Atrazine, Azinphos Methyl, Chlorpyrifos, Diclofop Methyl, Dimethoate, Diuron, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Fenamiphos, Fenitrothion, Fluometuron, Hexazinone, Metolachlor, Molinate, Myclobutanil, Prometryn, Propazine, Propiconazole, Simazine, Tebuconazole, Terbutryn and Trifluralin.
The following **organochloride & organophosphate pesticides** were not detected at any location: Aldrin, BHC (HCH), Bifenthrin, Bromophos Ethyl, Chlordane, Chlorothalonil, Chlorpyrifos, Diazinon, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Endrin, Ethion, Fenitrothion, Fipronil, Hexachlorobenzene (HCB), Heptachlor Epoxide, Heptachlor, Lindane, Malathion, Methoxychlor, o.p-DDT, Oxychlordane, p.p-DDD, p.p-DDE, p.p-DDT, Parathion Ethy, Parathion Methy, Trifluralin and Vinclozolin.
The following **total recoverable hydrocarbon (TRH)** fractions were not detected at any location: C10-C14, C15-C28, C29-C36, C10-C36 and >C10-C16, >C10-C16 (F2) less naphthalene, >C16-C34, >C34-C40, >C10-C40.
The following **BTEX compounds** were not detected at any location: Benzene, Toluene, Ethylbenzene, m&p-Xylenes, o-Xylenes and Xylenes.
The following **polycyclic aromatic hydrocarbons (PAH)** were not detected at any location: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b&j)fluoranthene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a.h)anthracene, Fluoranthene, Fluorene, Indeno(1.2.3-cd)pyrene, Naphthalene, Phenanthrene, Pyrene and Total PAH.
The following **per- and polyfluoroalkyl substances (PFAS)** were not detected at any location:
Perfluoroalkyl carboxylic acids (PFCAs): Perfluorononanoic acid (PFNA), Perfluorodecanoic acid (PFDA), Perfluorotridecanoic acid (PFTrDA), Perfluoroundecanoic acid (PFUnDA), Perfluorododecanoic acid (PFDoDA) and Perfluorotetradecanoic acid (PFTeDA).
Perfluoroalkyl sulfonic acids (PFSAs): Perfluorononanesulfonic acid (PFNS) and Perfluorodecanesulfonic acid (PFDS).
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs): 1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA), 1H.1H.2H.2H-perfluorooctanesulfonic acid(6:2 FTSA), 1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA), 1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)
Perfluoroalkyl sulfonamido substances: Perfluorooctane sulfonamide (FOSA), N-methylperfluoro-1-octane sulfonamide (N-MeFOSA), N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA), 2-(N-methylperfluoro-1-octane sulfonamido)-ethanol(N-MeFOSE), 2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol(N-EtFOSE), N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA) and N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA).
The following **polychlorinated biphenyls (PCB)** were not detected at any location: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, Aroclor-1260 and Total PCB.
The following semi-**volatile organic compounds (SVOC)** were not detected at any location: 2-Methyl-4.6-dinitrophenol, 1-Chloronaphthalene, 1-Naphthylamine, 1.2-Dichlorobenzene, 1.2.3-Trichlorobenzene, 1.2.3.4-Tetrachlorobenzene, 1.2.3.5-Tetrachlorobenzene, 1.2.4-Trichlorobenzene, 1.2.4.5-Tetrachlorobenzene, 1.3-Dichlorobenzene, 1.3.5-Trichlorobenzene, 1.4-Dichlorobenzene, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol (o-Cresol), 2-Naphthylamine, 2-Nitroaniline, 2-Nitrophenol, 2-Picoline, 2.3.4.6-Tetrachlorophenol, 2.4-Dichlorophenol, 2.4-Dimethylphenol, 2.4-Dinitrophenol, 2.4-Dinitrotoluene, 2.4.5-Trichlorophenol, 2.4.6-Trichlorophenol, 2.6-Dichlorophenol, 2.6-Dinitrotoluene, 3&4-Methylphenol (m&p-Cresol), 3-Methylcholanthrene, 3.3'-Dichlorobenzidine, 4-Aminobiphenyl, 4-Bromophenyl phenyl ether, 4-Chloro-3-methylphenol, 4-Chlorophenyl phenyl ether, 4-Nitrophenol, 4.4'-DDD, 4.4'-DDE, 4.4'-DDT, 7.12-Dimethylbenz(a)anthracene, Acetophenone, Aniline, Benzyl chloride, Bis(2-chloroethoxy)methane, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butyl benzyl phthalate, Di-n-butyl phthalate, Di-n-octyl phthalate, Dibenz(a.j)acridine, Dibenzofuran, Diethyl phthalate, Dimethyl phthalate, Dimethylaminoazobenzene, Diphenylamine, Endrin aldehyde, Endrin ketone, g-HCH (Lindane), Heptachlor, Heptachlor epoxide, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Methoxychlor, N-Nitrosodibutylamine, N-Nitrosodipropylamine, N-Nitrosopiperidine, Nitrobenzene, Pentachlorobenzene, Pentachloronitrobenzene, Pentachlorophenol, Phenol and Pronamide.

The following **volatile organic compounds (VOC)** were not detected at any location: 1.1-Dichloroethane, 1.1-Dichloroethene, 1.1.1-Trichloroethane, 1.1.1.2-Tetrachloroethane, 1.1.2-Trichloroethane, 1.1.2.2-Tetrachloroethane, 1.2-Dibromoethane, 1.2-Dichlorobenzene, 1.2-Dichloroethane, 1.2-Dichloropropane, 1.2.3-Trichloropropane, 1.2.4-Trimethylbenzene, 1.3-Dichlorobenzene, 1.3-Dichloropropane, 1.3.5-Trimethylbenzene, 1.4-Dichlorobenzene, 2-Butanone (MEK), 2-Propanone (Acetone), 4-Chlorotoluene, 4-Methyl-2-pentanone (MIBK), Allyl Chloride, Bromobenzene, Bromochloromethane, Bromodichloromethane, Bromoform, Bromomethane, Carbon Disulfide, Carbon Tetrachloride, Chlorobenzene, Chloroethane, Chloroform, Chloromethane, cis-1.2-Dichloroethene, cis-1.3-Dichloropropene, Dibromochloromethane, Dibromomethane, Dichlorodifluoromethane, Iodomethane, Isopropyl benzene (Cumene), Methylene Chloride, Styrene, Tetrachloroethene, trans-1.2-Dichloroethene, trans-1.3-Dichloropropene, Trichloroethene, Trichlorofluoromethane and Vinyl Chloride.

The 2024 results have been rescreened against updated DGVs.

ANZECC (2000)	Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1 The Guidelines. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand. October 2000. Available at: https://www.waterquality.gov.au/anz-guidelines/resources/previous-guidelines/anzecc-armcanz-2000
ANZG (2026)	Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian State and Territory Governments, created 2018 and updated April 2026. Available at: https://www.waterquality.gov.au/anz-guidelines
ANZG (2023)	Draft Livestock Drinking Water Guidelines. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian State and Territory Governments. November 2023. Available at: https://www.waterquality.gov.au/sites/default/files/documents/livestock-drinking-water-guidelines-draft.pdf
COK (2020)	City of Kalamunda (2020) Notice of Determination on Application for Planning Approval, Lot 3 (415) Mundaring Weir Road, Piesse Brook, Kalamunda
DOH (2014)	Contaminated Sites Groundwater and Surface Water Chemical Screening Guidelines. Government of Western Australia Department of Health. December 2014. Available at: https://www.health.wa.gov.au/-/media/Files/Corporate/general-documents/Environmental-health/Ground-and-Surface-Chemical-Water-Screening-Guidelines.pdf
DOH (2011)	Guidelines for the Non-Potable Uses of Recycled Water in Western Australia. Government of Western Australia Department of Health. 2011. Available at: https://www.health.wa.gov.au/~/media/Files/Corporate/general-documents/water/Recycling/Guidelines-for-the-Non-potable-Uses-of-Recycled-Water-in-WA.pdf
DWER (2021)	Assessment and Management of Contaminated Sites: Guidelines. Government of Western Australia Department of Water and Environmental Regulation. November 2021. Available at: https://www.wa.gov.au/system/files/2023-05/guideline-assessment-and-management-of-contaminated-sites.pdf
DWER (2020)	South West Index of River Condition (SWIRC). Government of Western Australia Department of Water and Environmental Regulation. December 2020. Available at: https://rivers.dwer.wa.gov.au/wp-content/uploads/2023/05/RSTS-1_2020_Storer-et-al_South-West-Index-of-River-Condition-overview.pdf
HEPA (2025)	PFAS National Environmental Management Plan (NEMP), Version 3.1. Heads of EPA Australia and New Zealand. 2025. Available at: https://www.dcceew.gov.au/sites/default/files/documents/pfas-nemp-3-1.pdf
NHMRC (2019)	Guidance on Per and Polyfluoroalkyl (PFAS) in Recreational Water. National Health and Medical Research Council & Natural Resource Management Ministerial Council, Commonwealth of Australia. 2019. Available at: https://www.nhmrc.gov.au/sites/default/files/documents/attachments/guidance-on-PFAS-in-recreational-water.pdf
NHMRC (2011)	Australian Drinking Water Guidelines 6, National Water Quality Management Strategy, Version 4.0 National Health and Medical Research Council & Natural Resource Management Ministerial Council, Commonwealth of Australia. Updated June 2025. Available at: https://www.nhmrc.gov.au/about-us/publications/australian-drinking-water-guidelines
SRT (1999)	Swan-Canning Cleanup Program: Action Plan. Swan River Trust, Government of Western Australia. May 1999. Available at: https://library.dbca.wa.gov.au/static/FullTextFiles/22030.pdf
US EPA (2024)	Regional Screening Levels - Generic Tables. United States Environmental Protection Agency. December 2024. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
WHO (2008)	Petroleum Products in Drinking Water. World Health Organisation. 2008. Available at: https://cdn.who.int/media/docs/default-source/wash-documents/wash-chemicals/petroleumproducts-2add-june2008.pdf?sfvrsn=9f397b0c_4

#A	NHMRC (2011) Australian Drinking Water Guidelines (ADWG)
#A1	NHMRC (2011) Guideline is for aldrin + dieldrin
#A2	NHMRC (2011) Guideline for Cr (VI) conservatively adopted for comparison to total chromium
#A3	NHMRC (2011) Guideline is for total cyanide, but other forms (free, WAD, SAD) should also be below the guideline
#A4	NHMRC (2011) E. coli, enterococci and thermotolerant coliforms should not be detected in a minimum 100mL sample of drinking water
#A5	NHMRC (2011) Converted from guideline for nitrate (as nitrate) - will protect bottle-fed infants under 3 months from methemoglobinemia; adults and children can safely drink up to 100 mg/L
#A6	NHMRC (2011) Converted from guideline for nitrite (as nitrite), rapidly oxidised to nitrate (see above)
#A7	NHMRC (2011) Chloride is derived from natural mineral salts and effluent contamination. High concentrations more common in groundwater and certain catchments. Insufficient data to set a drinking water guideline value based on health considerations.
#A8	NHMRC (2011) Hard water is caused by calcium and magnesium salts and is difficult to lather; <60 mg/L CaCO3 – soft but possibly corrosive; 60-200 mg/L CaCO3 – good quality; 200-500 mg/L CaCO3 – increasing scaling problems; >500 mg/L CaCO3 – severe scaling
#A9	NHMRC (2011) Sodium is a natural component of water - guideline value is a taste threshold
#A10	NHMRC (2011) Sulphate is a natural component of water and may be added via treatment chemicals - guideline value is a taste threshold as insufficient data to set a drinking water guideline value based on health considerations, >500 mg/L can have purgative effects
#A11	NHMRC (2011) 5 NTU is just noticeable in a glass; <0.2 NTU is the target for effective filtration of Cryptosporidium and Giardia; <1 NTU is the target for effective disinfection - insufficient data to set a drinking water guideline value based on health considerations, values are representative of base river flow in lowland rivers
#B	US EPA (2024) Tap Water Regional Screening Level (TR=1E-06; THQ=0.1) used in the absence of Australian Drinking Water Guideline
#C	DOH (2014) Guidelines for Non-Potable Use (NPUG) including watering gardens and edible garden produce, irrigating parks and reserves, and washing cars and clothes
#C1	DOH (2014) Guideline is for aldrin + dieldrin
#D	ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, refer Table 5.2.3 (general chemicals) and Table 5.2.4 (pesticides)
#D1	ANZECC (2000) For primary contact (e.g. swimming), the median bacterial content in freshwaters taken over the bathing season should not exceed 150 faecal coliform organisms/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month, with 4 of 5 samples containing <4,000 organisms/100 mL) and 35 enterococci organisms/100 mL (maximum number in any one sample: 60–100 organisms/100 mL), refer Table 5.2.2
#E	ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality
#E1	ANZECC (2000) Livestock Drinking Water Quality - in the absence of adequate information derived specifically for livestock under Australian and New Zealand conditions, it is recommended that the drinking water guidelines for human health be adopted
#F	ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use
#F1	ANZECC (2000) Primary Industries - Water Quality for Irrigation and General Water Use, Long Term Trigger Values (LTV), Table 4.2.10 - LTV are applicable to irrigation for up to 100 years in a non-domestic setting; for shorter periods, STV may be more appropriate
#F2	ANZECC (2000) Primary Industries - Water Quality for Irrigation and General Water Use, Short Term Trigger Values (STV), Table 4.2.10
#F3	ANZECC (2000) Trigger values for thermotolerant coliforms in irrigation waters for raw human food crops in direct contact with irrigation water, Table 4.2.2
#G	ANZECC (2000) Trigger Values for Freshwater Aquatic Ecosystems for slightly to moderately disturbed systems at 99% level of species protection (LOSP)
#G1	ANZECC (2000) Guideline is for unionised cyanide (HCN), measured as CN, but has been applied to all forms for screening purposes
#G2	ANZECC (2000) Ammonia as total ammonia (NH3-N) at pH 8 - guideline drops to 2.18 mg/L at pH 7, refer Vol 2, Table 8.3.7
#G3	ANZECC (2000) Default trigger values for lowland rivers and slightly disturbed ecosystems in south-west Australia, values reflect high site-specific and regional variability, Table 3.3.6 and 3.3.7
#H	ANZG (2026) Default Australian Water Quality Guidelines for Toxicants in Freshwater Ecosystems at 99% level of species protection (LOSP)
#H2	ANZG (2026) Guideline for chromium III applied in the absence of detectable chromium VI
#H3	ANZG (2026) Unknown level of species protection (LOSP)
#H4	ANZG (2026) Guidelines for 99% LOSP for soft water (<30 mg/L as CaCO3) is 0.64 mg/L, for moderately hard water (30-150 mg/L) is 1.0 mg/L, and for hard water (>150 mg/L) is 18 mg/L, protects against toxicity and not against eutrophication
#H5	ANZG (2026) Guideline for 99% LOSP, applies to total concentrations, rather than filtered/dissolved concentrations, but applied for screening purposes in this assessment in the absence of any other guidelines
#H6	ANZG (2026) Guidelines of 0.02 ug/L for 99% LOSP to aquatic species (including plants, invertebrates and fish), both via direct toxicity and bioaccumulation pathways, and 0.0005 ug/L for 99% LOSP to air-breathing animals that live in aquatic ecosystems or prey on aquatic organisms.
#H7	ANZG (2026) Guidelines for 99% LOSP at pH >6.5
#H8	ANZG (2026) Guideline for Arochlor 1254 adopted for comparison to total PCBs
#I	WHO (2008) Petroleum Products in Drinking Water
#I1	WHO (2008) Lowest derived guideline for aliphatic and aromatic fractions in this range
#I2	WHO (2008) Lowest derived guideline for aliphatic and aromatic fractions in this range rounded to 100 ug/L
#J	ANZG (2023) Draft Livestock Drinking Water Guidelines
#J1	ANZG (2023) 3.6 mg/L for chickens, 5 mg/L for general livestock
#J2	ANZG (2023) 0.5 mg/L for sheep, 1 mg/L for cattle, 5 mg/L for pigs and poultry
#J3	ANZG (2023) Nitrate = 25 mg/L for poultry, 100 mg/L for general livestock, 400 mg/L for cattle; nitrite = 10 mg/L for general livestock - levels of nitrate tolerance are lowest in poultry, medium in pigs and highest in cattle
#J4	ANZG (2023) 25 mg/L for poultry, 500 mg/L for livestock in general, pigs may tolerate higher levels
#J5	ANZG (2023) If livestock feed also contains fluoride, the guideline value should be reduced to 1.0 mg/L
#J6	ANZG (2023) 125 mg/L for poultry, 250 mg/L for lactating cows and ewes with lambs, 500 mg/L for ruminants in general - also, if sulphate levels are high, poultry performance may be affected at magnesium concentrations >50 mg/L
#L	DWER (2021) Microbial assessment levels (MAL) for water in urban recreational areas, open spaces, parks and gardens with unrestricted access and application, refer Table D2
#M	DWER (2021) For PFAS, values equal to the drinking water guideline values are appropriate Tier 1 screening levels for non-potable uses
#N	COK (2020) Common wastewater effluent criteria for on-site disposal in the Mandoon-Helena Catchment
#O	SRT (1999) Swan-Canning Cleanup Program: Action Plan, water quality targets adopted for screening purposes, compliance is based on combined data from three years
#O1	SRT (1999) Total nitrogen maximum concentrations for short and long-term catchment water quality targets: 1.0 mg/L long term/20 years and 2.0 mg/L short term/5 years. Recommended total nitrogen targets for the Helena River inflow: 1.0 mg/L.
#O2	SRT (1999) Total phosphorus maximum concentrations for short and long-term catchment water quality targets: total phosphorus = 0.1 mg/L long term/20 years and 0.2 mg/L short term/5 years. Recommended total phosphorus targets for the Helena River inflow: 0.1 mg/L.
#P	NHMRC (2019) Australian recreational water Health Based Guideline Value (HBGV), not protective of a pathway of PFAS accumulation in fish/shellfish, and subsequent human consumption (e.g. by recreational fishers or Noongar people sourcing traditional foods)
#Q	HEPA (2025) PFAS National Environmental Management Plan (NEMP), Version 3.1, interim guideline for 99% level of species protection used for high conservation value systems. Interim guidelines do not account for bioaccumulation and biomagnification effects of toxicants in air-breathing animals or in animals which prey on aquatic organisms. Interim guideline to be used until final PFOA guidelines can be set using the nationally agreed process under the ANZG.
#S	DOH (2011) Guidelines for the Non-Potable Uses of Recycled Water in Western Australia, Government of Western Australia Department of Health
#S1	DOH (2011) Compliance value for minimum ongoing monitoring for a high level of exposure risk (i.e. residential and urban use with unrestricted access and application) used for screening purposes, Table 8
#S2	DOH (2011) Compliance value for commissioning validation and verification monitoring for a high level of exposure risk (i.e. residential and urban use with unrestricted access and application) used in the absence of ongoing monitoring values, Table 7
#T	Isotope dilution is used for calibration of each native compound for which an exact labelled analogue is available (Isotope Dilution Quantitation) - the isotopically labelled analogues allow identification and recovery correction of the concentration of the associated native PFAS compounds
#U	Where the native PFAS compound does not have labelled analogue, then the quantification is made using the Extracted Internal Standard Analyte with the closest retention time to the analyte and no recovery correction has been made (Internal Standard Quantitation)
#V	*E. coli* to be used as a faecal pathogen indicator but where salinity exceeds one per cent (10,000 ppm), *Enterococci* should be substituted for *E. coli*
#W	DWER (2020) South West Index of River Condition (SWIRC), <4 mg/L is considered to be the lower limit for dissolved oxygen when assessing river condition

BoorYul-Bah-Bilya (Mandoon Bilya-Helena River)
LHAAC Water and Sediment Sampling, 2024-2025
Table T3a Sediment Sampling Results 2025 - Leachable Analysis

Group	Analysis	Default Guideline Values (DGVs): Freshwater Ecosystem			Human Health				Primary Industries			LOR (mg/L)	Helena Swan	Whiteman Rd	Helena Roe	Samson St	Nyaania Pool	Craignish US	Lower Pumpback Dam	Rocky Pool	Pipe Bridge	Cobblers Pool	LookSee Pool	Piesse Culvert	Salty Pool	Beraking Yarra
		Freshwater Ecosystem (99%)	Swan-Canning Targets	Wastewater Effluent Criteria	Drinking Water Health	Drinking Water Aesthetic	Non-Potable Use	Recreation & Swimming	Agriculture - Long-Term Irrigation	Agriculture - Short-Term Irrigation	Livestock Watering															
Nutrients	Ammonia-N	0.32[#G2]					0.388[#C]	0.01[#D]				< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
	Nitrate-N	0.64-1.0[#H4]			11[#A5]		113[#C]	10[#D]			25[#J3]	< 0.01	0.04	0.06	0.04	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.03
	Nitrite-N				0.9[#A6]		9.12[#C]	1[#D]			10[#J3]	< 0.01	0.01	0.04	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.02
	Total Oxidised Nitrogen (as NOx-N)	0.15[#G3]										< 0.01	0.06	0.1	0.05	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.05
	Total Kjeldahl Nitrogen											< 0.2	1.0	2.3	0.7	4.0	1.1	1.3	0.7	0.9	0.5	0.8	0.7	12	1.1	11
	Nitrogen (organic)											< 0.2	1.0	2.3	0.7	4.0	1.1	1.3	0.7	0.9	0.5	0.8	0.7	12	1.1	11
	Nitrogen (total)	1.2[#G3]	1.0[#O1]	<10[#N]					5[#F1]	25[#F2]		< 0.2	1.1	2.4	0.7	4.0	1.1	1.3	0.7	0.9	0.5	0.8	0.7	12	1.1	11
	Phosphorus (filterable reactive)	0.04[#G3]										< 0.01	0.08	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Phosphorus (total)	0.065[#G3]	0.1[#O2]	<2[#N]					0.05[#F1]	0.8[#F2]		< 0.01	0.77	0.32	0.20	0.19	0.22	0.19	0.13	0.14	0.09	0.11	0.08	0.27	0.16	0.08
Metals (Filtered)**	Aluminium	0.027[#H7]			20[#B]	0.2[#A]	0.2[#C]	0.2[#D]	5[#F1]	20[#F2]	3.6[#J1]	< 0.05	1.4	13	10	14	9.3	0.98	13	6.2	45	2.7	18	19	14	24
	Arsenic	0.008[#H1]			0.01[#A]			0.05[#D]	0.1[#F1]	2[#F2]	0.025[#J]	< 0.001	< 0.001	0.001	0.002	0.001	0.003	< 0.001	< 0.001	0.002	0.002	< 0.001	< 0.001	0.002	0.002	< 0.001
	Barium				2[#A]		20[#C]	1[#D]			2[#E1]	< 0.02	0.14	2.3	0.77	0.49	0.92	0.21	0.21	0.50	0.15	0.20	0.14	0.17	0.82	0.17
	Beryllium				0.06[#A]		0.6[#C]	0.6[#C]	0.1[#F1]	0.5[#F2]	0.06[#J]	< 0.001	< 0.001	0.007	0.001	< 0.001	0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Boron	0.09[#G]			4[#A]		40[#C]	1[#D]	0.5[#F1]	0.5[#F2]	5[#J]	< 0.05	0.32	0.53	0.32	0.26	0.56	0.24	0.33	0.26	0.20	0.23	0.21	< 0.05	0.46	0.25
	Cadmium	0.00006[#H]			0.002[#A]		0.02[#C]	0.005[#D]	0.01[#F1]	0.05[#F2]	0.01[#J]	< 0.0002	< 0.0002	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
	Chromium	0.00095[#H2]			0.05[#A2]			0.05[#D]	0.1[#F1]	1[#F2]	0.05[#J]	< 0.001	0.001	0.008	0.025	0.014	0.043	< 0.001	0.005	0.034	0.026	0.002	0.012	0.036	0.028	0.010
	Chromium III	0.00095[#H2]			22[#B]						0.05[#J]	< 0.002	< 0.002	0.008	0.025	0.014	0.043	< 0.002	0.005	0.034	0.026	0.002	0.012	0.036	0.028	0.010
	Chromium VI	0.00001[#H]			0.05[#A]		0.5[#C]	0.5[#C]			0.05[#J]	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
	Cobalt	0.0014[#H3]			0.006[#B]				0.05[#F1]	0.1[#F2]	1[#J]	< 0.001	< 0.001	0.006	0.008	0.007	0.012	0.01	< 0.001	0.009	0.001	< 0.001	< 0.001	0.003	0.006	0.002
	Copper	0.001[#H]			2[#A]	1[#A]	20[#C]	1[#D]	0.2[#F1]	5[#F2]	0.5[#J2]	< 0.001	0.003	0.044	0.013	0.015	0.032	0.08	0.005	0.018	0.003	0.003	0.003	0.033	0.010	0.003
	Iron	0.14[#H5]			14[#B]	0.3[#A]	0.3[#C]	0.3[#D]	0.2[#F1]	10[#F2]	NST	< 0.05	1.6	19	28	15	47	2.0	3.1	35	18	4.0	7.4	4.9	27	4.3
	Lead	0.001[#H]			0.01[#A]		0.1[#C]	0.05[#D]	2[#F1]	5[#F2]	0.1[#J]	< 0.001	0.004	0.081	0.026	0.013	0.038	0.001	0.002	0.015	0.005	0.001	0.003	0.012	0.012	0.005
	Lithium				0.04[#B]						0.04[#E1]	< 0.001	< 0.001	0.002	0.02	0.005	0.02	< 0.001	0.003	0.02	0.006	< 0.001	0.002	0.01	0.02	0.008
	Manganese	1.2[#H]			0.5[#A]	0.1[#A]	5[#C]	0.1[#D]	0.2[#F1]	10[#F2]	10[#J]	< 0.005	0.012	0.21	0.19	0.15	0.17	0.042	< 0.005	0.076	0.006	< 0.005	0.006	0.083	0.080	0.024
	Nickel	0.008[#H]			0.02[#A]		0.2[#C]	0.1[#D]	0.2[#F1]	2[#F2]	1[#J]	< 0.001	< 0.001	0.011	0.016	0.007	0.025	< 0.001	0.002	0.019	0.007	< 0.001	0.002	0.011	0.016	0.004
	Selenium	0.005[#H]			0.01[#A]		0.1[#C]	0.01[#D]	0.02[#F1]	0.05[#F2]	0.02[#J]	< 0.001	< 0.001	< 0.001	0.002	0.001	0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Titanium											< 0.005	0.051	0.067	0.92	0.58	2.3	0.050	0.23	1.9	0.88	0.095	0.46	1.2	1.3	0.85
	Uranium	0.0005[#H3]			0.02[#A]		0.2[#C]	0.2[#C]	0.01[#F1]	0.1[#F2]	0.2[#J]	< 0.005	< 0.005	0.032	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
	Vanadium	0.006[#H3]			0.086[#B]				0.1[#F1]	0.5[#F2]	0.1[#J]	< 0.005	< 0.005	0.087	0.052	0.028	0.084	< 0.005	0.007	0.091	0.052	< 0.005	0.030	0.072	0.056	0.023
	Zinc	0.0024[#H]			6[#B]	3[#A]	3[#C]	5[#D]	2[#F1]	5[#F2]	20[#J]	< 0.005	0.022	0.31	0.13	0.12	0.31	0.025	0.059	0.15	0.11	0.050	0.054	0.060	0.21	0.061
	Zirconium				0.0016[#B]						0.0016[#E1]	< 0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Herbicides & Pesticides**	Acidic Herbicides											Various ug/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Base Neutral Pesticides											Various ug/L	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Organochloride & Organophosphate Pesticides											Various ug/L	< LOR	< LOR	< LOR	< LOR	< LOR	See below	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Dieldrin	0.01[#H3]			0.3[#A1]		3[#C1]	1[#D]			0.3[#E1]	< 0.001 ug/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hydrocarbons**	Total Recoverable Hydrocarbons (TRH)											Various	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	BTEX Compounds											Various	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Polycyclic Aromatic Hydrocarbons (PAH)											< 0.001	< 0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Per- and Polyfluoroalkyl Substances (PFAS)**	Per- and Polyfluoroalkyl Substances											Various ug/L	See below	See below	See below	See below	See below	< LOR	See below	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Perfluorohexanoic acid (PFHxA)[#T]											< 0.001 ug/L	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluorooctanoic acid (PFOA)[#T]	19[#Q]			0.2[#A]		0.2[#M]	10[#P]			0.2[#E1]	< 0.001 ug/L	< 0.001	< 0.001	< 0.001	< 0.001	0.003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Perfluorooctanesulfonic acid (PFOS)[#T]	0.0005-0.02[#H6]			0.008[#A]		0.008[#M]	2[#P]			0.008[#E1]	< 0.0001 ug/L	0.0051	0.0025	0.0049	0.0034	0.0093	<0.0001	0.0040	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Perfluorohexanesulfonic acid (PFHxS)[#T]				0.03[#A]		0.03[#M]	2[#P]			0.03[#E1]	<0.001 ug/L	< 0.001	< 0.001	< 0.001	0.001	0.002	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Sum PFAS (n=30)											< 0.005 ug/L	< 0.05	< 0.05	< 0.05	< 0.05	0.015	< 0.005	0.006	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
	Sum WA DWER PFAS (n=10)											< 0.005 ug/L	< 0.005	< 0.005	< 0.005	< 0.005	0.0153	< 0.005	0.006	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Surfactants	Methylene Blue Active Substance (MBAS)							0.2[#D]				< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Water Quality Parameters	pH at 25°C	6.5-8.0[#G3]		6.5-8.5[#N]	6.5-8.5[#A]		6.5-8.5[#S1]	6.5-8.5[#D]	6-8.5[#F]	6-8.5[#F]		< 0.1 pH	7.5	8.0	7.5	6.5	6.8	6.4	6.1	6.7	6.5	6.8	6.8	7.4	6.7	7.1
	Salinity at 25°C											< 10	44	72	73	39	45	44	47	24	21	35	31	15	110	18
	Total Organic Carbon											< 5[#U]	< 100	160	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100

Notes

123	Concentration is at or above the DGV for primary industries
123	Concentration is at or above the DGV for freshwater ecosystems
123	Concentration is at or above the DGV for freshwater ecosystems and primary industries
123	Concentration is at or above the DGV for recreation & swimming
123	Concentration is at or above the DGV for human health and primary industries and/or freshwater ecosystems
< LOR	Concentration not detected above the laboratory limit of reporting

All units in mg/L unless otherwise specified.

Sediment analysis methods differed in 2025 and 2024, so the results cannot be directly compared. 2025 analysis = leachable concentrations in sediment as a liquid. 2024 analysis = total concentrations in sediment as a solid. Leachable analysis was undertaken in 2025 as a better metric for risk assessment.

Metals analysis methods differed between 2025 and 2024, so the results cannot be directly compared. 2025 analysis = dissolved metals concentrations from filtered samples. 2024 analysis = total metal concentrations from unfiltered samples. Dissolved metals analysis was undertaken in 2025 to assess bioavailability - a better metric for risk assessment.

** Only analytes with detectable concentrations are shown. Other contaminants were not detected above the laboratory limit of reporting (< LOR) as detailed below. Refer laboratory documentation for a full list of analytes and limits of reporting.
The following **metals and other inorganics** were not detected at any location: antimony, chromium VI, cyanide, mercury, molybdenum, silver, thallium, thorium and tin.
The following **acidic herbicides** were not detected at any location: 2.4-D, 2.4.5-T, 2.4.6-T, Clopyralid, Dicamba, Fluazifop, MCPA, Metsulfuron Methyl, Picloram and Triclopyr.
The following **base neutral pesticides** were not detected at any location: Amitraz, Atrazine, Azinphos Methyl, Chlorpyrifos, Diclofop Methyl, Dimethoate, Diuron, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Fenamiphos, Fenitrothion, Fluometuron, Hexazinone, Metolachlor, Molinate, Myclobutanil, Prometryn, Propazine, Propiconazole, Simazine, Tebuconazole, Terbutryn and Trifluralin.
The following **organochloride & organophosphate pesticides** were not detected at any location: Aldrin, BHC (HCH), Bifenthrin, Bromophos Ethyl, Chlordane, Chlorothalonil, Chlorpyrifos, Diazinon, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Endrin, Ethion, Fenitrothion, Fipronil, Hexachlorobenzene (HCB), Heptachlor Epoxide, Heptachlor, Lindane, Malathion, Methoxychlor, o.p-DDT, Oxychlordane, p.p-DDD, p.p-DDE, p.p-DDT, Parathion Ethy, Parathion Methy, Trifluralin and Vinclozolin.
The following **total recoverable hydrocarbon (TRH)** fractions were not detected at any location: C6-C9, C10-C14, C15-C28, C29-C36, C10-C36 and C6-C10, C6-C10 (F1) less BTEX, >C10-C16, >C10-C16 (F2) less naphthalene, >C16-C34, >C34-C40, >C10-C40.
The following **BTEX compounds** were not detected at any location: Benzene, Toluene, Ethylbenzene, m&p-Xylenes, o-Xylenes and Xylenes.
The following **polycyclic aromatic hydrocarbons (PAH)** were not detected at any location: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b&j)fluoranthene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a.h)anthracene, Fluoranthene, Fluorene, Indeno(1.2.3-cd)pyrene, Naphthalene, Phenanthrene, Pyrene and Total PAH.
The following **per- and polyfluoroalkyl substances (PFAS)** were not detected at any location:
Perfluoroalkyl carboxylic acids (PFCAs): Perfluorobutanoic acid (PFBA), Perfluoropentanoic acid (PFPeA), Perfluoroheptanoic acid (PFHpA), Perfluorononanoic acid (PFNA), Perfluorodecanoic acid (PFDA), Perfluorotridecanoic acid (PFTrDA), Perfluoroundecanoic acid (PFUnDA), Perfluorododecanoic acid (PFDoDA) and Perfluorotetradecanoic acid (PFTeDA).
Perfluoroalkyl sulfonic acids (PFSAs): Perfluorobutanesulfonic acid (PFBS), Perfluorononanesulfonic acid (PFNS), Perfluoropropanesulfonic acid (PFPrS), Perfluoropentanesulfonic acid (PFPeS), Perfluoroheptanesulfonic acid (PFHpS) and Perfluorodecanesulfonic acid (PFDS).
n:2 Fluorotelomer sulfonic acids (n:2 FTSAs): 1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA), 1H.1H.2H.2H-perfluorooctanesulfonic acid(6:2 FTSA), 1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA), 1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)
Perfluoroalkyl sulfonamido substances: Perfluorooctane sulfonamide (FOSA), N-methylperfluoro-1-octane sulfonamide (N-MeFOSA), N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA), 2-(N-methylperfluoro-1-octane sulfonamido)-ethanol(N-MeFOSE), 2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol(N-EtFOSE), N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA) and N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA).
Total polychlorinated biphenyls (PCB) and volatile & semi-volatile organic compounds (VOC & SVOC) were not analysed in 2025.
* pH recorded in the laboratory differs from that recorded in the field, likely because the laboratory test must begin within 30 minutes of sampling.

ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1 The Guidelines. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand. October 2000. Available at: https://www.waterquality.gov.au/anz-guidelines/resources/previous-guidelines/anzecc-armcanz-2000
ANZG (2026) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian State and Territory Governments, created 2018 and updated April 2026. Available at: https://www.waterquality.gov.au/anz-guidelines
ANZG (2023) Draft Livestock Drinking Water Guidelines. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian State and Territory Governments. November 2023. Available at: https://www.waterquality.gov.au/sites/default/files/documents/livestock-drinking-water-guidelines-draft.pdf
COK (2020) City of Kalamunda (2020) Notice of Determination on Application for Planning Approval, Lot 3 (415) Mundaring Weir Road, Piesse Brook, Kalamunda
DOH (2014) Contaminated Sites Groundwater and Surface Water Chemical Screening Guidelines. Government of Western Australia Department of Health. December 2014. Available at: https://www.health.wa.gov.au/-/media/Files/Corporate/general-documents/Environmental-health/Ground-and-Surface-Chemical-Water-Screening-Guidelines.pdf
DOH (2011) Guidelines for the Non-Potable Uses of Recycled Water in Western Australia. Government of Western Australia Department of Health. 2011. Available at: https://www.health.wa.gov.au/~/media/Files/Corporate/general-documents/water/Recycling/Guidelines-for-the-Non-potable-Uses-of-Recycled-Water-in-WA.pdf
DWER (2021) Assessment and Management of Contaminated Sites: Guidelines. Government of Western Australia Department of Water and Environmental Regulation. November 2021. Available at: https://www.wa.gov.au/system/files/2023-05/guideline-assessment-and-management-of-contaminated-sites.pdf
DWER (2020) South West Index of River Condition (SWIRC). Government of Western Australia Department of Water and Environmental Regulation. December 2020. Available at: https://rivers.dwer.wa.gov.au/wp-content/uploads/2023/05/RSTS-1_2020_Storer-et-al_South-West-Index-of-River-Condition-overview.pdf
HEPA (2025) PFAS National Environmental Management Plan (NEMP), Version 3.1. Heads of EPA Australia and New Zealand. 2025. Available at: https://www.dcceew.gov.au/sites/default/files/documents/pfas-nemp-3-1.pdf
NHMRC (2019) Guidance on Per and Polyfluoroalkyl (PFAS) in Recreational Water. National Health and Medical Research Council & Natural Resource Management Ministerial Council, Commonwealth of Australia. 2019. Available at: https://www.nhmrc.gov.au/sites/default/files/documents/attachments/guidance-on-PFAS-in-recreational-water.pdf
NHMRC (2011) Australian Drinking Water Guidelines 6, National Water Quality Management Strategy, Version 4.0 National Health and Medical Research Council & Natural Resource Management Ministerial Council, Commonwealth of Australia. Updated June 2025. Available at: https://www.nhmrc.gov.au/about-us/publications/australian-drinking-water-guidelines
SRT (1999) Swan-Canning Cleanup Program: Action Plan. Swan River Trust, Government of Western Australia. May 1999. Available at: https://library.dbca.wa.gov.au/static/FullTextFiles/22030.pdf
US EPA (2024) Regional Screening Levels - Generic Tables. United States Environmental Protection Agency. December 2024. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

#A NHMRC (2011) Australian Drinking Water Guidelines (ADWG)
#A1 NHMRC (2011) Guideline is for aldrin + dieldrin
#A2 NHMRC (2011) Guideline for Cr (VI) conservatively adopted for comparison to total chromium
#A3 NHMRC (2011) Guideline is for total cyanide, but other forms (free, WAD, SAD) should also be below the guideline
#A5 NHMRC (2011) Converted from guideline for nitrate (as nitrate) - will protect bottle-fed infants under 3 months from methemoglobinemia; adults and children can safely drink up to 100 mg/L
#A6 NHMRC (2011) Converted from guideline for nitrite (as nitrite), rapidly oxidised to nitrate (see above)
#B US EPA (2024) Tap Water Regional Screening Level (TR=1E-06; THQ=0.1) used in the absence of Australian Drinking Water Guidelines
#C DOH (2014) Guidelines for Non-Potable Use (NPUG) including watering gardens and edible garden produce, irrigating parks and reserves, and washing cars and clothes
#C1 DOH (2014) Guideline is for aldrin + dieldrin
#D ANZECC (2000) Guidelines for Recreational Water Quality and Aesthetics, refer Table 5.2.3 (general chemicals) and Table 5.2.4 (pesticides)
#E ANZECC (2000) Guidelines for Primary Industries - Livestock Drinking Water Quality
#E1 ANZECC (2000) Livestock Drinking Water Quality - in the absence of adequate information derived specifically for livestock under Australian and New Zealand conditions, it is recommended that the drinking water guidelines for human health be adopted
#F ANZECC (2000) Guidelines for Primary Industries - Water Quality for Irrigation and General Water Use
#F1 ANZECC (2000) Primary Industries - Water Quality for Irrigation and General Water Use, Long Term Trigger Values (LTV), refer Table 4.2.10 - LTV are applicable to application of irrigation water for up to 100 years in a non-domestic setting; for shorter periods, STV may be more appropriate
#F2 ANZECC (2000) Primary Industries - Water Quality for Irrigation and General Water Use, Short Term Trigger Values (STV), refer Table 4.2.10
#G ANZECC (2000) Trigger Values for Freshwater Aquatic Ecosystems for slightly to moderately disturbed systems at 99% level of species protection (LOSP)
#G1 ANZECC (2000) Guideline is for unionised cyanide (HCN), measured as CN, but has been applied to all forms for screening purposes
#G2 ANZECC (2000) Ammonia as total ammonia (NH3-N) at pH 8 - guideline drops to 2.18 mg/L at pH 7, refer Vol 2, Table 8.3.7
#G3 ANZECC (2000) Default trigger values for lowland rivers and slightly disturbed ecosystems in south-west Australia, values reflect high site-specific and regional variability, refer Table 3.3.6 and 3.3.7
#H ANZG (2026) Default Australian Water Quality Guidelines for Toxicants in Freshwater Ecosystems at 99% level of species protection (LOSP)
#H1 ANZG (2026) Guideline for As (VI) conservatively adopted for comparison to total arsenic
#H2 ANZG (2026) Guideline for chromium III applied in the absence of detectable chromium VI
#H3 ANZG (2026) Unknown level of species protection (LOSP)
#H4 ANZG (2026) Guidelines for 99% LOSP for soft water (<30 mg/L as CaCO3) is 0.64 mg/L, for moderately hard water (30-150 mg/L) is 1.0 mg/L, and for hard water (>150 mg/L) is 18 mg/L, protects against toxicity and not against eutrophication
#H5 ANZG (2026) Guideline for 99% LOSP, applies to total concentrations, rather than filtered/dissolved concentrations, but applied for screening purposes in this assessment in the absence of any other guidelines
#H6 ANZG (2026) Guidelines of 0.02 ug/L for 99% LOSP to aquatic species (including plants, invertebrates and fish), both via direct toxicity and bioaccumulation pathways, and 0.0005 ug/L for 99% LOSP to air-breathing animals that live in aquatic ecosystems or prey on aquatic organisms.
#H7 ANZG (2026) Guidelines for 99% LOSP at pH >6.5
#J ANZG (2023) Draft Livestock Drinking Water Guidelines
#J1 ANZG (2023) 3.6 mg/L for chickens, 5 mg/L for general livestock
#J2 ANZG (2023) 0.5 mg/L for sheep, 1 mg/L for cattle, 5 mg/L for pigs and poultry
#J3 ANZG (2023b) Nitrate = 25 mg/L for poultry, 100 mg/L for livestock in general, 400 mg/L for cattle; nitrite = 10 mg/L for livestock in general - levels of nitrate tolerance are lowest in poultry, medium in pigs and highest in cattle
#M DWER (2021) For PFAS, values equal to the drinking water guideline values are appropriate Tier 1 screening levels for non-potable uses
#N COK (2020) Common wastewater effluent criteria for on-site disposal in the Mandoon-Helena Catchment
#O SRT (1999) Swan-Canning Cleanup Program: Action Plan, water quality targets adopted for screening purposes, compliance is based on combined data from three years
#O1 SRT (1999) Total nitrogen maximum concentrations for short and long-term catchment water quality targets: 1.0 mg/L long term/20 years and 2.0 mg/L short term/5 years. Recommended total nitrogen targets for the Helena River inflow: 1.0 mg/L.
#O2 SRT (1999) Total phosphorus maximum concentrations for short and long-term catchment water quality targets: total phosphorus = 0.1 mg/L long term/20 years and 0.2 mg/L short term/5 years. Recommended total phosphorus targets for the Helena River inflow: 0.1 mg/L.
#P NHMRC (2019) Australian recreational water Health Based Guideline Value (HBGV), not protective of a pathway of PFAS accumulation in fish/shellfish, and subsequent human consumption (e.g. by recreational fishers or Noongar people sourcing traditional foods)
#Q HEPA (2025) PFAS National Environmental Management Plan (NEMP), Version 3.1, interim guideline for 99% level of species protection used for high conservation value systems. Interim guidelines do not account for bioaccumulation and biomagnification effects of toxicants in air-breathing animals or in animals which prey on aquatic organisms. Interim guideline to be used until final PFOA guidelines can be set using the nationally agreed process under the ANZG.
#S DOH (2011) Guidelines for the Non-Potable Uses of Recycled Water in Western Australia, Government of Western Australia Department of Health
#S1 DOH (2011) Compliance value for minimum ongoing monitoring for a high level of exposure risk (i.e. residential and urban use with unrestricted access and application) used for screening purposes, refer Table 8
#T Isotope dilution is used for calibration of each native compound for which an exact labelled analogue is available (Isotope Dilution Quantitation) - the isotopically labelled analogues allow identification and recovery correction of the concentration of the associated native PFAS compounds
#U Laboratory limit of reporting (LOR) was raised due to matrix interference

BoorYul-Bah-Bilya (Mandoon Bilya-Helena River)
LHAAC Water and Sediment Sampling, 2024-2025
Table T3b Sediment Sampling Results 2024 - Solid Analysis

Group	Analysis	Guideline Values (DGVs) ANZG (2018)[#]	Guideline Values (DGVs) ANZECC (2000)[##]	LOR (mg/kg)	Helena Swan	Whiteman Rd	Helena Roe	Craignish US	Lower Pumpback Dam	Rocky Pool	Pipe Bridge	Cobblers Pool*	LookSee Pool	Piesse Culvert	Salty Pool*	Beraking Yarra
Major Ions	Calcium			< 5	990	2,800	480	1,500	770	940	1,000	1,200	2,200	2,000	1,700	610
	Chloride			< 10	67	450	180	76	18	24	35	100	120	38	1,300	34
	Fluoride			< 0.1	0.3	< 0.1	0.4	0.1	0.2	0.7	< 0.1	< 0.1	< 0.1	0.4	0.3	< 0.1
	Magnesium			< 5	590	1,400	490	1,800	840	950	770	690	780	510	1,500	690
	Potassium			< 5	190	450	87	1,100	370	510	210	310	210	150	200	410
	Sodium			< 5	< 5	400	140	< 5	< 5	< 5	150	220	190	< 5	1,000	250
	Sulphate			< 10	70	310	72	200	140	27	130	70	160	120	150	< 10
Nutrients	Ammonia-N			< 10	30	28	29	51	32	33	59	45	65	56	43	42
	Nitrate-N			< 1	1.4	1.9	1.0	< 1	< 1	2.0	< 1	< 1	< 1	1.2	< 1	< 1
	Nitrite-N			< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
	Total Oxidised Nitrogen (as NOx-N)			< 1	1.4	2.0	1.1	< 1	< 1	2.1	< 1	< 1	< 1	1.4	< 1	< 1
	Total Kjeldahl Nitrogen			< 10	620	32,000	510	1,500	870	800	38,000	28,000	43,000	4,800	4,600	750
	Nitrogen (total)			< 10	620	32,000	510	1,500	870	800	38,000	28,000	43,000	4,800	4,600	750
	Phosphorus (reactive)			< 1	< 1	< 1	< 1	1.5	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1.8
	Phosphorus (total)			< 1	230	6.0	54	88	80	57	88	93	90	280	110	26
Metals (Total)**	Aluminium			< 20	7,300	17,000	5,000	7,600	5,800	7,200	17,000	13,000	14,000	35,000	8,500	11,000
	Arsenic	20	20	< 2	< 2	3.4	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
	Barium			< 10	34	110	25	61	28	33	44	39	35	78	65	49
	Beryllium			< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	2.1	< 2	< 2
	Cadmium	1.5	1.5	< 0.1	< 0.1	0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.3	< 0.1	< 0.1
	Chromium (total)	80	80	< 1	11	22	6.7	12	9.8	10	17	9.7	11	30	14	8.9
	Chromium (III)			< 1	11	22	6.7	12	9.8	10	17	9.7	11	30	14	8.9
	Chromium (VI)			< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
	Cobalt			< 5	< 5	12	< 5	7.9	< 5	< 5	< 5	< 5	< 5	7.3	< 5	< 5
	Copper	65	65	< 1	11	22	6.2	16	5.8	6.6	7.1	8.2	7.3	86	7.1	6.6
	Iron			< 20	19,000	59,000	9,700	16,000	15,000	14,000	12,000	13,000	11,000	45,000	17,000	7,700
	Lead	50	50	< 1	33	42	15	11	14	15	17	17	14	46	15	29
	Lithium			< 5	< 5	6.9	< 5	< 5	< 5	< 5	< 5	< 5	< 5	5.8	< 5	< 5
	Manganese			< 5	110	280	33	120	65	130	12	38	29	210	47	47
	Mercury	0.15	0.15	< 0.02	< 0.02	0.23	0.03	< 0.02	< 0.02	< 0.02	0.05	0.03	0.07	0.06	0.03	0.03
	Nickel	21	21	< 1	3.3	8.7	1.9	6.4	1.8	2.5	3.4	3.8	3.3	7.7	5.0	8.3
	Thorium			< 5	7.7	13	5.5	8.5	11	11	15	12	13	13	13	15
	Titanium			< 10	26	140	33	220	110	94	71	58	48	59	30	19
	Uranium			< 10	< 10	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	18	< 10	13
	Vanadium			< 10	24	58	20	32	26	28	51	37	35	130	42	44
	Zinc	200	200	< 5	48	110	34	23	17	25	190	27	25	67	15	5.6
	Zirconium			< 1	1.2	< 1	< 1	2.9	2.0	1.9	5.4	3.4	6.0	4.9	9.1	2.8
Herbicides & Pesticides**	Acidic Herbicides			Various	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Base Neutral Pesticides			Various	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Organochloride & Organophosphate Pesticides			Various	< LOR	See below	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	See below	< LOR	< LOR
	Bifenthrin			< 0.2	< 0.2	0.7	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	DDE	0.0014	0.0022	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05	< 0.01	< 0.01
	DDT	0.0012	0.0016	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.03	< 0.01	< 0.01
Hydrocarbons**	TRH C6-C9			< 20	< 20	33	25	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
	TRH C10-C14			< 20	< 20	43	< 20	22	< 20	< 20	94	51	72	< 20	80	24
	TRH C15-C28			< 50	< 50	210	< 50	99	< 50	64	620	410	440	< 50	510	100
	TRH C29-C36			< 50	< 50	120	< 50	88	65	52	410	280	260	< 50	380	70
	TRH C10-C36 (total)			< 50	< 50	373	< 50	209	65	116	1,124	741	772	< 50	970	194
	TRH C6-C10			< 20	< 20	77	56	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
	TRH C6-C10 (less BTEX) (F1)			< 20	< 20	77	56	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
	TRH >C10-C16			< 50	< 50	95	< 50	< 50	< 50	< 50	240	170	170	< 50	170	< 50
	TRH >C10-C16 (less naphthalene) (F2)			< 50	< 50	94.3	< 50	< 50	< 50	< 50	240	170	170	< 50	170	< 50
	TRH >C16-C34			< 100	< 100	240	< 100	130	110	< 100	710	510	520	< 100	680	130
	TRH >C34-C40			< 100	< 100	< 100	< 100	< 100	< 100	< 100	360	200	220	< 100	140	< 100
	TRH >C10-C40 (total)	280[#1]		< 100	< 100	335	< 100	130	110	< 100	1,310	880	910	< 100	990	130
	Total BTEX			Various	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Napthalene[#2]		0.16	< 0.5	< 0.5	0.7	0.8	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
	Total Polycyclic Aromatic Hydrocarbons (PAH)	10	4	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
PFAS**	PFAS Full Ultra Trace			5 ug/kg	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
Surfactants	Methylene Blue Active Substance (MBAS)[#3]			< 0.2	< 5	32	< 5	< 1	< 2	< 5	< 5	< 5	< 5	3.6	< 5	< 10
Volatiles**	Total Polychlorinated Biphenyls (PCB)[#4]	0.034	0.023	< 0.1	< 0.1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Semi-Volatile Organic Compounds (SVOC)			Various	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
	Volatile Organic Compounds (VOC)			Various	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR	< LOR
Water Quality Parameters	Alkalinity (mg CaCO3/kg)			< 50	< 50	70	< 50	< 50	< 50	< 50	< 50	< 50	< 50	53	< 50	50
	Moisture Content			< 1 %	24	47	26	37	29	30	55	40	58	42	39	41
	pH			< 0.1	6.1	6.3	5.9	6.0	5.6	5.8	5.7	5.7	6.0	6.7	6.1	6.1
	Total Organic Carbon			< 0.1	< 0.1	3.2	15	0.4	17	0.8	9.4	3.0	23	43	4.1	1.9

Notes

123 — Concentration is at or above the DGV for freshwater ecosystems

All units in mg/kg unless otherwise specified.

* Salty Pool is named "Helena Pony" in field notes and laboratory documentation.

* Cobblers Pool is named "Skeleton Pool" in field notes and laboratory documentation.

Sediment analysis methods differed in 2025 and 2024, so the results cannot be directly compared. 2025 analysis = leachable concentrations in sediment as a liquid. 2024 analysis = total concentrations in sediment as a solid. Leachable analysis was undertaken in 2025 as a better metric for risk assessment.

Metals analysis methods differed between 2025 and 2024, so the results cannot be directly compared. 2025 analysis = dissolved metals concentrations from filtered samples. 2024 analysis = total metal concentrations from unfiltered samples. Dissolved metals analysis was undertaken in 2025 to assess bioavailability - a better metric for risk assessment.

** Only analytes with detectable concentrations are shown. Other contaminants were not detected above the laboratory limit of reporting (< LOR) as detailed below.

The following **metals and other inorganics** were not detected at any location: antimony, boron, chromium VI, cyanide, molybdenum, selenium, silver, thallium and tin.

The following **acidic herbicides** were not detected at any location: 2.4-D, 2.4.5-T, 2.4.6-T, Clopyralid, Dicamba, Fluazifop, MCPA, Metsulfuron Methyl, Picloram and Triclopyr.

The following **base neutral pesticides** were not detected at any location: Amitraz, Atrazine, Azinphos Methyl, Chlorpyrifos, Diclofop Methyl, Dimethoate, Diuron, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Fenamiphos, Fenitrothion, Fluometuron, Hexazinone, Metolachlor, Molinate, Myclobutanil, Prometryn, Propazine, Propiconazole, Simazine, Tebuconazole, Terbutryn and Trifluralin.

The following **organochloride & organophosphate pesticides** were not detected at any location: Aldrin, BHC (HCH), Bromophos Ethyl, Chlordane, Chlorothalonil, Chlorpyrifos, Diazinon, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Endrin, Ethion, Fenitrothion, Fipronil, Hexachlorobenzene (HCB), Heptachlor Epoxide, Heptachlor, Lindane, Malathion, Methoxychlor, o.p-DDT, Oxychlordane, p.p-DDD, Parathion Ethy, Parathion Methy, Trifluralin and Vinclozolin.

The following **BTEX compounds** were not detected at any location: Benzene, Toluene, Ethylbenzene, m&p-Xylenes, o-Xylenes and Xylenes.

The following **polycyclic aromatic hydrocarbons (PAH)** were not detected at any location: Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b&j)fluoranthene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a.h)anthracene, Fluoranthene, Fluorene, Indeno(1.2.3-cd)pyrene, Phenanthrene, Pyrene and Total PAH.

The following **per- and polyfluoroalkyl substances (PFAS)** were not detected at any location:

Perfluoroalkyl carboxylic acids (PFCAs): Perfluoroalkyl carboxylic acids (PFCAs): Perfluorobutanoic acid (PFBA), Perfluoropentanoic acid (PFPeA), Perfluorohexanoic acid (PFHxA), Perfluoroheptanoic acid (PFHpA), Perfluorooctanoic acid (PFOA), Perfluorononanoic acid (PFNA), Perfluorodecanoic acid (PFDA), Perfluorotridecanoic acid (PFTrDA), Perfluoroundecanoic acid (PFUnDA), Perfluorododecanoic acid (PFDoDA) and Perfluorotetradecanoic acid (PFTeDA).

Perfluoroalkyl sulfonic acids (PFSAs): Perfluoroalkyl sulfonic acids (PFSAs): Perfluorobutanesulfonic acid (PFBS), Perfluorononanesulfonic acid (PFNS), Perfluorooctanesulfonic acid (PFOS), Perfluoropropanesulfonic acid (PFPrS), Perfluoropentanesulfonic acid (PFPeS), Perfluorohexanesulfonic acid (PFHxS), Perfluoroheptanesulfonic acid (PFHpS) and Perfluorodecanesulfonic acid (PFDS).

n:2 Fluorotelomer sulfonic acids (n:2 FTSAs): 1H.1H.2H.2H-perfluorohexanesulfonic acid (4:2 FTSA), 1H.1H.2H.2H-perfluorooctanesulfonic acid(6:2 FTSA), 1H.1H.2H.2H-perfluorodecanesulfonic acid (8:2 FTSA), 1H.1H.2H.2H-perfluorododecanesulfonic acid (10:2 FTSA)

Perfluoroalkyl sulfonamido substances: Perfluorooctane sulfonamide (FOSA), N-methylperfluoro-1-octane sulfonamide (N-MeFOSA), N-ethylperfluoro-1-octane sulfonamide (N-EtFOSA), 2-(N-methylperfluoro-1-octane sulfonamido)-ethanol(N-MeFOSE), 2-(N-ethylperfluoro-1-octane sulfonamido)-ethanol(N-EtFOSE), N-ethyl-perfluorooctanesulfonamidoacetic acid (N-EtFOSAA) and N-methyl-perfluorooctanesulfonamidoacetic acid (N-MeFOSAA).

The following **polychlorinated biphenyls (PCB)** were not detected at any location: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, Aroclor-1260 and Total PCB.

The following semi-**volatile organic compounds (SVOC)** were not detected at any location: 2-Methyl-4.6-dinitrophenol, 1-Chloronaphthalene, 1-Naphthylamine, 1.2-Dichlorobenzene, 1.2.3-Trichlorobenzene, 1.2.3.4-Tetrachlorobenzene, 1.2.3.5-Tetrachlorobenzene, 1.2.4-Trichlorobenzene, 1.2.4.5-Tetrachlorobenzene, 1.3-Dichlorobenzene, 1.3.5-Trichlorobenzene, 1.4-Dichlorobenzene, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol (o-Cresol), 2-Naphthylamine, 2-Nitroaniline, 2-Nitrophenol, 2-Picoline, 2.3.4.6-Tetrachlorophenol, 2.4-Dichlorophenol, 2.4-Dimethylphenol, 2.4-Dinitrophenol, 2.4-Dinitrotoluene, 2.4.5-Trichlorophenol, 2.4.6-Trichlorophenol, 2.6-Dichlorophenol, 2.6-Dinitrotoluene, 3&4-Methylphenol (m&p-Cresol), 3-Methylcholanthrene, 3.3'-Dichlorobenzidine, 4-Aminobiphenyl, 4-Bromophenyl phenyl ether, 4-Chloro-3-methylphenol, 4-Chlorophenyl phenyl ether, 4-Nitrophenol, 4.4'-DDD, 4.4'-DDE, 4.4'-DDT, 7.12-Dimethylbenz(a)anthracene, Acetophenone, Aniline, Benzyl chloride, Bis(2-chloroethoxy)methane, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butyl benzyl phthalate, Di-n-butyl phthalate, Di-n-octyl phthalate, Dibenz(a.j)acridine, Dibenzofuran, Diethyl phthalate, Dimethyl phthalate, Dimethylaminoazobenzene, Diphenylamine, Endrin aldehyde, Endrin ketone, g-HCH (Lindane), Heptachlor, Heptachlor epoxide, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Methoxychlor, N-Nitrosodibutylamine, N-Nitrosodipropylamine, N-Nitrosopiperidine, Nitrobenzene, Pentachlorobenzene, Pentachloronitrobenzene, Pentachlorophenol, Phenol and Pronamide.

The following **volatile organic compounds (VOC)** were not detected at any location: 1.1-Dichloroethane, 1.1-Dichloroethene, 1.1.1-Trichloroethane, 1.1.1.2-Tetrachloroethane, 1.1.2-Trichloroethane, 1.1.2.2-Tetrachloroethane, 1.2-Dibromoethane, 1.2-Dichlorobenzene, 1.2-Dichloroethane, 1.2-Dichloropropane, 1.2.3-Trichloropropane, 1.2.4-Trimethylbenzene, 1.3-Dichlorobenzene, 1.3-Dichloropropane, 1.3.5-Trimethylbenzene, 1.4-Dichlorobenzene, 2-Butanone (MEK), 2-Propanone (Acetone), 4-Chlorotoluene, 4-Methyl-2-pentanone (MIBK), Allyl Chloride, Bromobenzene, Bromochloromethane, Bromodichloromethane, Bromoform, Bromomethane, Carbon Disulfide, Carbon Tetrachloride, Chlorobenzene, Chloroethane, Chloroform, Chloromethane, cis-1.2-Dichloroethene, cis-1.3-Dichloropropene, Dibromochloromethane, Dibromomethane, Dichlorodifluoromethane, Iodomethane, Isopropyl benzene (Cumene), Methylene Chloride, Styrene, Tetrachloroethene, trans-1.2-Dichloroethene, trans-1.3-Dichloropropene, Trichloroethene, Trichlorofluoromethane and Vinyl Chloride.

ANZG (2019)[#]	Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Default guideline values for sediment quality, Table 1. Available at https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants
ANZECC (2000)[##]	Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1 The Guidelines. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand. October 2000. Recommended sediment quality guidelines - ISQG-Low (Trigger Value), Table 3.5.1. Available at: https://www.waterquality.gov.au/anz-guidelines/resources/previous-guidelines/anzecc-armcanz-2000
#1	ANZG (2019) Origin described in Appendix A5 of Simpson SL, Batley GE & Chariton AA (2013) Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines, CSIRO Land and Water Report 8/07, CSIRO Land and Water.
#2	Where both volatile (P&T GCMS) and semi volatile (GCMS) naphthalene is reported, results may not be identical. Any observed differences are likely due to procedural differences in each methodology. Results have passed all QAQC acceptance criteria and are technically valid.
#3	LORs were raised due to sample interference. Interference could be due to varying organic sulfonates, sulphates, carboxylates and phenols, and inorganic thiocyanates, cyanates, nitrates, and chlorides. MBAS was not detected above a LOR of 1-5 mg/kg for any sample.
#4	LOR was raised for one sample as a dilution was required due to the matrix. This is usually due to some types of sediments causing the PCB profile to be masked by the organic material in the sample, so the dilution is required to get a clear chromatogram.

BoorYul-Bah-Bilya (Mandoon Bilya-Helena River)
LHAAC Water and Sediment Sampling, 2024-2025
Table T4 eDNA Water Sampling – Summary of Key Findings

Group	Common Name	Scientific Name	SWIRC Code	Taxonomy	Helena Swan	Whiteman Rd	Helena Roe	Samson St	Nyaania Pool	Craignish US	Lower Pumpback Dam	Rocky Pool	Pipe Bridge	Cobblers Pool	LookSee Pool	Piesse Culvert	Salty Pool	Beraking Yarra
Fish	Western pygmy perch	*Nannoperca vittata*	NVIT	Species	X	X	X	X		X		X		X	X			
	Nightfish	*Bostockia porosa*	BPOR	Species	X	X	X	X		X	X			X	X			
	Western minnow	*Galaxias occidentalis*	GOCC	Species	X	X	X	X		X	X			X	X		X	
	Western hardyhead	*Leptatherina wallacei*	LWAL	Species						X								
	Grey mullet; Sea mullet	*Mugil cephalus*	MCEP	Species		X												
	Gobies	*Pseudogobius*		Genus	X	X	X	X		X				X	X			
	Hardyhead/Silversides	*Leptatherina*		Genus						X	X							
	Mullets	*Mugil*		Genus	X	X												
	Catfishes	*Siluriformes*		Order										X				
	Eastern mosquitofish	*Gambusia holbrooki*	GHOL	Species	X	X	X	X		X	X	X		X	X	X		
	European perch; Redfin perch	*Perca fluviatilis*	PFLU	Species										X	X			
	Common carp; koi carp	*Cyprinus carpio*	CCAR	Species										X				
	Western Australian dhufish	*Glaucosoma buergeri*		Species					X									
	Salmonids	*Salmonidae*		Family								X						
	Sunfishes and others	*Centrarchiformes*		Order	X	X	X			X	X				X			
Crayfish	Gilgie; freshwater crayfish	*Cherax quinquecarinatus*	CQUI	Species	X	X	X	X		X	X			X	X			
	Smooth marron	*Cherax cainii*	CCAI	Species	3 sites (locations withheld to protect against)													
	Common yabby	*Cherax destructor*	CDES	Species						X		X						
	Yabbies; crayfish	*Cherax*		Genus	X	X	X	X		X	X	X		X	X			
Macroinvertebrates: Crustaceans	Freshwater isopod	*Paramphisopus palustris*	PPAL	Species	X	X	X	X							X			
	South-west glass shrimp	*Palaemon australis*	PAUS	Species						X				X	X			
	Caridean shrimps; true shrimps	*Palaemon*		Genus										X	X			
	Indistinct river shrimp	*Caridina indistincta B*	CIND	Species		X	X			X								
Macroinvertebrates: Insects	Caddisflies	*Hydroptilidae sp.*		Species		X						X						
	Caddisflies	*Notalina*		Genus								X						
	Caddisflies	*Trichoptera*		Order	X	X	X		X			X		X	X	X		
	Mayflies	*Cloeon*		Genus										X	X			
	Mayflies	*Meridialaris*		Genus					X			X	X					
	Mayflies	*Ephemeroptera*		Order					X			X						
	Stoneflies	*Newmanoperla exigua*		Species								X						
	Stoneflies	*Newmanoperla*		Genus								X						
	Stoneflies	*Plecoptera*		Order								X						
	Blue-spotted hawker dragonfly	*Adversaeschna brevistyla*		Species						X								
	Australian emerald dragonfly	*Hemicordulia australiae*		Species										X				
	Dragonflies	*Adversaeschna*		Genus										X				
	Slender ringtail damselfly	*Austrolestes analis*		Species								X						
	Damselflies	*Archiargiolestes*		Genus	X	X	X	X	X			X			X	X		
	Damselflies	*Austrolestes*		Genus								X						
	Damselflies	*Caliphaea*		Genus		X												
	Dragonflies and damselflies	*Odonata*		Order				X										
	Cosmopolitan diving beetle	*Rhantus suturalis*		Species		X											X	
	Large diving beetle; green diving beetle	*Onychohydrus scutellaris*		Species		X						X			X			
	Diving beetle	*Limbodessus inornatus*		Species		X	X				X			X				
	Diving beetles	*Exocelina*		Genus													X	
	Diving beetles	*Necterosoma*		Genus								X						
	Diving beetles	*Rhantus*		Genus												X	X	X
	Diving beetles	*Cybistrini*		Tribe											X		X	
	Diving beetles	*Dytiscidae*		Family	X	X						X			X		X	X
	Water boatmen	*Sigara*		Genus												X		
	Water boatmen	*Corixidae*		Family											X			
	Water scavenger beetle	*Berosus*		Genus									X					
	Australian water moth; pond moth	*Hygraula nitens*		Species												X		
Macroinvertebrates: Molluscs	Carter's freshwater mussel	*Westralunio carteri*	WCAR	Species						X	X				X			
	Freshwater mussels	*Hyriidae*		Family						X	X				X			
	Bivalve molluscs	*Palaeoheterodonta*		Super Order		X	X			X								
	Pea mussels	*Sphaeriidae*		Family												X		
	Freshwater limpet	*Pettancylus sp. 'Queensland'*		Species	X	X	X											
	Freshwater limpets	*Ancylidae*		Family	X	X	X	X	X			X			X			X
	Freshwater limpets	*Ferrissia*		Genus		X			X									
	Freshwater limpets	*Pettancylus*		Genus	X	X	X					X						
	Bladder snail; European physa	*Physella acuta*		Species	X	X	X	X				X			X	X		
	American ribbed fluke snail	*Pseudosuccinea columella*		Species												X		
	Ramshorn snail	*Gyraulus convexiusculus*		Species	X													
	Freshwater snails	*Gyraulus*		Genus				X										
	Freshwater snails	*Physella*		Genus	X	X	X	X	X		X	X			X	X		
	Freshwater snails	*Sulcospira*		Genus										X	X			
	Freshwater snails	*Physidae*		Family	X	X	X					X				X		
	Ramshorn snails	*Planorbidae*		Family	X	X	X	X	X			X						
	Pond snails	*Lymnaeidae*		Family												X		
	Freshwater snails	*Lymnaeoidea*		Super Family												X		

Notes

ABC	Endemic to southwest Western Australia
ABC	Known introduced species
ABC	Anomalous / unexplained results
X	eDNA detected in water sample

SWIRC = South West Index of River Condition

Abbreviations

ADWG	Australian drinking water guideline(s)
ANZECC	Australia and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand guideline(s)
ATU	Aerobic treatment unit
BBB	BoorYul-Bah-Bilya
BNAA	Bibbul Ngarma Aboriginal Association Incorporated
BOD	Biochemical oxygen demand
BTEX	Benzene, toluene, ethylbenzene, xylene
CFU	Colony forming unit
COK	City of Kalamunda
COPC	Contaminant of potential concern
COS	City of Swan
D	Detected
DBCA	Department of Biodiversity, Conservation and Attractions
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DEED	Department of Energy and Economic Diversification
DFES	Department of Fire and Emergency Services
DGV	Default guideline value(s)
DLGSC	Department of Local Government, Sport and Cultural Industries
DMPE	Department of Mines, Petroleum and Exploration
DO	Dissolved oxygen
DOH	Department of Health
DOT	Department of Transport
DOW	Department of Water (now DWER)
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
E. coli	*Escherichia coli*
eDNA	Environmental DNA
EMRC	Eastern Metropolitan Regional Council
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera
ERLP	Eastern Region Landcare Program
F1	C6-C10 less BTEX compounds
F2	C10-C16 less naphthalene
FPC	Forest Products Commission
ILUA	Indigenous Land Use Agreement
IWSS	Integrated Water Supply Scheme
HPC	Heterotrophic plate count
LHAAC	Local Health Authorities Analytical Committee

LOR	Limit of reporting
LOSP	Level of species protection
LPD	Lower Pumpback Dam
LTV	Long term trigger value
MAL	Microbial assessment level(s)
MBAS	Methylene blue active substance
NATA	National Association of Testing Authorities
ND	Not detected
NEMP	National environmental management plan
NHMRC	National Health and Medical Research Council
NPUG	Non-potable use guideline
NTU	Nephelometric turbidity units
ORP	Oxidation-reduction potential (redox)
PAH	Polyaromatic hydrocarbon(s)
PCB	Total polychlorinated biphenyl(s)
PCU	Platinum cobalt units
PDWSA	Public drinking water source area
PFAS	Per- and polyfluoroalkyl substances
PFBA	Perfluorobutanoic acid
PFBS	Perfluorobutanesulfonic acid
PFHpA	Perfluoroheptanoic acid
PFHpS	Perfluoroheptanesulfonic acid
PFHxA	Perfluorohexanoic acid
PFHxS	Perfluorohexanesulfonic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PFPeA	Perfluoropentanoic acid
PFPeS	Perfluoropentanesulfonic acid
PFPrS	Perfluoropropanesulfonic acid
ppm	Parts per million
RPD	Relative percentage difference
RPZ	Reservoir protection zone
RSL	Regional screening level(s)
SOM	Shire of Mundaring
STV	Short term trigger value
SVOC	Semi-volatile organic compound(s)
SWIRC	South West Index of River Condition
TDS	Total dissolved solids
TFA	Trifluoroacetic acid
TKN	Total Kjeldahl nitrogen
TOC	Total organic carbon
TPH	Total petroleum hydrocarbon(s)
TRH	Total recoverable hydrocarbon(s)

TSS	Total suspended solids
VOC	Volatile organic compound(s)
WA	Western Australia
WAPC	Western Australian Planning Commission
WHO	World Health Organisation
WIR	Water information reporting

References

1. Western Australian Legislative Assembly, E. and I. S. C. *Bellevue Hazardous Waste Fire Inquiry Volume 1, Report No. 1*. (2001).
2. Western Australian Legislative Assembly, E. and I. S. C. *Bellevue Hazardous Waste Fire Inquiry Volume 2, Report No. 2*. (2002).
3. Golder Associates. *Former Waste Control Site, Bellevue WA: Stakeholder Update Meeting Briefing Document, Prepared for Department of Environment and Conservation*. (2009).
4. Mundle, K. World-First PRB Remediation System. *Waste Management and Environment* 24, 49 (2013).
5. Thompson, H. Public outcry sees Alcoa walk back Perth Hills exploration plans. *WA Today* (2025).
6. Ho, C. Alcoa shelves plans to explore Perth Hills for bauxite mining expansion. *ABC News* (2025).
7. Lewis, P. Indigenous Association part of Alcoa Fight. *Echo News* (2025).
8. Smith, R. A., Bari, M. A., Dixon, R. N. M. & Rowlands, D. W. *Helena River Salinity Situation Statement, Water Resource Technical Series, Report No WRT 34*. (2007).
9. Bibbul Ngarma Aboriginal Association. *Media Statement: No Mining in Our Drinking Water Catchments*. (2025).
10. Storey, A. & Creagh, S. *Lower Helena River: Trial Environmental Releases, Report Prepared on Behalf of Department of Water*. (2010).
11. Water and Rivers Commission & Department of Environment. The Importance of Western Australia's Waterways. *Archived from website on 1 July 2004*. (2004).
12. Office of the Auditor General Western Australia. *Our Heritage and Our Future: Health of the Swan Canning River System, Report 16*. (2014).
13. Close, P., Ford, B., Maughan, J. & Ryan, T. *Evaluation of Environmental Water Releases on the Aquatic Fauna of the Helena River, Aquatic Fauna Surveys Summer 2013 and Autumn 2014*. (2014).
14. Quicke, E. *Mundaring Weir Among the Hills*. (1979).
15. Quicke, E. *The Helena Story*. (1985).
16. Green, N. *Broken Spears: Aborigines and Europeans in the Southwest of Australia*. (1984).
17. Bates, M. & Bates, C. R. *A Report on the Geophysical Investigation of the Site of a Grave in Everton Cemetery, Liverpool, Unpublished Technical Report*. (1997).
18. Lowe, G. The Golden Pipeline. *Australian Journal of Multi-Disciplinary Engineering* 2, 45–53 (2004).
19. Batini, F. Mundaring Weir and the Pipeline to Kalgoorlie. *Australian Rural and Regional News* (2022).
20. Hartley, R. A century of water supply to the Western Australian goldfields and wheat-belt from Mundaring Weir and the Kalgoorlie pipeline. *Early Days: Journal of the Royal Western Australian Historical Society* 11, 727–744 (2000).
21. Tauman, M. *The Chief, C Y O'Connor*. (University of Western Australia Press, Nedlands, 1978).
22. Schwede, M. L. Super Trench - Phase 2: A Report on Excavation Results. in *Archaeology at ANZAAS 1983* 53–62 (1983).
23. McGilvray, A. & Sylva, K. *Helena River (Mandoon) Tributary Foreshore Assessment*. (2018).
24. Bibbul Ngarma Aboriginal Association Inc. *Media Announcement: New Quokka Population Discovered in Perth Hills*. (2024).
25. Bibbul Ngarma Aboriginal Association. *Media Statement: Locally Extinct Fish Discovered in the Perth Hills*. (2026).
26. Forster, P. *Review of Aboriginal Culture in Relation to Granite Outcrops, a Western Australian Focus*. (2020).
27. Commonwealth of Australia. *Draft National Recovery Plan for Clay Pans of the Swan Coastal Plain Ecological Community*. (2017).
28. Braimbridge, M. & Commander, P. *Water Notes for River Management: The Wheatbelt's Ancient Rivers*. (2005).
29. CSIRO & Bureau of Meteorology. *Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report*. (2015).

30. Water Corporation. Dam Levels. (2023).

31. Flynn, F. & Ugle, G. *Mandoon - The Helena River Confluence, Waterways Western Australia*. (2023).

32. Eastern Metropolitan Regional Council. *Helping the Helena: Establishing a Baseline of Water Quality Pollutants for Linkages in Fish and Mussel Decline*. (2014).

33. Gager, P. & Conacher, A. Erosion of Access Tracks in Kalamunda National Park, Western Australia: Causes and management implications. *Australian Geographer* 32, 343–357 (2001).

34. Siemon, N. *Foreshore Assessment in the Helena River Catchment, Report No. 20*. (2001).

35. Foulsham, G. *et al. A Baseline Study of Organic Contaminants in the Swan and Canning Catchment Drainage System Using Passive Sampling Devices*. (2009).

36. Nice, H., Foulsham, G., Morgan, B. & Evans, S. *A Baseline Study of Contaminants in the Swan and Canning Catchment Drainage System, Water Science Technical Series, Report No WST 3*. (2009).

37. Nice, H. E. *A Baseline Study of Contaminants in the Sediments of the Swan and Canning Estuaries, Water Science Technical Report Series No 6*. (2009).

38. Novak, P., Hoeksema, S. & Department of Biodiversity Conservation & Attractions. *An Assessment of Per- and Poly-Fluoroalkyl Substances (PFAS) in the Surface Water and Biota of the Swan Canning Estuary and Its Catchment*. (2022).

39. Novak, P. & Hoeksema, S. *An Assessment of Contaminants in the Sediments of the Swan Canning Estuary*. (2022).

40. Flynn, F. *Mandoon Bilya (Helena River) Baseline Surface Water and Sediment Sampling Report 2024, Part of the BoorYul-Bah-Bilya Program*. (2025).

41. Trayler, K. *Understanding and Predicting Riparian Decline: Ecohydrology and Hydro-Climatological Change. Information Sheet 101/2020*. (2020).

42. Creagh, S. & Storey, A. *Helena River Fish and Macroinvertebrate Surveys 2010 and 2011, Prepared for the Eastern Metropolitan Regional Council*. (2011).

43. Wansbrough, C. & Stewart, S. *Helena River Freshwater Fish Habitat Survey*. (2006).

44. Klunzinger, M. W., Beatty, S. & Lymbery, A. J. *Freshwater Mussel Response to Drying in the Lower Helena Pipehead Dam, Mussel Translocation Strategy for Conservation Management, Report to Swan River Trust*. (2011).

45. Edward, D. H. & Aquatic Research Laboratory. *Stream Fauna Study: Bioaccumulation of Organochlorine Pesticides by the Freshwater Mussel, Westralunio Carteri Iredale, Piesse Gully, Lower Helena River Catchment, Report No 14*. (1990).

46. Forests Department of Western Australia, Batini, F. & Selkirk, A. *Salinity Sampling in the Helena Catchment, Western Australia, Research Paper No 45*. (1978).

47. Wood, W. Increase of Salinity in Soil and Streams following Destruction of Native Vegetation. *J. R. Soc. West. Aust.* 10, 35–47 (1924).

48. Batini, F. E. & Selkirk, A. B. *Salinity Sampling in the Helena Catchment, Research Paper 45*. (1978).

49. Forests Department of Western Australia & Ward, D. *Tree Removal and Salinity in Helena Catchment, Western Australia, Research Paper No 29*. (1977).

50. Croton, J. T. & Dalton, J. A. *Stream Salinity Response to Clearing and Revegetation of the Helena Catchment, Prepared for Water & Rivers Commission*. (1999).

51. Menck, C. *Mundaring Weir Forestry Settlement 1923-2011. A History of Community Life and Work.* (Mundaring and Hills Historical Society, 2013).

52. Bush, F. *Heritage Assessment: Mundaring Weir Forestry Settlement*. (2009).

53. Shire of Mundaring. *Mundaring Foothills Growth Strategy*. (2017).

54. City of Swan. *Local Planning Scheme No 17 Amendment No. 85: Hazelmere Enterprise Area Structure Plan, Precinct 2A Helena River*. (2014).

55. Helena River Catchment Group & Hill, A. *Letter from A Hill to Shire of Mundaring CEO, Planning to Ensure Protection of Kadina Brook and the Helena River's Bellevue Wetlands from Proposed Developments on Lot*

206 Helena Valley Road and Adjacent Lands in Local Subdivision and Infrastructure Plan No 298, 15 December 2010. (2010).

56. Shire of Mundaring. *Ordinary Council Meeting Agenda, Item 10.2 Endorsement of Draft Helena Valley Urban Expansion Strategy for Advertising*. (2016).
57. RPS. *Helena Valley Land Use Study*. (2013).
58. Cardno. *Helena Valley Traffic and Land Use Study*. (2015).
59. TPG Town Planning, U. D. and H. *Lots 2, 3 and 6 Midland Road Helena Valley, Local Structure Plan: Part 1 Implementation*. (2016).
60. Department of Planning Lands and Heritage. *North-East Sub-Regional Planning Framework, Perth and Peel @ 3.5 Million*. (2018).
61. Department of Planning and Urban Development. *Foothills Structure Plan, Final*. (1992).
62. Department of Planning & City of Swan. *Hazelmere Enterprise Area Structure Plan*. (2011).
63. Metropolitan Redevelopment Authority. *Midland Heritage Interpretation Strategy*. (2017).
64. Midland Redevelopment Authority. *Heritage Strategy for the Midland Central Redevelopment Area*. (2004).
65. Crisalis International Pty Ltd. *Midland Railway Workshops Site, Helena East Precinct: Review of Reports Relating to Hydrogeology of the Site and Potential Impacts of Groundwater Contaminants on the Helena River. Report to ATA Environmental for Midland Redevelopment Authority*. (2005).
66. Environmental Protection Authority. *Remediation of Midland Railway Workshops Site - Inquiry under Section 46 of the Environmental Protection Act 1986 to Amend Ministerial Statements 583, 612, 640 and 742*. (2019).
67. Environmental Protection Authority. *Remediation of Midland Railway Workshop Site, Helena West, Midland by the Midland Redevelopment Authority, Report and Recommendations of the Environmental Protection Authority, Bulletin 1111*. (2003).
68. Midland Redevelopment Authority. *Remediation of the Midland Railway Workshops Site Area B, D and D for the Proposed Police Operations Support Facility, Public Environmental Review* . (2001).
69. Environmental Protection Authority. *Remediation of the Midland Railway Workshops – Areas B, C and D for the Proposed Police Operations Support Facility Midland, Report and Recommendations, Bulletin 1057, Prepared for the Midland Redevelopment Authority*. (2002).
70. Ellis, N. & Smyth, C. *Midland Railway Workshops: A History in Pictures 1904-2004*. (St George Books, Osbourne Park, 2004).
71. Environmental Protection Authority. *Remediation of the Midland Railway Workshops Site, Clayton Precinct Area E, Midland, Report and Recommendations, Bulletin 1030, Prepared for the Midland Redevelopment Authority*. (2001).
72. Environmental Protection Authority. *Helena East Remediation and Redevelopment: Report and Recommendations.* (2006).
73. Midland Redevelopment Authority. *Helena East Precinct Remediation and Redevelopment: Public Environmental Review, Volume 1 and Volume 2 (Appendices), Version 3, Report No: 2005/142*. (2006).
74. Landcorp. *Bellevue Cleanup Update*. (2018).
75. Department of Environment and Conservation. *Bellevue Community Update, November 2009*. (2009).
76. Department of Environment and Conservation. *Bellevue Community Update, March 2009*. (2009).
77. Department of Environment Regulation. *Bellevue Site - Clean Up, Contaminated Sites Fact Sheet 17*. (2013).
78. Department of Environment Regulation. *Bellevue Site - Groundwater Monitoring, Contaminated Sites Fact Sheet 18*. (2013).
79. Department of Environment Regulation. *Bellevue Site - Background and Risk, Contaminated Sites Fact Sheet 16*. (2013).
80. Golder Associates. *Construction Environmental Management Plan for Installation of Sequenced Permeable Reactive Barriers, Bellevue WA, Prepared for Landcorp*. (2010).
81. Taylor, J. Developer withdraws plans for Perth data centre after fierce community opposition. *The Guardian* (2026).

82. Prestipino, D. Locals save Mandoon Bilya from massive AI data centre. *National Indigenous Times* (2026).
83. Department of Parks and Wildlife and Swan River Trust. *Swan Canning River Protection Strategy*. (2015).
84. Clark, C. Should Nature Have Rights? Orthodoxy and Innovation. *Law & Social Inquiry* 48, 1471–1476 (2023).
85. Barkham, P. Should rivers have the same rights as people? *The Guardian* (2021).
86. O'Donnell, E. The River's Voice. *The Association of Commonwealth Universities*.
87. Swan River Trust. *Swan-Canning Cleanup Program Action Plan*. (1999).
88. Storer, T., White, G., O'Neill, K., Galvin, L. & van Looij, E. *South-West Index of River Condition - Method Summary for the Assessment of River Health for South-West Western Australian Rivers, River Science Technical Series Report 1, Healthy Rivers Program*. (2020).
89. Beatty, S. J., Ryan, T. J., Summers, V. & Morgan, D. L. *Fish Response to Flow in the Lower Helena River. A Report to the Department of Biodiversity Conservation and Attractions*. (2020).
90. Wetland Research Management. *Lower Helena River, Ecological Condition Assessment 2018-2019, Unpublished Report to the Water Corporation*. (2019).
91. Conti, L., Wilke, S. & Koska, L. *Lower Helena Catchment Water Quality Study, Report No: SSB 01/91*. (1991).
92. Students of Environmental Management. *Environment and Recreation Study of the Lower Helena Water Catchment, Prepared for the Water Authority of Western Australia*. (1987).
93. Australian and New Zealand Governments and Australian State and Territory Governments. Australian and New Zealand Guidelines for Fresh and Marine Water Quality, created 2018, updated April 2026. https://www.waterquality.gov.au/anz-guidelines (2018).
94. Government of Western Australia. *Environmental Protection Act 1986*. (1986).
95. ANZECC & ARMCANZ. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Volume 1 The Guidelines, National Water Quality Management Strategy Paper No. 4*. (2000).
96. HEPA. *PFAS National Environmental Management Plan Version 3.1*. (2025).
97. City of Kalamunda. *Notice of Determination on Application for Planning Approval, Lot 3 (415) Mundaring Weir Road, Piesse Brook*. (2020).
98. National Health and Medical Research Council. *Australian Drinking Water Guidelines Paper 6, National Water Quality Management Strategy, Version 3.8 (2011, Updated 2022)*. (2022).
99. United States Environmental Protection Agency. Regional Screening Levels - Generic Tables. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables (2024).
100. World Health Organisation. *Petroleum Products in Drinking Water*. (2008).
101. Department of Health. *Contaminated Sites Ground and Surface Water Chemical Screening Guidelines*. (2014).
102. Department of Water and Environmental Regulation. *Guideline: Assessment and Management of Contaminated Sites*. (2021).
103. Department of Health. *Guidelines for the Non-Potable Uses of Recycled Water in Western Australia*. (2011).
104. National Health and Medical Research Council. *Guidance on Per and Polyfluoroalkyl Substances (PFAS) in Recreational Water*. (2019).
105. Australian and New Zealand Governments. *Draft Australian & New Zealand Guidelines for Fresh and Marine Water Quality: Livestock Drinking Water Guidelines*. (2023).
106. Department of Biodiversity Conservation and Attractions. *Swan Canning Catchment Sampling and Analysis Plan, Rivers and Estuaries Science*. (2022).
107. Department of Water and Environmental Regulation. *Swan Canning Water Quality Improvement Plan (Project: SG-C-SCWQIP), Sampling and Analysis Plan, TRIM File No: WT9835, Aquatic Science Branch*. (2018).
108. Department of Water and Environmental Regulation. *Swan and Canning River Catchment Water Quality Monitoring Program (Project: SG-C-SWANCATCH), Sampling and Analysis Plan, TRIM File No: WT895, Water Science Branch*. (2018).
109. Department of Environmental Regulation. *Interim Guideline on the Assessment and Management of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS): Contaminated Sites Guidelines*. (2016).

110. Department of Water. *Field Sampling Guidelines: A Guideline for Field Sampling for Surface Water Quality Monitoring Programs*. (2009).

111. Department of Water. *Surface Water Sampling Methods and Analysis - Technical Appendices: Standard Operating Procedures for Water Sampling - Methods and Analysis*. (2009).

112. Department of Water. *Water Quality Monitoring Program Design: A Guideline to the Development of Surface Water Quality Monitoring Programs*. (2009).

113. CSIRO. *Handbook for Sediment Quality and Assessment*. (2005).

114. Department of Water and Environmental Regulation. *Helena River: Swan Canning Catchment Nutrient Report 2018*. (2019).

115. University of Western Australia. Kangaroo paw's poisonous past. *https://www.news.uwa.edu.au/archive/201106223672/research/kangaroo-paws-poisonous-past/* (2011).

116. National Health and Medical Research Council. *Australian Recreational Water Quality Guidelines: Public Consultation DRAFT*. (2026).

117. Klunzinger, M. W., Beatty, S. J., Pinder, A. M. & Lymbery, A. J. Range decline and conservation status of Westralunio carteri Iredale, 1934 (Bivalvia : Hyriidae) from south-western Australia. *Aust. J. Zool.* 63, 127–135 (2015).

118. Department of Planning. *Middle Helena Catchment Area: Land Use and Water Management Strategy*. (2010).

119. Department of Planning Lands and Heritage. *Draft State Planning Policy 2.9 Planning for Water*. (2021).

120. Department of Water. *Mundaring Weir Catchment Area, Drinking Water Source Protection Plan, Report No 69*. (2007).

121. Department of Water and Environmental Regulation. *Operational Policy 13: Recreation within Public Drinking Water Source Areas on Crown Land*. (2019).

122. Department of Water and Environment Regulation. *Water Quality Information Sheet 39, Aboriginal Customary Activities in Public Drinking Water Source Areas in the South West Native Title Settlement Area*. (2019).

123. Trility. *Mundaring Water Treatment Project: Achieving and Securing Future Water Needs*. (2020).

124. Department of Water. *Operational Policy 4.3, , Identifying and Establishing Waterways Foreshore Area*. (2012).

125. Department of Water and Environmental Regulation. *Waterwise Perth Action Plan 2: Kep Katitjin Gabi Kaadadjan - Growing Waterwise Communities in Boorloo (Perth) and Bindjareb (Peel) to Address Climate Change*. (2022).

126. Department of Biodiversity Conservation and Attractions. *Planning for Localities along the Swan Canning Development Control Area - Draft for Public Comment*. (2022).

127. Department of Biodiversity Conservation and Attractions. *Mandoon (Helena River) Locality Plan*. (2026).

128. Hassell Ltd. *Swan and Helena Rivers Management Framework Report*. (2007).

129. Latitude Creative Services, Heritage and Conservation Professionals & National Trust (WA). *Swan and Helena Rivers Management Framework: Heritage Audit and Statement of Significance, Prepared for the Eastern Metropolitan Regional Council*. (2009).

130. Eastern Metropolitan Regional Council. *Eastern Catchment Management Plan 2012-2022*. (2012).

131. Eastern Metropolitan Regional Council. Story Map: Swan and Helena Rivers Floodplain Development Strategy. https://www.arcgis.com/apps/MapJournal/index.html?appid=c93ca8893b584e06976bbb35ce502c6a (2020).

132. Transplan Pty Ltd. *Swan and Helena Rivers Regional Recreational Path, Development Plan Prepared for Eastern Metropolitan Regional Council*. (2009).

133. Stephens, D. *Swan and Helena Rivers Flood Study: Hydrology. Prepared for Eastern Metropolitan Regional Council*. (2016).

134. Nathan, R. *Swan and Helena Rivers Flood Study, Review of HARC Draft Report for the Eastern Metropolitan Regional Council*. (2016).

135. Eastern Metropolitan Regional Council. *Understanding and Managing Flood Risk in Perth's Eastern Region, Final Project Report*. (2016).

136. Department of Biodiversity, C. and A. & Conservation and Parks Commission. *Forest Management Plan 2024-2033*. (2023).

137. Environmental Protection Authority. *Bauxite Mining in the Darling Range, Western Australia*. (1978).

138. Milne, P. Alcoa mining threatens Perth's drinking water. *WA Today* (2023).

139. Thompson, B. WA Premier warns Alcoa over threat to drinking water. *Australian Financial Review* (2023).

140. Beatty, S. *et al. Adapting to Climate Change: A Risk Assessment and Decision Making Framework for Managing Groundwater Dependent Ecosystems with Declining Water Levels, Supporting Document 4: Environmental Variables in the Habitats of Southwestern Australian Freshwater Fishes: An Approach for Setting Threshold Indicator Values*. (2013).

Rocky Pool on Piesse Brook, Kalamunda National Park

Appendix 1 Mandoon Catchment Management

In Australia, state and territory governments are responsible for managing rivers and their catchments. Management of the Mandoon catchment is highly fragmented, with responsibility shared by many state and local government agencies, each with different legislation. Work effort and priorities are focused on individual legislation, with widely varying resources and capacities across agencies. Outside of the drinking water catchment area, no one agency has overall responsibility, meaning there is no overarching plan for the entire catchment.

Under the South West Native Title Settlement 2021, Noongar people are recognised as Traditional Owners of southwest WA through six Indigenous Land Use Agreements (ILUAs). The Whadjuk ILUA covers most of Mandoon catchment except the river's headwaters which fall under the Ballardong and Gnaala Karla Booja ILUAs. In 2022, the Whadjuk, Ballardong and Gnaala Karla Booja Aboriginal Corporations were appointed to represent the ILUAs. The settlement includes opportunities for co-management of conservation land with DBCA and creation of the Noongar Land Estate, with up to 320,000 hectares to be held by the Noongar Boodja Trust. Large areas of the Middle Mandoon are earmarked for potential transfer to the Estate

Planning authorities, such as the Western Australian Planning Commission (WAPC), Department of Planning, Lands and Heritage (DPLH), local governments and redevelopment authorities (e.g. DevelopmentWA), administer the *Planning and Development Act 2005*. Authorities seek advice on water resources and waterways from relevant government departments e.g. DWER and DBCA. Planning in the Mandoon Catchment is administered by six local government planning schemes (Mundaring, Swan, Kalamunda, York, Beverley and Northam) and decisions are impacted by different knowledge levels and motivations of local government councillors.

In 2010, DPLH released the *Middle Helena Land Use and Water Management Strategy*[118] to combine land use planning, management and water protection in the middle catchment (upper and lower excluded). The *Draft State Planning Policy 2.9 Planning for Water*[119] and its guidelines apply to land planning decisions that may impact the river. DPLH also manage the river's heritage values including the Helena River Aboriginal Heritage Site under the Aboriginal Heritage Act 1972.

The WAPC acquires and manages land on the Lower Mandoon foreshore for parks and recreation under the *Metropolitan Region Scheme 1963*, including large areas in Midland, Hazelmere, Guildford and Woodbridge. DevelopmentWA is responsible for developing areas of the foreshore for public use under the *Metropolitan Redevelopment Act 2011*, including the former Midland Railway Workshops.

Water resources in WA are protected and managed under six separate management acts. Through one of these, the *Water Agencies (Powers) Act 1984*, the Department of Water and Environmental Regulation (DWER) leads water resources management and coordinates cross-government efforts. A Water Reform Bill was proposed in 2006 to consolidate and modernise the six separate pieces of legislation that govern WA's water resources, but the state government abandoned the reform in December 2023, shortly before its planned release.

DWER manage parts of the Mandoon catchment for public drinking water supply through the *Mundaring Weir Catchment Area Drinking Water Source Protection Plan*[120] and *Operational Policy 13, Recreation in Public Drinking Water Source Areas (PDWSA)*[121]. PDWSA are managed under the *Country Areas Water Supply Act 1947* and *Metropolitan Water Supply, Sewerage and Drainage Act 1909*. Noongar Traditional Owners have controlled access to heritage sites in PDWSA for cultural activites[122].

Management is shared with Water Corporation, a water service provider of public drinking water, wastewater and drainage which operates the river's dams and drinking water infrastructure under license conditions. The river has two major water supply dams: Mundaring Weir and the Lower Pumpback Dam. Water Corporation release water from the Lower Pumpback Dam to maintain downstream habitat, although there is no surface water allocation plan to guide these releases, and no releases occur from Mundaring Weir.

A global infrastructure company, Acciona, operates the 165 ML/day water treatment plant at Mundaring Weir and supplies treated water to Water Corporation for distribution in the Integrated Water Supply Scheme

(IWSS) to Perth, the Goldfields and Agricultural Region, and parts of southwest WA[123]. Treatment includes filtration, disinfection and compliance with Australian drinking water guidelines.

DWER have a role in approving water management strategies that accompany planning proposals adjacent foreshore areas where development may impact waterways, consistent with *Operational Policy 4.3, Identifying and Establishing Waterways Foreshore Areas*[124]. DWER also manages water and environmental regulation (e.g. vegetation clearing, industry licences, permits and approvals), urban water management and building waterwise communities[125].

DWER coordinates the *Healthy Rivers* program, which collects data and develops management solutions to improve river health. Assessments use standard methods from the *South West Index of River Condition*[88] including physical form, land use, hydrology (flow), fringing vegetation, water quality (nutrients and water quality parameters), and aquatic biota (fish, crayfish and macroinvertebrates).

Until recently, two *Healthy Rivers* sites had been monitored on the Mandoon Bilya: at Whiteman Road in the lower catchment (Whiteman Road – SWN10) and at Looksee Pool in the middle catchment (Mundaring Weir Downstream – HRDSMW). Both sites were last assessed in 2012. Species records from these assessments are published on the *Healthy Rivers* website, and DWER has shared the field data with BNAA as part of the BBB program. In December 2025, DWER and BNAA collaborated to undertake *Healthy Rivers* assessments at two sites in the upper catchment for the first time. Results will be published by DWER in 2026. BNAA continues to work with DWER to explore further opportunities for assessments in the Mandoon catchment, including potential sites on the Darkin River and Beraking Brook.

The Department of Health (DOH) regulates the quality of drinking water in WA in accordance with guidance set out in the Australian Drinking Water Guidelines[98]. These guidelines are published by the National Health and Medical Research Council, Australia's peak public health policy organisation, and are designed to provide an authoritative reference on what defines safe, good quality water, how it can be achieved and how it can be assured. Scheme suppliers, such as Water Corporation, must manage and monitor their systems and report the results to the DOH in accordance with agreed protocols. The Advisory Committee for the Purity of Water is a non-statutory inter-departmental committee that operates under the DOH. The Committee has been monitoring the quality of drinking water in WA since 1925, and also recommends improvements in monitoring and management protocols to the Ministers responsible for Health and Water Resources.

The Department of Biodiversity, Conservation and Attractions (DBCA) manages state forest and conservation estate along the river under the *Conservation and Land Management Act 1984 (CALM Act)*. There are no individual management plans for the river's seven national parks (Beelu, Gooseberry Hill, Greenmount, Helena, Kalamunda, Korung and Wandoo).

DBCA also manages the lower reaches of the Mandoon Bilya, downstream of the Lower Pumpback Dam, under the *Swan and Canning Rivers Management Act 2006* and the *Swan Canning River Protection Strategy 2015*[83]. The Swan River Trust is an advisory body under the Act. Under the Act, the Riverbed (River Reserve) is vested in DBCA and the Riverpark (crown land along the river) is jointly managed by DBCA and various foreshore managers, who include local government, other state government agencies and private land owners. The CALM Act established the *Swan Canning Development Control Area (DCA)* for which DBCA is the primary planning authority. In 2022, DBCA released a draft Planning Policy for the DCA, including the Lower Helena 'Mandoon' area[126], and in 2026, they released the *Mandoon Locality Plan*[127].

The *Swan Canning Water Quality Monitoring Program* is a long-term routine monitoring program that supports the DBCA in managing the Swan Canning Estuary, including the lower Mandoon Bilya up to the Lower Pumpback Dam. The program tracks water quality and assesses compliance with nutrient targets established under the *Swan Canning Cleanup Program*[87]. Key analytes measured include nitrogen, phosphorus, dissolved organic carbon, suspended solids, dissolved oxygen, pH, temperature and specific conductivity. There is one monitoring site on the Mandoon Bilya: at Whiteman Road in the lower catchment (Whiteman Road – HELENR). Data is available in the Water Information Reporting (WIR) platform: (https://wir.water.wa.gov.au/Pages/Water-Information-Reporting.aspx).

DBCA is also responsible for biodiversity and threatened flora, fauna and ecological communities in accordance with the *Biodiversity Conservation Act 2016* and support community on-ground action and strategic initiatives in the catchment via the Eastern Region Landcare Program (ERLP), the Swan Alcoa Landcare Program (SALP) and Community Rivercare grants.

The ERLP coordinates landcare by state and local government and community groups in Perth's Eastern Region. This includes the catchments of the Mandoon Bilya (Helena River), Jane Brook, Susannah Brook, Blackadder-Woodbridge Creek and Wooroloo Brook. ERLP was hosted by the Eastern Metropolitan Regional Council (EMRC) until 2021 and Perth NRM until 2023. DBCA are currently exploring future ERLP delivery models with the community. Under EMRC, the ERLP produced the *Swan and Helena River Management Framework 2007*[128], the *Swan and Helena Rivers Heritage Audit & Statement of Significance* 2009[129], the *Eastern Catchment Management Plan 2012-2022*[130], the *Swan and Helena Rivers Floodplain Development Strategy 2020*[131] and various flood, ecology and recreation plans[132–135].

The Forest Products Commission (FPC) manages and develops WA's forest industry including plantation and native forest on state government land. In the Mandoon catchment, this includes Greenmount and Mundaring State Forests. The FPC work under the *Forest Products Act 2000* and the *WA Forest Management Plan 2024-2033*[136] which was produced by DBCA. The plan aims for a significant reduction in native forest logging although it excludes clearing for mining.

The Department of Mines, Petroleum and Exploration (DMPE) typically regulates mining activities in Western Australia, including environmental compliance and management. However, some major mining operations are governed by individual long-term State Agreements that are ratified by Acts of Parliament and managed by the Department of Energy and Economic Diversification (DEED). Alcoa operates under one such agreement, known as Mineral Lease 1SA (ML1SA), which has enabled extensive bauxite mining in the jarrah forests of southwest WA for over 60 years. ML1SA spans the entire length of the Darling Range, from the Mandoon catchment in the north to east of Bunbury in the south[137]. The Mandoon catchment also contains several other tenements that not yet been mined extensively, including those held by South32 in the east and Telupac in the north.

While some sand and gravel extraction occurs in the northern part of the catchment, it has so far avoided the large-scale vegetation clearing and bauxite strip mining that have significantly impacted forests to the south[138,139]. Alcoa recently withdrew exploration plans for the Mandoon catchment following strong public opposition, with advocacy from BNAA and local governments playing a key role[5–7]. However, mining remains a real possibility within tenements held by Alcoa, South32, Telupac and others. Any vegetation clearing for mining would be expected to increase salinity in the catchment, posing additional risks to aquatic ecosystems and drinking water[8]. BNAA maintains that strip mining poses unacceptable risks in drinking water catchments[9].

The Department of Primary Industries and Regional Development (DPIRD) administer the *Fish Resources Management Act 1994* under which it is illegal to capture freshwater fish and crayfish without a licence. A south-west freshwater angling licence is required for waters south of Greenough and above the tidal influence, including all lakes, dams, rivers and streams, and a separate licence and rules apply to marron. Fishing is prohibited in all drinking water catchments.

DPIRD undertake surveillance, monitoring and, where possible, eradication of aquatic pests. This includes the interactive online *Freshwater Fish Distribution Map*, and *FishWatch*, a 24 hour hotline for reporting aquatic pests, illegal fishing and fish kills. DPIRD is also the state coordinator for fish kill responses, although DWER manages fish kills in estuaries, rivers and inland water bodies, and DBCA manages fish kills that occur in the Swan Canning system, which includes the lower Mandoon Bilya up to the Lower Pumpback Dam.

Appendix 2 Laboratory Analysis Suite

The suite of laboratory analyses undertaken in 2025 and 2024 is detailed below. The laboratory results are presented in **Tables T1–T3**.

Group	Analysis	Rationale	2025	2024
Major Ions*	Calcium, Chloride, Fluoride, Magnesium, Potassium, Sodium, Sulphate	Water quality indicators	✓	✓
Nutrients	Ammonia, Nitrate, Nitrite, Total Oxidised Nitrogen (Nitrate + Nitrite as NOx-N), Total Kjeldahl Nitrogen, Nitrogen (total), Phosphorus (filterable reactive), Phosphorus (total)	COPC for agriculture, rural land use and wastewater	✓	✓
Metals & Other Inorganics	Aluminium, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Thorium, Tin, Titanium, Uranium, Vanadium, Zinc, Zirconium	COPC for agriculture and rural land use and wastewater	✓	✓
	Chromium (total, III and VI)		✓	✓
	Cyanide	COPC in lower catchment	✓	✓
Microbes*	Heterotrophic Plate Count at 37°C (total)	Measure of bacterial colonies	✓	✓
	Total Coliforms, *Escherichia. coli, Enterococci*	Faecal contamination indicators	✓	✓
	Thermophilic Amoeba, *Thermophilic Naegleria* species *and Naegleria fowleri*	Warm water pathogens	✓	✓
Herbicides & Pesticides	Acidic Herbicides: 2.4-D, 2.4.5-T, 2.4.6-T, Clopyralid, Dicamba, Fluazifop, MCPA, Metsulfuron Methyl, Picloram, Triclopyr	COPC for rural land and public open space	✓	✓
	Base Neutral Pesticides: Amitraz, Atrazine, Azinphos Methyl, Chlorpyrifos, Diclofop Methyl, Dimethoate, Diuron, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Fenamiphos, Fenitrothion, Fluometuron, Hexazinone, Metolachlor, Molinate, Myclobutanil, Prometryn, Propazine, Propiconazole, Simazine, Tebuconazole, Terbutryn, Trifluralin	COPC for rural land use and public open space	✓	✓
	Organochloride & Organophosphate Pesticides: alpha-BHC (HCH), Aldrin, beta-BHC (HCH), Bifenthrin, Bromophos Ethyl, Chlordane, Chlorothalonil, Chlorpyrifos, delta BHC (HCH), Diazinon, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Endrin, Ethion, Fenitrothion, Fipronil, Hexachlorobenzene (HCB), Heptachlor Epoxide, Heptachlor, Lindane, Malathion, Methoxychlor, o.p-DDT, Oxychlordane, Parathion Ethyl, Parathion Methyl, p.p-DDD, p.p-DDE, p.p-DDT, Trifluralin, Vinclozolin	COPC for rural land use and public open space	✓	✓
Hydrocarbons	Total Recoverable Hydrocarbons (TRH): TRH C6-C9, TRH C10-C14, TRH C15-C28, TRH C29-C36, TRH C10-C36 (Total), and NEPM fractions: TRH C6-C10, TRH >C10-C16, TRH >C16-C34, TRH >C34-C40, TRH >C10-C40 (total) BTEX Compounds: Benzene, Toluene, Ethylbenzene, m&p-Xylenes, o-Xylene, Xylenes (total)	COPC for broad urban and rural land uses	✓	✓
	Polycyclic Aromatic Hydrocarbons (PAH): Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b&j)fluoranthene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a.h)anthracene, Fluoranthene, Fluorene, Indeno(1.2.3-cd)pyrene, Naphthalene, Phenanthrene, Pyrene, Total PAH	Industrial COPC in lower catchment and by-product of incomplete combustion. Elevated concentrations in middle catchment in 2014 study.[32]	✓	✓

Group	Analysis	Rationale	2025	2024
Per- and Polyfluoroalkyl Substances (PFAS)	Perfluoroalkyl carboxylic acids (PFCAs): Perfluorobutanoic acid (PFBA), Perfluoropentanoic acid (PFPeA), Perfluorohexanoic acid (PFHxA), Perfluoroheptanoic acid (PFHpA), Perfluorooctanoic acid (PFOA), Perfluorononanoic acid (PFNA), Perfluorodecanoic acid (PFDA), Perfluorotridecanoic acid (PFTrDA), Perfluoroundecanoic acid (PFUnDA), Perfluorododecanoic acid (PFDoDA), Perfluorotetradecanoic acid (PFTeDA) Perfluoroalkyl sulfonic acids (PFSAs): Perfluorobutanesulfonic acid (PFBS), Perfluorononanesulfonic acid (PFNS), Perfluorooctanesulfonic acid (PFOS), Perfluoropropanesulfonic acid (PFPrS), Perfluoropentanesulfonic acid (PFPeS), Perfluorohexanesulfonic acid (PFHxS), Perfluoroheptanesulfonic acid (PFHpS), Perfluorodecanesulfonic acid (PFDS) Perfluoroalkyl sulfonamido substances Fluorotelomer sulfonic acids (n:2 FTSAs)	Persistent and widespread COPC	✓	✓
Surfactants	Methylene Blue Active Substance (MBAS)	Indicator of surfactants such as detergents	✓	✓
Volatile and Semi-Volatile Organic Compounds (VOC/SVOC)	Polychlorinated Biphenyls: Aroclor-1016, 1221, 1232,1242, 1248, 1254, 1260, Total PCB	COPC for historical land use in lower catchment	X	✓
	Semi-Volatile Organic Compounds: 1.2.3.4-Tetrachlorobenzene, 1.2.3.5-Tetrachlorobenzene, 1.2.3-Trichlorobenzene, 1.2.4.5-Tetrachlorobenzene, 1.2.4-Trichlorobenzene, 1.2-Dichlorobenzene, 1.3.5-Trichlorobenzene, 1.3-Dichlorobenzene, 1.4-Dichlorobenzene, 1-Chloronaphthalene, 1-Naphthylamine, 2.3.4.6-Tetrachlorophenol, 2.4.5-Trichlorophenol, 2.4.6-Trichlorophenol, 2.4-Dichlorophenol, 2.4-Dimethylphenol, 2.4-Dinitrophenol, 2.4-Dinitrotoluene, 2.6-Dichlorophenol, 2.6-Dinitrotoluene, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methyl-4.6-dinitrophenol, 2-Methylnaphthalene, 2-Methylphenol (o-Cresol), 2-Naphthylamine, 2-Nitroaniline, 2-Nitrophenol, 2-Picoline, 3&4-Methylphenol (m&p-Cresol), 3.3'-Dichlorobenzidine, 3-Methylcholanthrene, 4.4'-DDD, 4.4'-DDE, 4.4'-DDT, 4-Aminobiphenyl, 4-Bromophenyl phenyl ether, 4-Chloro-3-methylphenol, 4-Chlorophenyl phenyl ether, 4-Nitrophenol, 7.12-Dimethylbenz(a)anthracene, Acenaphthene, Acenaphthylene, Acetophenone, a-HCH, Aldrin, Aniline, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b&j)fluoranthene, Benzo(g.h.i)perylene, Benzo(k)fluoranthene, Benzyl chloride, b-HCH, Bis(2-chloroethoxy)methane, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butyl benzyl phthalate, Chrysene, d-HCH, Dibenz(a.h)anthracene, Dibenz(a.j)acridine, Dibenzofuran, Dieldrin, Diethyl phthalate, Dimethyl phthalate, Dimethylaminoazobenzene, Di-n-butyl phthalate, Di-n-octyl phthalate, Diphenylamine, Endosulfan I, Endosulfan II, Endosulfan sulphate, Endrin, Endrin aldehyde, Endrin ketone, Fluoranthene, Fluorene, g-HCH (Lindane), Heptachlor, Heptachlor epoxide, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1.2.3-cd)pyrene, Methoxychlor, Naphthalene, Nitrobenzene, N-Nitrosodibutylamine, N-Nitrosodipropylamine, N-Nitrosopiperidine, Pentachlorobenzene, Pentachloronitrobenzene, Pentachlorophenol, Phenanthrene, Phenol, Pronamide, Pyrene, Total PAH, Trifluralin	COPC for historical land use in lower catchment e.g. former Bellevue Waste Facility and Midland Railway Workshops	X	✓
	Volatile Organic Compounds: 1.1.1.2-Tetrachloroethane, 1.1.1-Trichloroethane, 1.1.2.2-Tetrachloroethane, 1.1.2-Trichloroethane, 1.1-Dichloroethane,	COPC for historical land use in lower	X	✓

Group	Analysis	Rationale	2025	2024
	1.1-Dichloroethene, 1.2.3-Trichloropropane, 1.2.4-Trimethylbenzene, 1.2-Dibromoethane, 1.2-Dichlorobenzene, 1.2-Dichloroethane, 1.2-Dichloropropane, 1.3.5-Trimethylbenzene, 1.3-Dichlorobenzene, 1.3-Dichloropropane, 1.4-Dichlorobenzene, 2-Butanone (MEK), 2-Propanone (Acetone), 4-Chlorotoluene, 4-Methyl-2-pentanone (MIBK), Allyl chloride, Bromobenzene, Bromochloromethane, Bromodichloromethane, Bromoform, Bromomethane, Carbon disulfide, Carbon Tetrachloride, Chlorobenzene, Chloroethane, Chloroform, Chloromethane, cis-1.2-Dichloroethene, cis-1.3-Dichloropropene, Dibromochloromethane, Dibromomethane, Dichlorodifluoromethane, Iodomethane, Isopropyl benzene (Cumene), Methylene Chloride, Styrene, Tetrachloroethene, trans-1.2-Dichloroethene, trans-1.3-Dichloropropene, Trichloroethene, Trichlorofluoromethane	catchment e.g. former Bellevue Waste Facility and Midland Railway Workshops		
Water Quality Parameters*	Alkalinity: Bicarbonate, Carbonate, Hydroxide, Total	Acid-neutralising capacity	✓	✓
	Hardness	Capacity to precipitate soap	✓	✓
	pH, Salinity, Conductivity	Acidity, saltiness	✓	✓
	Colour, Turbidity	Water clarity	✓	✓
	Total Suspended Solids, Total Dissolved Solids	Sediment in water	✓	✓
	Biochemical Oxygen Demand, Total Organic Carbon (TOC)	Organic material in water	✓	✓

* Water samples only, not applicable to sediment samples (apart from pH, salinity and total organic carbon)

Piesse Brook in Kalamunda National Park

Appendix 3 Default Guideline Values

Default guideline values (DGVs) used to assess water and sediment quality in the Mandoon Bilya catchment are summarised below. The DGVs and notes on their application are presented in **Tables T1–T3**.

	Default Guideline Values (DGVs)
Freshwater Ecosystems	**Australian and New Zealand Guidelines for Freshwater Quality (ANZG, 2018)**[93] *Australian and New Zealand Governments and Australian State and Territory Governments* Available at: https://www.waterquality.gov.au/anz-guidelines The ANZG default guideline values (DGVs) define the quality and environmental values of natural and semi-natural waters. They provide different levels of species protection (LOSP) depending on the current or desired ecosystem condition. For the BBB program, the 99% LOSP for *high conservation/ecological value* ecosystems has been applied. These ecosystems are effectively unmodified or other highly valued ecosystems, typically (but not always) occurring in national parks, conservation reserves or remote/inaccessible areas. This choice reflects both the condition of much of the upper Mandoon catchment, and the aspiration of BNAA Senior Elders to restore the river to its pre-colonisation health as much as reasonably possible. The ANZG DGVs include physical and chemical guideline values specific to lowland rivers in South-West Australia. However, there are currently no regional toxicant guideline values available for inland waters within the Southwest Coast drainage division, which includes the Mandoon catchment. The Australian Government is in the process of developing these regional values, although progress has been significantly delayed due to the prioritisation of certain marine regions, such as the Great Barrier Reef. The ANZG DGVs are updated on a rolling basis to reflect the latest scientific evidence. Since the 2024 sampling, several DGVs have been updated, as summarised below: • The DGV for nitrate increased from 0.017 mg/L to 0.64 mg/L in soft water and 1.0 mg/L in moderately hard water, based on additional data published on the chronic toxicity of nitrate to freshwater species. • The DGV for chromium III decreased from 0.0033 mg/L to 0.00095 mg/L. Whilst this value applies to total chromium III, rather than filtered/dissolved concentrations, it was applied for screening purposes in this assessment in the absence of any other more suitable guidelines, noting that comparison of the dissolved phase concentrations to these DGVs may underestimate risk but is preferable to not assessing them at all. • The DGV for iron decreased from 0.3 mg/L to 0.14 mg/L. Similarly to chromium III, whilst this value applies to total iron, rather than filtered/dissolved concentrations, it was applied for screening purposes in this assessment in the absence of any other guidelines. • The DGV for PFOS increased from the interim value of 0.00023 µg/L to 0.02 µg/L, reflecting updated evidence that indicates that direct toxicity risks to lower-order biota are lower than previously understood. *Refer below for more details. The 2024 results have been rescreened against the revised guidelines to ensure consistency in interpretation across both years. *** Revised PFOS DGV** In March 2026, ANZG released finalised DGVs for PFOS in freshwater ecosystems, which have subsequently been included in the latest version of the PFAS National Environmental Management Plan (HEPA, 2025)[96]. These guidelines have been used to assess potential risks to freshwater ecosystems in the current assessment, with PFOS concentrations compared with the 99% level of species protection (LOSP). The DGVs offers protection to aquatic species (including plants, invertebrates and fish), both via direct toxicity (i.e. direct exposure to the water) and also via bioaccumulation pathways (e.g. fish consuming lower order biota into which PFAS has accumulated). It is important to note the toxicant DGVs are not intended to protect air-breathing animals that live in aquatic ecosystems, or prey on aquatic organisms. Consequently, the DGVs may not account for effects in higher-order biota which result from the bioaccumulation of toxicants such as PFOS. Based on the potential for bioaccumulation higher up the food chain, the Technical Brief also provides a PFOS "screening threshold" of 0.0005 µg/L. Measured PFOS concentrations have additionally been compared to this screening threshold to assess the potential risks to air-

Default Guideline Values (DGVs)

breathing animals which might be exposed to PFOS through the consumption of aquatic biota (into which PFOS has accumulated) as part of their diet.

In the Mandoon catchment, there are a wide range of species which might consume aquatic biota as part of their diet, including mammals, amphibians (e.g. turtles), reptiles and birds, including the waalitj (wedge-tailed eagle), Australia's largest bird of prey.

Australian and New Zealand Guidelines for Freshwater Quality (ANZECC, 2000)[95]

Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)

Available at: https://www.waterquality.gov.au/anz-guidelines/resources/previous-guidelines/anzecc-armcanz-2000

The ANZECC guidelines apply to natural and semi-natural water resources and were prepared as part of Australia's National Water Quality Management Strategy (NWQMS).

They are used in situations where ANZG are not available for a specific contaminant – in this instance, boron and cyanide.

The guidelines also provide recommended levels for a range of physical and chemical stressors, including nutrients, dissolved oxygen and pH.

Australian and New Zealand Guidelines for PFAS in Freshwater Ecosystems (HEPA, 2025)[96]

Heads of Environmental Protection Authorities of Australia and New Zealand (HEPA)

Available at: https://www.dcceew.gov.au/sites/default/files/documents/pfas-nemp-3.pdf

The PFAS National Environmental Management Plan (NEMP) provides guidelines for Per and Polyfluoroalkyl Substances (PFAS) in freshwater ecosystems, including interim guidelines for PFOA. The 99% level of species protection (LOSP) is recommended for PFOA as it bioaccumulates and biomagnifies in wildlife. Interim guidelines do not account for bioaccumulation and biomagnification effects of toxicants in air-breathing animals or in animals which prey on aquatic organisms. Interim guideline to be used until final PFOA guidelines can be set using the nationally agreed process under the ANZG.

Swan Canning Catchment Water Quality Targets (SRT, 1999)[87]

Swan River Trust, Government of Western Australia

Available at: https://library.dbca.wa.gov.au/static/FullTextFiles/22030.pdf

In some cases, the required protection level for a waterbody, catchment or aquatic ecosystem is defined in a management strategy published by the responsible agency or local authority. For the Swan–Canning river system, including the lower Mandoon Bilya, specific water quality targets have been established for nutrients in the form of nitrogen and phosphorus.

The targets were established in 1999 as part of the *Swan Canning Cleanup Program* and continue to be used to assess progress under the *Swan Canning River Protection Strategy*[83]. They are intended to evaluate the effectiveness of nutrient-reduction measures, which are critical for reducing algal bloom frequency and preventing further declines in water quality. In recognition of the long timeframes required for catchment management to affect nutrient levels in tributaries, both short and long-term targets were developed.

Data is collected under typical conditions during the river's main discharge period (winter and spring). For compliance assessment, three years of data (up to and including the most recent sampling event) are combined to calculate the median, the number of samples exceeding the target, and the 90% confidence interval of those exceedances. A tributary is considered compliant if the 90% confidence interval lies below the target; it is considered non-compliant if the interval lies above it (exceedance).

If a tributary meets the short-term target, it is then assessed against the long-term target. Tributaries that comply with both are further evaluated to ensure that water quality is not declining over time.

South West Index of River Condition (SWIRC) (DWER, 2020)[88]

Department of Water and Environmental Regulation

Under the SWIRC, <4 mg/L is considered to be the lower limit for dissolved oxygen when assessing river condition. This limit aligns with Beatty *et al.* (2013)[140] where southwest native fish species were shown to typically reside in sites with dissolved oxygen levels above 4 mg/L.

	Default Guideline Values (DGVs)
	Wastewater Effluent Criteria for on-site Discharge in the Mandoon Catchment (COK, 2020)[97] *City of Kalamunda* Some areas of the Mandoon catchment are not connected to the government sewerage network, meaning that treated wastewater must be treated and discharged on-site. While leachate drains were commonly used in the past, new developments must now install aerobic treatment units (ATUS) for on-site wastewater treatment. Most development approvals include specific criteria for treated wastewater effluent to ensure nearby aquatic ecosystems are protected in the event of an accidental release. For screening purposes in this assessment, criteria from a development approval located within a Priority 2 Public Drinking Water Source Area (PDWSA) in the Mandoon catchment were applied. The reference approval relates to Chalet Rigi at 415 Mundaring Weir Road, Piesse Brook, Kalamunda.
	Australian and New Zealand Guidelines for Sediment Quality (ANZG, 2018)[93] *Australian and New Zealand Governments and Australian State and Territory Governments* Available at: https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants The ANZG define default guideline values (DGVs) for toxicants in sediment. The DGVs are applicable to total solid concentrations in sediment only. For leachable sediment concentrations, the DGVs for water should be applied.
	Australian and New Zealand Guidelines for Sediment Quality (ANZECC, 2000)[95] *Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)* Available at: https://www.waterquality.gov.au/anz-guidelines The ANZG define recommended interim sediment quality guidelines (ISQG). The ISQG-low trigger values were adopted for screening in the current assessment. The values are applicable to total solid concentrations in sediment only. For leachable sediment concentrations, the guidelines for water should be applied.
Drinking Water	**Australian Drinking Water Guidelines (NHMRC, 2011)**[98] *National Health and Medical Research Council (NHMRC)* Available at: https://www.nhmrc.gov.au/about-us/publications/australian-drinking-water-guidelines The Australian drinking water guidelines (ADWG) provide the national framework for assessing the quality of water supplied to consumers across Australia. They consider both the protection of human health and desirable aesthetic properties such as taste, odour and appearance. Although the ADWG form part of Australia's National Water Quality Management Strategy (NWQMS), they are not legally enforceable standards, and each state and territory determines how they are implemented. The ADWG are updated on a rolling basis to reflect the latest scientific evidence. The most recent revision contained updated PFAS guidelines, which differ from those used during the 2024 sampling, as summarised below. The 2024 results have been rescreened against the updated guidelines to ensure consistency in interpretation across both years. • The PFOA DGV was lowered from 0.56 ug/L to 0.2 ug/L. • The DGV for PFOS and PFHxS combined was removed (0.07 ug/L). • A PFOS DGV was established (0.008 ug/L). • A PFHxS DGV was established (0.03 ug/L). • A PFBS DGV was established (1 ug/L). • Corresponding changes to the DGVs for non-potable use and livestock watering, which are currently equal to the ADWG.
	American Tap Water Regional Screening Levels (US EPA, 2024)[99] *United States of America, Environmental Protection Agency* Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables Used for screening purposes in the absence of ADWG for aluminium, chromium III, cobalt, iron, thallium, tin, vanadium, zinc and zirconium.
	World Health Organisation Guidelines for Petroleum Products in Drinking Water (WHO, 2008)[100]

	Default Guideline Values (DGVs)
	World Health Organisation Available at: https://cdn.who.int/media/docs/default-source/wash-documents/wash-chemicals/petroleumproducts-2add-june2008.pdf?sfvrsn=9f397b0c_4 Used for screening purposes in the absence of ADWG for petroleum products.
Non-Potable Uses	**Western Australian Non-Potable Use Guidelines (DOH, 2014)**[101] *Department of Health (DOH), Government of Western Australia* Available at: https://www.health.wa.gov.au/-/media/Files/Corporate/general-documents/Environmental-health/Ground-and-Surface-Chemical-Water-Screening-Guidelines.pdf The *Contaminated Sites Groundwater and Surface Water Chemical Screening Guidelines* apply to chemicals in groundwater and surface water at known or suspected contaminated sites, with the aim of protecting human health and maintaining desirable aesthetic properties. They provide non-potable use screening guidelines (NPUG) for water that is not intended for drinking, including water used for irrigation of gardens/parks/reserves, growing vegetables, filling swimming pools, flushing toilets, washing vehicles and supressing dust. NPUG are typically ten times the corresponding ADWG, although exceptions apply for chemicals with strong odours or other aesthetic concerns.
	Western Australian Microbial Assessment Levels (DWER, 2021)[102] *Department of Water and Environmental Regulation (DWER), Government of Western Australia* Available at: https://www.wa.gov.au/system/files/2023-05/guideline-assessment-and-management-of-contaminated-sites.pdf The *Assessment and Management of Contaminated Sites Guidelines* summarise include microbial assessment levels (MAL) for water used in gardens/parks/reserves with unrestricted public access. These MAL have been applied to *E. coli* concentrations in the current assessment as an indicator of faecal pathogen contamination. The guidelines also make recommendations for PFAS concentrations in non-potable water, including adoption of the ADWG as Tier 1 screening levels for non-potable uses.
	Western Australian Guidelines for the Non-Potable Uses of Recycled Water (DOH, 2011)[103] *Department of Health (DOH), Government of Western Australia* Available at: https://www.health.wa.gov.au/~/media/Files/Corporate/general-documents/water/Recycling/Guidelines-for-the-Non-potable-Uses-of-Recycled-Water-in-WA.pdf These guidelines provide ongoing monitoring requirements for the use of recycled water in WA. Recycled water is defined as water produced from industry or sewage (including greywater, yellow water and black water) that has been treated to achieve a fit-for-purpose quality for its intended use. These uses may include agriculture, irrigation, industrial applications or environmental purposes, such as enhancing environmental flows in waterways. The guidelines set compliance values for treated effluent, including minimum ongoing monitoring requirements for pH and turbidity, and commissioning, validation and verification monitoring requirements for biochemical oxygen demand and suspended solids. The high exposure risk values were adopted in this assessment for screening purposes (i.e. unrestricted application).
Recreation & Aesthetics	**Australian and New Zealand Guidelines for Recreational Water Quality (ANZECC, 2000)**[95] *Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)* Available at: https://www.waterquality.gov.au/anz-guidelines/resources/previous-guidelines/anzecc-armcanz-2000 The ANZECC guidelines provide recommended levels for a range of physical and chemical stressors to ensure safe recreational water use, including consideration of natural hazards (e.g. currents, aquatic organisms) and artificial hazards (e.g. pollution and pathogens).
	Western Australian Non-Potable Use Guidelines (DOH, 2014)[101] *Department of Health (DOH), Government of Western Australia* Available at: https://www.health.wa.gov.au/-/media/Files/Corporate/general-documents/Environmental-health/Ground-and-Surface-Chemical-Water-Screening-Guidelines.pdf

	Default Guideline Values (DGVs)
	The *Contaminated Sites Groundwater and Surface Water Chemical Screening Guidelines* apply to chemicals in ground and surface water at known or suspected contaminated sites, with the aim of protecting human health and maintaining desirable aesthetic properties. They provide non-potable use screening guidelines (NPUG) for water that is not intended for drinking, including the recreational use of surface water. They include values for fluoride and several metals that are not considered in ANZECC (2000).
	Western Australian Microbial Assessment Levels (DWER, 2021)[102] *Department of Water and Environmental Regulation (DWER), Government of Western Australia* Available at: https://www.wa.gov.au/system/files/2023-05/guideline-assessment-and-management-of-contaminated-sites.pdf The *Assessment and Management of Contaminated Sites Guidelines* summarise include microbial assessment levels (MAL) for water used in gardens/parks/reserves with unrestricted public access. These MAL have been used for screening purposes in the absence of other recreational guidelines for microbes.
	Australian Guidance for PFAS in Recreational Water (NHMRC, 2019)[104] *National Health and Medical Research Council (NHMRC) & Natural Resource Management Ministerial Council (NRMMC), Commonwealth of Australia* Available at: https://www.nhmrc.gov.au/sites/default/files/documents/attachments/guidance-on-PFAS-in-recreational-water.pdf These guidance provides health based guideline values (HBGV) for PFAS levels in recreational water including accidental ingestion, direct surface water contact and inhalation of volatile chemicals. It does not consider fish/shellfish caught and consumed during recreational fishing.
Primary Industries – Agriculture & Farming	**Australian and New Zealand Livestock Drinking Water Guidelines - Draft (ANZG, 2023)**[105] *Australian and New Zealand Governments and Australian State and Territory Governments* Available at: https://www.waterquality.gov.au/sites/default/files/documents/livestock-drinking-water-guidelines-draft.pdf These draft guidelines assess the suitability of livestock drinking water. PFAS are not considered in the guidelines, including their potential accumulation in livestock and subsequent human exposure. While the ADWG has been used as a screening tool in this assessment, additional assessment may be necessary where PFAS contamination is present.
	Australian and New Zealand Guidelines for Primary Industries (ANZECC, 2000)[95] *Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)* Available at: https://www.waterquality.gov.au/anz-guidelines/resources/previous-guidelines/anzecc-armcanz-2000 These guidelines consider water quality requirements for primary industries, including agricultural irrigation and livestock drinking water. For irrigation, long-term trigger values are provided for periods of up to 100 years, while short-term trigger values apply to shorter timeframes. The guidelines also include trigger values for thermotolerant coliforms in water used on raw human food crops. PFAS are not considered in the guidelines, including potential uptake by crops or subsequent human exposure.
	Aquaculture Guideline Values Primary industries also include aquaculture and human consumption of aquatic food; however, fishing is banned in drinking water catchments across WA, including most of Mandoon catchment. As such, aquaculture guideline values were not applied in this assessment. Nonetheless, anecdotal evidence suggests that some people may harvest and consume fish or crustaceans from the river. Where PFAS is present and fishing activity is likely, further assessment is recommended to evaluate potential risks to human health.
Cultural & Spiritual	Australian guidelines do not currently exist for the cultural/spiritual values of rivers.

Appendix 4 Sampling Procedures

Sampling is undertaken in the following order:

1. Sampling for chemical analysis.
2. Measurement of physiochemical parameters.
3. Any other measurements and samples (i.e. stream width, macroinvertebrate presence etc).

Sampling is undertaken in accordance with the following procedures.

General Sampling Procedures

- Complete the sample documentation and field record sheets during the sampling. Chain of custody forms are required to keep track of samples from the field to the laboratory.
- Wear a new pair of powder-free, disposable nitrile gloves at each site whilst sampling. Once sampling has been completed, the gloves must be disposed of in the designated bin bag to avoid cross contamination between different sites and contamination from suncream etc. Latex and PVC gloves are not suitable for sampling.
- Always use laboratory supplied sample bottles.
- Do not remove the lid from the sample bottle until just before the sample is to be taken and replace the lid immediately afterwards. Never put the lid on the ground as this increases contamination risk.
- Do not touch the inside of sample collection vessels (e.g., grab pole sampler), sample bottles or lids with bare hands or other sampling equipment.
- Certain parameters require direct collection into the sample bottle (with no transfer allowed) including PAH, TRH, PFAS and various pesticides and herbicides.
- Sample bottles should not be pre-rinsed when sampling for metals, TOC, BTEX, PFAS and VOC. This includes any sample bottles containing acid preservatives.
- Fill sample bottles slowly and down the side edge to the specified level. Slow filling is essential to prevent splash back of corrosive and toxic chemicals and loss of preservatives.
- In some cases, the sample bottle must be filled to the top, as the existence of an air space may affect the sample, including samples collected for the analysis of TRH, BTEX and VOC. Samples that need to be filled completely, to exclude all air space, must never be frozen.
- All other sample bottles should be filled to just below the shoulder of the bottle (~80% of capacity) to leave an airspace which will allow for freezing.
- Store and transport the samples as specified. Most samples require storage at 1-4 °C and to be kept cool using ice bricks or ice (refrigeration), however, samples for amoeba should not be chilled and should be kept at ambient temperature.
- Samples must be received by the laboratory within the maximum holding time for the parameter to be analysed, allowing enough time within the holding time for the laboratory to process the sample.
- Samples that require filtration should be filtered as soon as possible after sample collection. Take care never to handle the filter paper. Filter papers should never be reused.
- If in any doubt about any aspect of sample collection, treatment, storage or analysis for particular parameters, then consult the analytical laboratory for up-to-date advice/techniques.

Water Sampling for Chemical Analysis

Water samples will be collected by direct sampling or grab pole sampling as follows:

1. Ensure that labelling on the bottle to be filled is correct and that the sample number matches the number on the paperwork (field record sheets and chain of custody form).
2. Take the sample from the bank, or wade into the water in waders or wellington boots, minimising disturbance as much as possible.
3. When filling the bottle (both for rinsing and for the final sample) take the sample upstream and to the side of you. Collect samples from just below the surface, avoiding any surface scum and debris.
4. Uncap the bottle to be filled, immerse the bottle in the water (depth of ~15 cm) lying it flat with its mouth towards the flow of the water, then slowly move the bottle forwards into the flowing water.
5. If the bottles contain preservatives, they must not be rinsed and should be filled by decanting from another rinsed bottle. Be careful when filling to prevent splash back.
6. If rinsing is required, allow approximately 20 mL of water to enter the bottle. Cap, shake well and pour the rinsate out downstream. Repeat twice so the bottle is rinsed three times (if required).

7. Fill the bottle, again upstream and to the side of yourself at a depth of ~15 cm, moving it slowly forwards through the water to the required level.
8. Cap tightly and store the sample bottle as required for transport to the laboratory.

Filtering Water Samples

Some water samples should be filtered in the field using either a portable filter station or a disposable filter and syringe supplied by the laboratory. A portable filter station was used for the current assessment. For all filtering:

1. Wear nitrile gloves at all times.
2. Preferably filter the samples on a level surface (e.g. back of a ute tray).
3. Avoid dusty conditions and rain.
4. Homogenise your sample gently before filtering.

Cleaning and Assembling the Filter Station

Clean the filter station after every new sample that is filtered.

1. First, disassemble the filter tower, being careful not to touch the filter holder. Place the top of the filter tower onto a flat surface, upside down. Place the filter holder onto the top of the filter tower with the filter surface facing upwards.
2. Remove the bungs from the vacuum hose attachments.
3. Use a spray bottle of deionised water to rinse the inside of the bottom part of the filter tower (the collection chamber) well, pouring out the rinsate through both vacuum ports. Make sure to rinse the neck of the container.
4. Carefully pick up the filter holder, making sure not to touch the centre of it, and rinse well on both sides with deionised water. Check that there is nothing sticking to the filter holder.
5. Place the filter holder onto the rinsed collection chamber.
6. Carefully place the correct type of filter paper (0.45µm mixed cellulose ester) onto the centre of the filter holder using metal tweezers, making sure not to touch the filter holder or the paper directly with your skin.
7. Rinse the top funnel of the filter tower well with deionised water, making sure to also rinse the underside.
8. Screw the rinsed top funnel section on to the filter tower taking care not to crease the filter paper. One hand should apply downwards pressure to the top section while the other hand screws in the collar that connects the top to the bottom section. Check that it has screwed on properly by gently trying to rotate the upper section while holding the bottom section. Repeat if there is movement.
9. Rinse a rubber bung with deionised water and place it on one of the two vacuum ports.
10. Attach a vacuum pump to the other vacuum port.

Filtering a Sample using the Filter Station

1. Pour a small amount of the sample into the top funnel of the cleaned and assembled filter tower, to be used as rinsate.
2. Swirl the rinsate in the top funnel of the filter tower to rinse the inside edge of this top section.
3. Use the vacuum pump to filter the sample by switching the pump on.
4. Once the sample is filtered, remove the vacuum pump and the rubber bung
5. Swirl the filtered sample around the collection chamber, being careful not to splash the bottom of the filter holder.
6. Discard the filtered sample by carefully pouring it through both vacuum ports and onto the rubber bung you intend to filter with.
7. Put the rinsed rubber bung back on and re-attach the vacuum hose.
8. Pour the required amount of sample plus 30mL extra for each sample container you are required to fill with this batch of filtrate into the top funnel of the filter tower.
9. Use the vacuum pump to filter the sample.
10. While the sample is being filtered clean and prepare the second filter tower for the next site.
11. Once the sample is filtered remove the bung and vacuum hose from the collection chamber (this prevents the sample from splashing back up to the bottom of the filter holder).
12. Carefully pour a small amount (~10mL) of your filtered sample into your pre-labelled sample container. Always pour out the sample from the vacuum port taking care not to touch any part of the filter tower to the sample container. Cap, swirl around the filtrate and discard.
13. Repeat this twice more, so that you have rinsed your sample container three times.
14. Then, fill your labelled sample container with the filtrate by pouring through the vacuum port to the required level. There is no need to remove the top funnel after filtering as this can introduce contaminants to the sample.
15. Cap and store the sample container in an esky on ice-bricks.

Filtering a Sample using a Disposable Filter and Syringe

1. Fill the syringe with sample water.
2. Carefully pick up the filter, making sure not to touch the centre and that nothing is stuck to it, and screw the syringe onto the filter.
3. Slowly close the syringe to push the water through the filter and fill the sample bottle.
4. Cap tightly and store the sample bottle in an esky on ice-bricks.

Sediment Sampling for Chemical Analysis

Sediment samples are collected by direct sampling as follows:

1. Ensure that labelling on the container to be filled is correct and that the sample number matches the number on the paperwork (field record sheets and chain of custody form).
2. Take the sample from the bank, or wade into the water in waders or wellington boots, minimising disturbance as much as possible.
3. Take the sediment sample from upstream and to the side of you. Collect samples from the surface sediment, avoiding any vegetation, rocks, gravel and debris.
4. Uncap the container to be filled.
5. Push the container on an angle into the sediment of the riverbed to a depth of ~5 cm and slowly move forwards into the direction of the current to fill with sediment.
6. Whilst the container is still under the water, replace the lid and close tightly.
7. Store the sample container as required for transport to the laboratory.

Measurement of Physiochemical Parameters

Measurement

Physiochemical parameters are measured using the following process:

1. Remove the protective, water filled cap.
2. Turn on the YSI Pro DSS handheld unit.
3. Lower the clean and calibrated Pro DSS into the water near or at the same site where water samples were taken. Take care to minimise sediment disturbance if you have to enter the water.
4. Ensure that all probes are fully submerged in the water. In shallow water, the probe may need to be held on an angle. Ideally the probes should be ~10cm under the water surface, but this may not be possible in shallow waters, and not within ~10cm of sediments. If the water is very shallow, place the probes in the middle of the water column and kept them in a gentle motion while taking care not to stir up the sediments.
5. Allow sufficient time for the probe to stabilise (minimum of two minutes).
6. Press enter to log the measurements and then record the readings on the field record sheet. Results should be stored electronically on the instrument as well as the field record sheet as a back-up in case the electronic file is corrupted. Include the date and time of sampling in the record.
7. When back at the car, store the sonde back in its protective water filled casing.

Take care when handling and transporting the meter as they are delicate and can easily be damaged.

Calibration of the water quality parameter is critical to ensure the accuracy and precision of the probes and the physiochemical data you collect. It allows you to verify the data and ensure it can be used with confidence. Daily calibration is required each day before you go out into the field and as soon as you return from sampling. You should keep a written record of these calibrations.

Calibration Process

The YSI Pro DSS unit is calibrated using the following process:

Conductivity:

1. Rinse calibration cup and probes with a small amount of 1413uS/cm solution three times.
2. Fill calibration cup with 1413uS/cm conductivity so that the solution is above the vent holes of sensor, then place probes into calibration cup and allow readings to stabilise.
3. Once stable, press ‘Cal’, then select Conductivity → Sp Conductance → SPC mS/cm.
4. Using the arrow keys select ‘Calibration Value’ and enter 1.413 using the arrow keys, then Enter.
5. Select ‘Accept Calibration’ – this will correct your reading to 1.413mS/cm.
6. Empty standard solution into container labelled ‘Post Check 1.413mS/cm solution.

pH (2 point):

1. Rinse calibration cup and probes with a small amount of pH 7 solution three times.
2. Fill calibration cup with pH 7 solution so that the probes are fully immersed, then place probes into calibration cup and allow readings to stabilise.
3. Once stable, press 'Cal', then select pH.
4. Select 'Accept Calibration' – pH is automatically adjusted due inbuilt temperature compensation.
5. At the bottom of the screen will ready 'Ready for point 2'.
6. Empty pH 7 solution into container labelled 'Post Check pH 7'.
7. Rinse calibration cup and probes with a small amount of pH 10 solution three times.
8. Fill calibration cup with pH 10 solution so that the probes are fully immersed, then place probes into calibration cup and allow readings to stabilise.
9. Select 'Accept Calibration'.
10. At the bottom of the screen, will ready 'Ready for point 3'.
11. Repeat above steps for third calibration point (pH 10 solution). If undertaking a two-step process, press 'Cal' to finish.
12. Rinse calibration cup and probes with tap water.

Dissolved oxygen:

1. Gently remove any moisture from the DO cap and temperature probes with a cotton bud.
2. Place 1 cm of tap water in the bottom of the calibration cup (ensure probe is not immersed).
3. Screw the lid partially on to allow the DO probe to be vented to the atmosphere (1-2 threads).
4. Allow a few minutes for the readings to stabilise.
5. Press 'Cal', then select DO → DO %.
6. When stable select 'Accept Calibration' – this will correct your readings to 100%.

After calibration, wash the calibration cup with tap water and fill with 3 cm of water for storage. Ensure cables are clean and near for the next use and enter the details into the Field Record Sheets.

PFAS Sampling Procedures

Cross contamination is a significant risk when sampling for PFAS. To avoid this, the DWER *Interim Guideline on the Assessment and Management of PFAS*[109] protocols are strictly adhered to during all sampling and laboratory processing.

Sun cream must not be worn. Physical barriers will be used instead i.e. long sleeved shirt, face and neck sleeve, wide brimmed hat, long pants and nitrile gloves. All clothing must be more than six washes old. Hand creams, moisturisers and make up must not be worn. Plastic or foil packaged food or drink with a non-stick internal barrier is not allowed.

<u>Sampling</u>

1. Before sampling commences, samplers are assigned roles: one person is the sample collector and the other is assigned the "clean-hands" role.
2. At the start of each sampling day, both samplers wash their hands and forearms with soap, then PFAS free deionised water, then dry their hands with a clean paper towel and put on clean nitrile gloves.
3. At each site and before sample collection, the clean hands sampler puts on new nitrile gloves and then provides the sample collector with clean nitrile gloves and a sample bottle (HDPE with no PFTE liner provided by the laboratory).
4. When samples are collected on foot, the sampler enters the water downstream of the intended sampling location and walks slowly into the flow.
5. Once at the desired location, the sampler submerges the sample bottle into the water, cap first. When fully submerged the bottle is faced into the direction flow and the cap removed to allow the bottle to fill.
6. Before the bottle is removed from the water, the cap is screwed on tightly.
7. The sampler returns the sample to the clean hands sampler, who dries the bottle with a clean paper towel.
8. The sample collector removes their gloves, washes their hands with deionised water, dries them with a clean paper towel and puts on a new pair of gloves.
9. The sample bottle is double bagged (in food grade snap-lock HDPE bag) and stored in a clean esky on double bagged ice.
10. The same nitrile gloves are worn whilst travelling to the next site.

eDNA Sampling Procedures

Cross contamination is a significant risk when sampling for eDNA.

Water samples are collected for eDNA analysis using laboratory supplied kits and a drill.

1. Wear clean nitrile gloves for all eDNA sampling.
2. Open the pump head by sliding the lever to the left.
3. Insert the tubing into the slot and push it to the back.
4. Secure the tubing by sliding the lever to the right.
5. Retrieve a big syringe from the water sampling kit, remove the plunger and set it aside.
6. First, fit the smaller upper section to the compatible end of the pump tube (it only fits one side) and secure with a quarter turn.
7. Then fit the white side of the filter to the other end of the pump tube.
8. Collect water in a laboratory supplied tub or filter water directly from the source if possible.
9. Place the syringe end of the pump tube into the water to be sampled.
10. Press the drill trigger and allow the water to move up into the syringe.
11. Check the filter end – water should be moving out freely.
12. Collect the water discharging from the filter into a tub marked with visible measurements.
13. Aim to filter 1 litre through the filter if possible. Stop filtering if the flow reduces or stops.
14. Remove the syringe from the filter and allow air to pump through the filter for a few seconds.
15. Record the amount of water that has been filtered.
16. Retrieve the small preservative syringe from the water sampling kit.
17. Screw the black cap off the syringe and screw it onto the blue side of the filter.
18. Next, unscrew the filter from the tubing and put it straight onto the small preservative syringe.
19. Push the plunger so the preservative goes into the filter and then give it a little gentle shake to distribute evenly.
20. Do not remove the syringe or the cap from the filter – keep it sealed and place it straight into the sample bag.
21. Record the site name, location coordinates, date and amount of water filtered in your field notes and on the sample kit using permanent marker. It is easier to write on the bag before you put the sample in it.
22. You can use the same pump tube for different sites, providing the tube is well rinsed with sample water at each site before sample collection starts.


Lower Pumpback Dam site, base of the dam wall

Appendix 5 Field Observations and Results by Location

Samson St site in the lower catchment

Name	Helena Swan
Waterway	Mandoon Bilya (Helena River) – lower catchment
Location	-31.89708, 115.98581 – in the main river channel under Bushmead Rd bridge
Elevation	19.9 m AHD
WIR Ref	Not applicable – nearest WIR site (6161091) is 90 m upstream
Locality	City of Swan
Rationale	Most downstream site that is not tidally influenced by Derbarl Yerrigan (Swan River). Downstream of former Midland Railway Workshops. Upstream of long term restoration site of the Lower Helena Association.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	938 uS/cm	-	62.8 %	7.00	103.7 mV	611 mg/L	-
Sept 2024	1,095 uS/cm	550 ppm	54.8 %	6.76	131.3 mV	712 mg/L	17.6 NTU

	September 2025	September 2024
Field Notes	• Flowing, brown/yellow colour, approx. 600 mm depth. • No sheen, foam or floating debris. • Banks muddy, not well defined, little fringing vegetation. • Much fallen branches and organic material in channel. • Debris on adjacent floodplain, evidence of high flows. • Adjacent waterlogged ground and decaying grasses. • No visible fish, frogs, tadpoles and no frog noises. • Many mosquitoes, ducks in water. • Animal footprints in mud (birds, dog/fox?). • Some native vegetation: E. rudis, melaleuca paperbarks. • Many weeds: fumitory, grasses, oxalis, oats, arum lily. • Much litter on banks and floodplain, graffiti on bridge. • **Refer iNaturalist for complete record of species.**	• Flowing, brown/orange colour. • No sheen, foam or floating debris. • Banks muddy, not well defined, little fringing vegetation. • Many weeds: fumitory, grasses, arum lily, bamboo. • Water ribbons – unsure if local or introduced species. • Some native vegetation: E. rudis, melaleuca paperbarks. • No visible fish, frogs, tadpoles and no frog noises. • Bubbles coming from river bed. Many mosquitoes. • Animal footprints in mud (birds, dog/fox/cat?). • Much litter on banks and floodplain. • Difficult access, steep slope from bridge, trip hazards. • Busy bridge, much traffic and aeroplane noise.

Water Samples

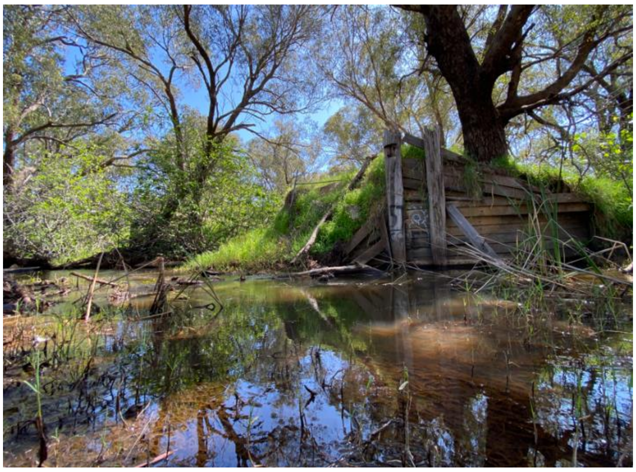
	2025	2024
Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected:** pesticides, herbicides, hydrocarbons	**Detected**: metals, nutrients, surfactants, microbes **Undetected**: PFAS, pesticides, herbicides, hydrocarbons, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (120 CFU/100ml) above DGV (detection) ***Enterococci*** (61 CFU/100ml) above DGV (detection) **PFOS** (0.039 ug/L) above DGV (0.008)	***E. coli*** (130 CFU/100ml) above DGV (detection) ***Enterococci*** (160 CFU/100ml) above DGV (detection)
Aesthetic	**Iron** (dissolved) (0.95 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.1 mg/L) above DGV (0.1) **TDS** (600–611 mg/L) above DGV (600) **Turbidity** (15 NTU) above DGV (5)	**Iron** (total) (4.6 mg/L) above DGV (0.3) **Manganese** (total) (0.13 mg/L) above DGV (0.1) **TDS** (700–712 mg/L) above DGV (600) **Turbidity** (17–18 NTU) above DGV (5)
Non-Potable	***E. coli*** (120 CFU/100ml) above DGV (1) **Iron** (dissolved) (0.95 mg/L) above DGV (0.3) **PFOS** (0.039 ug/L) above DGV (0.008) **Turbidity** (15 NTU) above DGV (5)	***E. coli*** (130 CFU/100ml) above DGV (1) **Iron** (total) (4.6 mg/L) above DGV (0.3) **Turbidity** (17–18 NTU) above DGV (5)
Recreation	**Ammonia** (0.06 mg/L) above DGV (0.01) ***E. coli*** (120 CFU/100ml) above DGV (1) ***Enterococci*** (61 CFU/100ml) above DGV (60-100) **Iron** (dissolved) (0.95 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.1 mg/L) above DGV (0.1) **MBAS** (0.26 mg/L) above DGV (0.2)	**Ammonia** (0.02 mg/L) above DGV (0.01) ***E. coli*** (130 CFU/100ml) above DGV (1) ***Enterococci*** (160 CFU/100ml) above DGV (60-100) **Iron** (total) (4.6 mg/L) above DGV (0.3) **Manganese** (total) (0.13 mg/L) above DGV (0.1) **MBAS** (0.3 mg/L) above DGV (0.2)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock	***E. coli*** (120 CFU/100ml) above DGV (100) **PFOS** (0.039 ug/L) above DGV (0.008) **TDS** (600-611 mg/L) above DGV (500)	***E. coli*** (130 CFU/100ml) above DGV (100) ***Enterococci*** (160 CFU/100ml) above DGV (100) **TDS** (700-712 mg/L) above DGV (500)
Agriculture	**Chloride** (220 mg/L) above DGV (175) ***E. coli*** (120 CFU/100ml) above DGV (10) **Iron** (dissolved) (0.95 mg/L) above long-term DGV (0.2)	**Chloride** (230 mg/L) above DGV (175) ***E. coli*** (130 CFU/100ml) above DGV (10) **Iron** (total) (4.6 mg/L) above long-term DGV (0.2) **Phosphorus** (0.06 mg/L) above long-term DGV (0.05) **Sodium** (140 mg/L) above DGV (115)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Conductivity** (938–1,000 mg/L) above DGV (300) **DO** (62.8%) below DGV (>80%) **Fluoride** (0.3 mg/L) above DGV (0.29) **Iron** (dissolved) (0.95 mg/L) above DGV (0.14) **Nitrogen** (oxidised) (0.21 mg/L) above DGV (0.15) **PFOS** (0.039 ug/L) above air-breathing DGV (0.0005) **PFOS** (0.039 ug/L) above aquatic animal DGV (0.02) **Zinc** (dissolved) (0.010 mg/L) above DGV (0.0024)	**Aluminium** (total) (0.14 mg/L) above DGV (0.027) **Conductivity** (1,095–1,200 mg/L) above DGV (300) **Copper** (total) (0.001 mg/L) equal to DGV (0.001) **DO** (54.8%) below DGV (>80%) **Nitrogen** (1.2 mg/L) above DGV (1.2) **Nitrogen** (1.2 mg/L) above Swan Canning target (1) **Nitrogen** (oxidised) (0.18 mg/L) above DGV (0.15) **Uranium** (total) (0.001 mg/L) above DGV (0.0005) **Zinc** (total) (0.005 mg/L) above DGV (0.0024)

Wastewater	***E. coli*** (120 CFU/100ml) above criteria (10)	***E. coli*** (130 CFU/100ml) above criteria (10)
	Sediment Samples	
	2025 – Leachable Concentrations	**2024 – Total Concentrations**
Detections	**Detected:** PFAS, metals, nutrients **Undetected:** pesticides, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients **Undetected:** PFAS, pesticides, herbicides, hydrocarbons, surfactants, volatiles
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Aesthetic	**Aluminium** (dissolved) (1.4 mg/L) above DGV (0.2) **Iron** (dissolved) (1.6 mg/L) above DGV (0.3)	No exceedances of the DGVs Limited DGVs exist
Non-Potable	**Aluminium** (dissolved) (1.4 mg/L) above DGV (0.2) **Iron** (dissolved) (1.6 mg/L) above DGV (0.3)	
Recreation	**Aluminium** (dissolved) (1.4 mg/L) above DGV (0.2) **Iron** (dissolved) (1.6 mg/L) above DGV (0.3)	
	2025 – Primary Industries Exceedances	
Agriculture	**Iron** (dissolved) (1.6 mg/L) above long-term DGV (0.2) **Phosphorus** (0.77 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (1.4 mg/L) above DGV (0.027) **Boron** (dissolved) (0.32 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.001 mg/L) above DGV (0.00095) **Copper** (dissolved) (0.003 mg/L) above DGV (0.001) **Iron** (dissolved) (1.6 mg/L) above DGV (0.14) **Lead** (dissolved) (0.004 mg/L) above DGV (0.001) **Nitrogen** (1.1 mg/L) above Swan Canning target (1) **PFOS** (0.0051 ug/L) above DGV (0.0005) **Phosphorus** (0.77 mg/L) above Swan Canning target (0.1) **Phosphorus** (0.77 mg/L) above DGV (0.065) **Phosphorus** (reactive) (0.08 mg/L) above DGV (0.04) **Zinc** (dissolved) (0.022 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		
Looking Downstream		

Name	Whiteman Rd						
Waterway	Mandoon Bilya (Helena River) – lower catchment						
Location	-31.90006, 116.00762 – at the former Whiteman Rd bridge						
Elevation	26.3 m AHD						
WIR Ref	616086						
Locality	City of Swan						
Rationale	DBCA Swan Canning Water Quality Monitoring Program site SWN10 and DWER Healthy Rivers site HELENR. Downstream of Hazelmere industrial estate and Bellevue Hazardous Waste Facility. Location of BNAA river restoration works, including Community Rivercare 9 grant in 2025.						
	Field Observations						
	Conductivity	**Salinity**	**DO**	**pH**	**Redox**	**TDS**	**Turbidity**
Sept 2025	960 uS/cm	-	67.9 %	7.03	98.2 mV	624 mg/L	-
Sept 2024	1,176 uS/cm	590 ppm	56.5 %	6.64	158.9 mV	764 mg/L	14.70 NTU

	September 2025	September 2024
Field Notes	• Flowing, brown/yellow colour, approx. 400 mm depth. • Slight organic sheen, no foam or floating debris. • Banks muddy, not well defined, little fringing vegetation. • Slight sulphurous/eggy odour. • Adjacent waterlogged ground, decaying grasses. • Debris on adjacent floodplain, evidence of high flows. • Small fish (*Gambusia*?), no visible frogs or frog noises. • Loud insects, big Monarch butterflies, dragonflies, march flies, mosquitoes, spiders, song birds, 28 parrots, white cockatoos, black coot, wardong (ravens). • Big old gum trees, many weeds, little understorey. • Much fly-tipping, tyres, green waste, food, household, industrial/commercial, furniture, white goods, drums, concrete, bricks, tiles, mattresses, burned out motorbike. • **Refer iNaturalist for complete record of species.**	• Flowing, brown/yellow colour. • No sheen, foam or floating debris. • Banks muddy, not well defined, little fringing vegetation. • Many weeds: grasses, arum lily, blackberry, fig, wavy gladioli, oxalis, castor oil, cotton bush, wattles. • Water ribbons – unsure if local or introduced. • Some native vegetation: *E.* rudis, melaleuca, typha. • No visible fish, frogs, tadpoles and no frog noises. • Bubbles coming from river bed. • Loud insects (crickets/cicadas?), dragonflies, butterflies, galahs, 28 parrots, wardong, blue wren, song birds. • Much litter, fly-tipped commercial waste, drums, tyres, concrete, barbed wire fence, green waste. • 4WD tracks in floodplain and crossing the river. • Steep and rough access from Whiteman Rd.
	Water Samples	
Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (230 CFU/100ml) above DGV (detection) ***Enterococci*** (50 CFU/100ml) above DGV (detection) **PFOS** (0.04 ug/L) above DGV (0.008)	***E. coli*** (140 CFU/100ml) above DGV (detection) ***Enterococci*** (53 CFU/100ml) above DGV (detection) **PFOS** (0.041 ug/L) above DGV (0.008)
Aesthetic	**Iron** (dissolved) (0.87 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.11 mg/L) above DGV (0.1) **TDS** (610–624 mg/L) above DGV (600) **Turbidity** (11 NTU) above DGV (5)	**Chloride** (300 mg/L) above DGV (250) **Hardness** (200 mg/L) equal to DGV (200) **Iron** (total) (3.8 mg/L) above DGV (0.3) **Manganese** (total) (0.12 mg/L) above DGV (0.1) **TDS** (760–764 mg/L) above DGV (600) **Turbidity** (10–15 NTU) above DGV (5)
Non-Potable	***E. coli*** (230 CFU/100ml) above DGV (1) **Iron** (dissolved) (0.87 mg/L) above DGV (0.3) **PFOS** (0.04 ug/L) above DGV (0.008) **Turbidity** (11 NTU) above DGV (5)	**Chloride** (300 mg/L) above DGV (250) ***E. coli*** (140 CFU/100ml) above DGV (1) **Iron** (total) (3.8 mg/L) above DGV (0.3) **PFOS** (0.041 ug/L) above DGV (0.008) **Turbidity** (10–15 NTU) above DGV (5)
Recreation	**Ammonia** (0.11 mg/L) above DGV (0.01) ***E. coli*** (230 CFU/100ml) above DGV (1) **Iron** (dissolved) (0.87 mg/L) above DGV (0.3) **Manganese** (dissolved) 0.11 mg/L) above DGV (0.1) **MBAS** (0.66 mg/L) above DGV (0.2)	**Ammonia** (0.13 mg/L) above DGV (0.01) ***E. coli*** (140 CFU/100ml) above DGV (1) **Iron** (total) (3.8 mg/L) above DGV (0.3) **Manganese** (total) (0.12 mg/L) above DGV (0.1) **MBAS** (0.4 mg/L) above DGV (0.2)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock	***E. coli*** (230 CFU/100ml) above DGV (100) **PFOS** (0.04 ug/L) above DGV (0.008) **TDS** (610-624 mg/L) above DGV (500)	***E. coli*** (140 CFU/100ml) above DGV (100) **PFOS** (0.041 ug/L) above DGV (0.008) **TDS** (760-764 mg/L) above DGV (500)
Agriculture	**Chloride** (240 mg/L) above DGV (175) ***E. coli*** (230 CFU/100ml) above DGV (10) **Iron** (dissolved) (0.87 mg/L) above long-term DGV (0.2)	**Chloride** (300 mg/L) above DGV (175) ***E. coli*** (140 CFU/100ml) above DGV (10) **Iron** (total) (3.8 mg/L) above long-term DGV (0.2) **Sodium** (160 mg/L) above DGV (115)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Conductivity** (960–1,000 mg/L) above DGV (300) **DO** (67.9%) below DGV (>80%) **Fluoride** (0.3 mg/L) above DGV (0.29) **Iron** (dissolved) (0.87 mg/L) above DGV (0.14) **Nitrogen** (oxidised) (0.21 mg/L) above DGV (0.15) **PFOS** (0.04 ug/L) above air-breathing DGV (0.0005) **PFOS** (0.04 ug/L) above aquatic animal DGV (0.02)	**Boron** (total) (0.09 mg/L) equal to DGV (0.09) **Conductivity** (1,176–1,300 mg/L) above DGV (300) **DO** (56.5%) below DGV (>80%) **Fluoride** (0.3 mg/L) above DGV (0.29) **Nitrogen** (oxidised) (0.21 mg/L) above DGV (0.15) **PFOS** (0.041 ug/L) above air-breathing DGV (0.0005) **PFOS** (0.041 ug/L) above aquatic animal DGV (0.02)

		Uranium (total) (0.002 mg/L) above DGV (0.0005) **Zinc** (total) (0.006 mg/L) above DGV (0.0024)
Wastewater	***E. coli*** (230 CFU/100ml) above criteria (10)	***E. coli*** (140 CFU/100ml) above criteria (10)
	Sediment Samples	
	2025 – Leachable Concentrations	**2024 – Total Concentrations**
Detections	**Detected:** PFAS, metals, nutrients **Undetected:** pesticides, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients, pesticides, hydrocarbons, surfactants **Undetected:** PFAS, herbicides, volatile organics
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Barium** (dissolved) 2.3 mg/L) above DGV (2) **Cobalt** (dissolved) (0.006 mg/L) equal to DGV (0.006) **Iron** (dissolved) (19 mg/L) above DGV (14) **Lead** (dissolved) (0.081 mg/L) above DGV (0.01) **Uranium** (dissolved) (0.032 mg/L) above DGV (0.02) **Vanadium** (dissolved) (0.087 mg/L) above DGV (0.086) **Zirconium** (dissolved) (0.02 mg/L) above DGV (0.0016)	
Aesthetic	**Aluminium** (dissolved) (13 mg/L) above DGV (0.2) **Iron** (dissolved) (19 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.21 mg/L) above DGV (0.1)	
Non-Potable	**Aluminium** (dissolved) (13 mg/L) above DGV (0.2) **Iron** (dissolved) (19 mg/L) above DGV (0.3)	
Recreation	**Aluminium** (dissolved) (13 mg/L) above DGV (0.2) **Barium** (dissolved) (2.3 mg/L) above DGV (1) **Iron** (dissolved) (19 mg/L) above DGV (0.3) **Lead** (dissolved) (0.081 mg/L) above DGV (0.05) **Manganese** (dissolved) (0.21 mg/L) above DGV (0.1)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (13 mg/L) above DGV (3.6) **Barium** (dissolved) (2.3 mg/L) above DGV (2) **Zirconium** (dissolved) (0.02 mg/L) above DGV (0.0016)	
Agriculture	**Aluminium** (dissolved) (13 mg/L) above long-term DGV (5) **Boron** (dissolved) (0.53 mg/L) above DGV (0.5) **Iron** (dissolved) (19 mg/L) above long-term DGV (0.2) **Iron** (dissolved) (19 mg/L) above short-term DGV (10) **Manganese** (dissolved) (0.21 mg/L) above long-term DGV (0.2) **Phosphorus** (0.32 mg/L) above long-term DGV (0.05) **Uranium** (dissolved) (0.032 mg/L) above long-term DGV (0.01)	**Mercury (total)** (0.23 mg/kg) above DGV (0.15) **Naphthalene** (0.7 mg/kg) above DGV (0.16) **TRH C10-C40** (335 mg/kg) above DGV (280) Limited DGVs exist
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (13 mg/L) above DGV (0.027) **Boron** (dissolved) (0.53 mg/L) above DGV (0.09) **Cadmium** (dissolved) (0.0002 mg/L) above DGV (0.00006) **Chromium** (dissolved) (0.008 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.008 mg/L) above DGV (0.00095) **Cobalt** (dissolved) (0.006 mg/L) above DGV (0.0014) **Copper** (dissolved) (0.044 mg/L) above DGV (0.001) **Iron** (dissolved) (19 mg/L) above DGV (0.14) **Lead** (dissolved) (0.081 mg/L) above DGV (0.001) **Nickel** (dissolved) (0.011 mg/L) above DGV (0.008) **Nitrogen** (2.4 mg/L) above DGV (1.2) **Nitrogen** (2.4 mg/L) above Swan Canning target (1) **PFOS** (0.0025 ug/L) above air-breathing DGV (0.0005) **Phosphorus** (0.32 mg/L) above DGV (0.065) **Phosphorus** (0.32 mg/L) above Swan Canning target (0.1) **Uranium** (dissolved) (0.032 mg/L) above DGV (0.0005) **Vanadium** (dissolved) (0.087 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.31 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**

Looking Upstream		
Looking Downstream		

Name	Helena Roe
Waterway	Mandoon Bilya (Helena River) – lower catchment
Location	-31.90540, 116.01589 – under Military Rd bridge
Elevation	27.4 m AHD
WIR Ref	Not applicable – nearest WIR site (6167030) is 80 m upstream
Locality	City of Swan
Rationale	Immediately downstream of City of Swan and Shire of Mundaring boundary. Adjacent former Bellevue Hazardous Waste Facility. WIR 6167030 is a Helping the Helena site (Helena2) that previously had elevated metals and acidic conditions.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	973 uS/cm	-	56.4 %	7.02	80.5 mV	630.5 mg/L	-
Sept 2024	1,128 uS/cm	560 ppm	59.1 %	6.73	106.4 mV	733 mg/L	17.8 NTU

	September 2025	September 2024
Field Notes	• High flow, slight brown/yellow, clear, 800-1000 mm depth. • Very slight organic sheen, no foam or floating debris. • Debris on bridge footings – evidence of previous high flows. • Very eroded and muddy river banks, matting or material for erosion control, very little fringing vegetation. • Tiny fish (Gambusia?), no visible tadpoles or frog noises. • Very large old river gums, paperbark trees, some local wattles, bracken, very little understorey. • Aquatic ribbon plants – unsure if local species. • Weeds: castor oil, cotton bush, prickly hibiscus, palms, blackberry, fumitory, radium weed, Pattersons curse. • Very neglected and degraded, much litter. • **Refer iNaturalist for complete record of species.**	• Flowing water, brown and orange colour, no sheen or floating debris, eroded banks. • Many weeds e.g. grasses, bamboo, figs, oxalis, castor oil, plantain, possible aquatic weeds. • Some native vegetation e.g. large river gums. • Many mosquitoes, wardong (ravens). • No visible fish, frogs, tadpoles and no frog noises. Bubbles observed from river bed when taking sample. • Very neglected and degraded, much litter, plastic, traffic cones, construction fencing on floor. • Bridge works in process (shoring up), river fenced off with construction fencing. Much traffic on bridge. • Track running along south of the river for riverpark.

Water Samples

	2025	2024
Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (460 CFU/100ml) above DGV (detection) ***Enterococci*** (66 CFU/100ml) above DGV (detection) **PFOS** (0.045 ug/L) above DGV (0.008)	***E. coli*** (240 CFU/100ml) above DGV (detection) ***Enterococci*** (120 CFU/100ml) above DGV (detection) **PFOS** (0.048 ug/L) above DGV (0.008)
Aesthetic	**Iron** (dissolved) (0.81 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.13 mg/L) above DGV (0.1) **TDS** (620–631 mg/L) above DGV (600) **Turbidity** (13 NTU) above DGV (5)	**Chloride** (250 mg/L) above DGV (250) **Iron** (total) (3.8 mg/L) above DGV (0.3) **Manganese** (total) (0.12 mg/L) above DGV (0.1) **TDS** (710–733 mg/L) above DGV (600) **Turbidity** (18-19 NTU) above DGV (5)
Non-Potable	***E. coli*** (460 CFU/100ml) above DGV (1) **Iron** (dissolved) (0.81 mg/L) above DGV (0.3) **PFOS** (0.045 ug/L) above DGV (0.008) **TSS** (24 mg/L) above DGV (10) **Turbidity** (13 NTU) above DGV (5)	**Chloride** (250 mg/L) above DGV (250) ***E. coli*** (240 CFU/100ml) above DGV (1) **Iron** (total) (3.8 mg/L) above DGV (0.3) **PFOS** (0.048 ug/L) above DGV (0.008) **Turbidity** (18-19 NTU) above DGV (5)
Recreation	**Ammonia** (0.18 mg/L) above DGV (0.01) ***E. coli*** (460 CFU/100ml) above DGV (1) ***Enterococci*** (66 CFU/100ml) above DGV (60-100) **Iron** (dissolved) (0.81 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.13 mg/L) above DGV (0.1) **MBAS** (0.26 mg/L) above DGV (0.2)	**Ammonia** (0.12 mg/L) above DGV (0.01) ***E. coli*** (240 CFU/100ml) above DGV (1) ***Enterococci*** (120 CFU/100ml) above DGV (60-100) **Iron** (total) (3.8 mg/L) above DGV (0.3) **Manganese** (total) (0.12 mg/L) above DGV (0.1) **MBAS** (0.3 mg/L) above DGV (0.2)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock	***E. coli*** (460 CFU/100ml) above DGV (100) **PFOS** (0.045 ug/L) above DGV (0.008) **TDS** (620-631 mg/L) above DGV (500)	***E. coli*** (240 CFU/100ml) above DGV (100) ***Enterococci*** (120 CFU/100ml) above DGV (100) **PFOS** (0.048 ug/L) above DGV (0.008) **TDS** (710–733 mg/L) above DGV (500)
Agriculture	**Chloride** (240 mg/L) above DGV (175) ***E. coli*** (460 CFU/100ml) above DGV (10) **Iron** (dissolved) (0.81 mg/L) above long-term DGV (0.2)	**Chloride** (250 mg/L) above DGV (175) ***E. coli*** (240 CFU/100ml) above DGV (10) **Iron** (total) (3.8 mg/L) above long-term DGV (0.2) **Sodium** (140 mg/L) above DGV (115)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (0.06 mg/L) above DGV (0.027) **Conductivity** (973–1,000 mg/L) above DGV (300) **DO** (56.4%) below DGV (>80%) **Fluoride** (0.3 mg/L) above DGV (0.29) **Iron** (dissolved) (0.81 mg/L) above DGV (0.14) **Nitrogen** (oxidised) (0.16 mg/L) above DGV (0.15) **PFOS** (0.045 ug/L) above air-breathing DGV (0.0005) **PFOS** (0.045 ug/L) above aquatic animal DGV (0.02) **Zinc** (dissolved) (0.006 mg/L) above DGV (0.0024)	**Aluminium** (total) (0.06) above DGV (0.027) **Conductivity** (1,128–1,200 mg/L) above DGV (300) **DO** (59.1%) below DGV (>80%) **PFOS** (0.048 ug/L) above air-breathing DGV (0.0005) **PFOS** (0.048 ug/L) above aquatic animal DGV (0.02) **Uranium** (total) (0.002 mg/L) above DGV (0.0005)

Wastewater	***E. coli*** (460 CFU/100ml) above criteria (10)	***E. coli*** (240 CFU/100ml) above criteria (10)
	Sediment Samples	
	2025 – Leachable Concentrations	**2024 – Total Concentrations**
Detections	**Detected:** PFAS, metals, nutrients **Undetected:** pesticides, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients, hydrocarbons **Undetected:** PFAS, pesticides, herbicides, surfactants, volatiles
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Cobalt** (dissolved) (0.008 mg/L) equal to DGV (0.006) **Iron** (dissolved) (28 mg/L) above DGV (14) **Lead** (dissolved) (0.026 mg/L) above DGV (0.01)	**Naphthalene** (0.8 mg/kg) above DGV (0.16) Limited DGVs exist
Aesthetic	**Aluminium** (dissolved) (10 mg/L) above DGV (0.2) **Iron** (dissolved) (28 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.19 mg/L) above DGV (0.1)	
Non-Potable	**Aluminium** (dissolved) (10 mg/L) above DGV (0.2) **Iron** (dissolved) (28 mg/L) above DGV (0.3)	
Recreation	**Aluminium** (dissolved) (10 mg/L) above DGV (0.2) **Iron** (dissolved) (28 mg/L) above DGV (0.3) **Lead** (dissolved) (0.026 mg/L) above DGV (0.05) **Manganese** (dissolved) (0.19 mg/L) above DGV (0.1)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (10 mg/L) above DGV (3.6)	
Agriculture	**Aluminium** (dissolved) (10 mg/L) above long-term DGV (5) **Iron** (dissolved) (28 mg/L) above short-term DGV (10) **Iron** (dissolved) (28 mg/L) above long-term DGV (0.2) **Phosphorus** (0.20 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (10 mg/L) above DGV (0.027) **Boron** (dissolved) (0.32 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.025 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.025 mg/L) above DGV (0.00095) **Cobalt** (dissolved) (0.008 mg/L) above DGV (0.0014) **Copper** (dissolved) (0.013 mg/L) above DGV (0.001) **Iron** (dissolved) (28 mg/L) above DGV (0.14) **Lead** (dissolved) (0.026 mg/L) above DGV (0.001) **Nickel** (dissolved) (0.016 mg/L) above DGV (0.008) **PFOS** (0.0049 ug/L) above air-breathing DGV (0.0005) **Phosphorus** (0.20 mg/L) above DGV (0.065) **Phosphorus** (0.20 mg/L) above Swan Canning target (0.1) **Vanadium** (dissolved) (0.052 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.13 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		

Looking Downstream		

Name	Samson St
Waterway	Mandoon Bilya (Helena River) – lower catchment
Location	-31.91924, 116.03736 - adjacent Samson Street, access from the south on Lomandra Rd
Elevation	Not recorded
WIR Ref	Not applicable
Locality	Shire of Mundaring
Rationale	Located between Craignish and Helena Roe sites to assess general water quality decline in the lower catchment. Upstream of BBB Mandoon Bilya Riverpark initiative.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	690 uS/cm	-	78.9 %	6.75	80.7 mV	449 mg/L	-
Sept 2024	-	-	-	-	-	-	-

	September 2025	September 2024
Field Notes	• Flowing, clear, slight brown/yellow colour, 200-400 mm depth. • Slight organic sheen, no foam or floating debris. • Channel not well defined in parts – muddy, waterlogged and decomposing grasses on adjacent banks. • Much frog noises – quacking sound. • Song birds, galahs, 28 parrots, kookaburra, kulbardi (magpie), rainbow lorikeets, ducks, many spiders, mosquitos, march flies. • Rabbit in parkland near the Darwinia Crescent playground. • Big old river gums, paperbark trees, not much understorey. • Revegetation in adjacent reserve: hakea, bottlebrush, gums. • Many weeds on river banks incl. fumitory, oxalis, strappy bulbs, grasses, oats, paddock weeds, blackberry, figs. • Partial trail along river's edge for future riverpark. • Private property signs on public land on southern bank. • Noticeably cooler by the river compared to adjacent park. • Parklands recently mowed, all grass and few large trees. • Old barbed wire fence and wooden fence posts. • Drainage pipe from housing estate – flowing and weedy. • Litter removed, large plastic crate remains in river. • Empty locked/gated compound to the immediate south. • **Refer iNaturalist for complete record of species.**	• Not sampled in 2024

Water Samples

Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected:** pesticides, herbicides, hydrocarbons	Not sampled in 2024
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (260 CFU/100ml) above DGV (detection) ***Enterococci*** (79 CFU/100ml) above DGV (detection)	Not sampled in 2024
Aesthetic	**Iron** (dissolved) (0.54 mg/L) above DGV (0.3) **Turbidity** (12 NTU) above DGV (5)	
Non-Potable	**BOD** (12 mg/L) above DGV (10) ***E. coli*** (260 CFU/100ml) above DGV (1) **Iron** (dissolved) (0.54 mg/L) above DGV (0.3) **Turbidity** (12 NTU) above DGV (5)	
Recreation	**Ammonia** (0.04 mg/L) above DGV (0.01) ***E. coli*** (260 CFU/100ml) above DGV (1) ***Enterococci*** (79 CFU/100ml) above DGV (60-100) **Iron** (dissolved) (0.54 mg/L) above DGV (0.3) **MBAS** (0.2 mg/L) above DGV (0.2)	
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock	***E. coli*** (260 CFU/100ml) above DGV (100)	Not sampled in 2024
Agriculture	**Chloride** (190 mg/L) above DGV (175) ***E. coli*** (260 CFU/100ml) above DGV (10) **Iron** (dissolved) (0.54 mg/L) above long-term DGV (0.2)	
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (0.07 mg/L) above DGV (0.027) **Conductivity** (690–630 mg/L) above DGV (300) **DO** (78.9%) below DGV (>80%) **Fluoride** (0.3 mg/L) above DGV (0.29) **Iron** (dissolved) (0.54 mg/L) above DGV (0.14) **PFOS** (0.0070 ug/L) above air-breathing DGV (0.0005) **Zinc** (dissolved) (0.010 mg/L) above DGV (0.0024)	Not sampled in 2024
Wastewater	***E. coli*** (260 CFU/100ml) above criteria (10)	

Sediment Samples

	2025 – Leachable Concentrations	2024 – Total Concentrations

Detections	**Detected:** PFAS, metals, nutrients **Undetected:** pesticides, herbicides, hydrocarbons, surfactants	Not sampled in 2024
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Cobalt** (dissolved) (0.007 mg/L) above DGV (0.006) **Iron** (dissolved) (15 mg/L) above DGV (14) **Lead** (dissolved) (0.013 mg/L) above DGV (0.01)	Not sampled in 2024
Aesthetic	**Aluminium** (dissolved) (14 mg/L) above DGV (0.2) **Iron** (dissolved) (15 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.15 mg/L) above DGV (0.1)	
Non-Potable	**Aluminium** (dissolved) (14 mg/L) above DGV (0.2) **Iron** (dissolved) (15 mg/L) above DGV (0.3)	
Recreation	**Aluminium** (dissolved) (14 mg/L) above DGV (0.2) **Iron** (dissolved) (15 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.15 mg/L) above DGV (0.1)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (14 mg/L) above DGV (3.6)	
Agriculture	**Aluminium** (dissolved) (14 mg/L) above long-term DGV (5) **Iron** (dissolved) (15 mg/L) above short-term DGV (10) **Iron** (dissolved) (15 mg/L) above long-term DGV (0.2) **Phosphorus** (0.19 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (14 mg/L) above DGV (0.027) **Boron** (dissolved) (0.26 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.014 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.014 mg/L) above DGV (0.00095) **Cobalt** (dissolved) (0.007 mg/L) above DGV (0.0014) **Copper** (dissolved) (0.015 mg/L) above DGV (0.001) **Iron** (dissolved) (15 mg/L) above DGV (0.14) **Lead** (dissolved) (0.013 mg/L) above DGV (0.001) **Nitrogen** (4 mg/L) above DGV (1.2) **Nitrogen** (4 mg/L) above Swan Canning target (1) **PFOS** (0.0034 ug/L) above air-breathing DGV (0.0005) **Phosphorus** (0.19 mg/L) above DGV (0.065) **Phosphorus** (0.19 mg/L) above Swan Canning target (0.1) **Vanadium** (dissolved) (0.028 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.12 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		Not sampled in 2024
Looking Downstream		Not sampled in 2024

Name	**Nyaania Pool**
Waterway	Nyaania Creek – lower catchment
Location	- 31.93109, 116.0692 – upstream of Victor Road bridge at the largest waterfall pool
Elevation	Not recorded
WIR Ref	Not applicable
Locality	Shire of Mundaring
Rationale	Major tributary that flows into the Mandoon Bilya downstream of the Lower Pumpback Dam. Flows through Darlington, Glen Forrest and Mahogany Creek residential areas. Known swimming spot and location of BNAA river restoration works, including Community Rivercare 8 grant in 2025.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	578 uS/cm	-	89.4 %	7.89	103.1 mV	376 mg/L	-
Sept 2024	-	-	-	-	-	-	-

	September 2025	September 2024
Field Notes	• Flowing, clear, colourless, no foam or organic sheen. • Green/brown algae on river channel and rocks. • Much fallen branches and debris in water channel and adjacent banks – evidence of previous high flows. • Song birds, wardong (ravens), 28 parrots, galahs feeding on the ground, Carnaby's cockatoos calling in distance. • No visible fish, tadpoles or frogs, no frog noises. • Jarrah and marri forest, balga, zamia palm, good understorey, trymalium in flower, saligna, prickly hakea, native grasses. • Seedlings planted by BNAA as part of DBCA CR8 grant. • Evidence of recent weed control by BNAA including removal of arundo fake bamboo in the channel. • Weeds remain incl. bridal creeper, paddock weeds, oxalis, capeweed, fumitory, onion weed, nasturtium, bulbs/iris? • **Refer iNaturalist for complete record of species.**	Not sampled in 2024

Water Samples

Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons	Not sampled in 2024
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (120 CFU/100ml) above DGV (detection) ***Enterococci*** (53 CFU/100ml) above DGV (detection) **PFOS** (0.0083 ug/L) above DGV (0.008)	Not sampled in 2024
Aesthetic	**Aluminium** (dissolved) (0.2 mg/L) equal to DGV (0.2)	
Non-Potable	**Aluminium** (dissolved) (0.2 mg/L) equal to DGV (0.2) ***E. coli*** (120 CFU/100ml) above DGV (1) **PFOS** (0.0083 ug/L) above DGV (0.008)	
Recreation	**Aluminium** (dissolved) (0.2 mg/L) equal to DGV (0.2) **Ammonia** (0.04 mg/L) above DGV (0.01) ***E. coli*** (120 CFU/100ml) above DGV (1)	
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock	***E. coli*** (120 CFU/100ml) above DGV (100) **PFOS** (0.0083 ug/L) above DGV (0.008)	Not sampled in 2024
Agriculture	***E. coli*** (120 CFU/100ml) above DGV (10) **Phosphorus** (0.10 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (0.2 mg/L) above DGV (0.027) **Conductivity** (578–620 mg/L) above DGV (300) **Fluoride** (0.3 mg/L) above DGV (0.29) **Iron** (dissolved) (0.16 mg/L) above DGV (0.14) **Nitrogen** (oxidised) (0.25 mg/L) above DGV (0.15) **PFOS** (0.0083 ug/L) above air-breathing DGV (0.0005) **Phosphorus** (0.1 mg/L) above DGV (0.065) **Phosphorus** (0.1 mg/L) equal to Swan Canning target (0.1) **Zinc** (dissolved) (0.006 mg/L) above DGV (0.0024)	Not sampled in 2024
Wastewater	***E. coli*** (120 CFU/100ml) above criteria (10)	

Sediment Samples

	2025 – Leachable Concentrations	**2024 – Total Concentrations**
Detections	**Detected:** PFAS, metals, nutrients **Undetected:** pesticides, herbicides, hydrocarbons, surfactants	Not sampled in 2024
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Cobalt** (dissolved) (0.012 mg/L) equal to DGV (0.006) **Iron** (dissolved) (47 mg/L) above DGV (14) **Lead** (dissolved) (0.038 mg/L) above DGV (0.01) **Nickel** (dissolved) (0.025 mg/L) above DGV (0.02)	Not sampled in 2024

	PFOS (0.0093 ug/L) above DGV (0.008) **Vanadium** (dissolved) (0.084 mg/L) above DGV (0.086)	
Aesthetic	**Aluminium** (dissolved) (9.3 mg/L) above DGV (0.2) **Iron** (dissolved) (47 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.17 mg/L) above DGV (0.1)	
Non-Potable	**Aluminium** (dissolved) (9.3 mg/L) above DGV (0.2) **Iron** (dissolved) (47 mg/L) above DGV (0.3) **PFOS** (0.0093 ug/L) above DGV (0.008)	
Recreation	**Aluminium** (dissolved) (9.3 mg/L) above DGV (0.2) **Iron** (dissolved) (47 mg/L) above DGV (0.3) **Lead** (dissolved) (0.038 mg/L) above DGV (0.05) **Manganese** (dissolved) (0.17 mg/L) above DGV (0.1)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (9.3 mg/L) above DGV (3.6) **PFOS** (0.0093 ug/L) above DGV (0.008)	
Agriculture	**Aluminium** (dissolved) (9.3 mg/L) above long-term DGV (5) **Boron** (dissolved) (0.56 mg/L) above DGV (0.5) **Iron** (dissolved) (47 mg/L) above long-term DGV (0.2) **Iron** (dissolved) (47 mg/L) above short-term DGV (10) **Phosphorus** (0.22 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (9.3 mg/L) above DGV (0.027) **Boron** (dissolved) (0.56 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.043 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.043 mg/L) above DGV (0.00095) **Cobalt** (dissolved) (0.012 mg/L) above DGV (0.0014) **Copper** (dissolved) (0.032 mg/L) above DGV (0.001) **Iron** (dissolved) (47 mg/L) above DGV (0.14) **Lead** (dissolved) (0.038 mg/L) above DGV (0.001) **Nickel** (dissolved) (0.025 mg/L) above DGV (0.008) **Nitrogen** (1.1 mg/L) above Swan Canning target (1) **PFOS** (0.0093 ug/L) above air-breathing DGV (0.0005) **Phosphorus** (0.22 mg/L) above DGV (0.065) **Phosphorus** (0.22 mg/L) above Swan Canning target (0.1) **Vanadium** (dissolved) (0.084 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.31 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		Not sampled in 2024
Looking Downstream		Not sampled in 2024

Name	Craignish US
Waterway	Mandoon Bilya (Helena River) – lower catchment
Location	-31.93560, 116.06864 – immediately upstream of Craignish Weir gauging station
Elevation	32.9 m AHD
WIR Ref	6167032
Locality	Shire of Mundaring – City of Kalamunda boundary
Rationale	Long-established gauging station (WIR 616018). Helping the Helena site (Helena4) that previously had elevated hydrocarbons (PAH). Location of BNAA river restoration works, including Community Rivercare 8 grant in 2025.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	484 uS/cm	-	49.0 %	6.31	79.0 mV	315 mg/L	-
Sept 2024	498 uS/cm	240 ppm	59.3 %	6.24	89.1 mV	288 mg/L	28.8 NTU

	September 2025	September 2024
Field Notes	• Flowing over weir, slight brown/yellow colour, clear. • Slight organic sheen, no foam, no floating debris. • Carnaby's cockatoos heard in the distance. • Ducks on the water, 28 parrots. • Tiny fish, no visible tadpoles or frogs, frogs calling. • Mosquitoes, march flies. • Vegetation as per 2024 incl. trymalium in flower. • Seedlings planted by BNAA as part of DBCA CR8 grant. • Weeds – bulbs with white flowers, buckthorn, bridal creeper, cape tulip, grassy paddock weeds. • Large tree fallen across path, rotten at base. • White scat at the water with feathers in it – fox or cat? • Smoke from prescribed burn visible towards weir. • **Refer iNaturalist for complete record of species.**	• Flowing, brown/orange colour, no sheen or floating debris. • Water depth at 1 m at gauging station, light flow over weir. • Many weeds e.g. cape tulip, bridal creeper, weedy grasses, oxalis, buckthorn, olive, eastern states wattles, fumitory, possible aquatic weeds, algae. • Native vegetation in surrounding forest e.g. river gums, melaleuca, jarrah and marri trees. • Lots of tiny silver fish, no visible frogs or tadpoles, many loud frog noises (motorbike frog and unidentified). • Lots of dragonflies (big brown, small red and medium blue), kulbardi (magpie), 28 parrot, galahs, ducks, unknown bird song, honey bees, Carters freshwater mussels on bank. • Two groups of walkers sitting by the river, dog/fox (?) footprints on bank. Easy to access from existing trails. • Damage to south bank from Water Corporation dredging.

Water Samples

	2025	2024
Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (36 CFU/100ml) above DGV (detection) ***Enterococci*** (13 CFU/100ml) above DGV (detection) **pH** (6.3) below DGV (6.5-8.5)	***E. coli*** (100 CFU/100ml) above DGV (detection) ***Enterococci*** (98 CFU/100ml) above DGV (detection) **pH** (6.24) below DGV (6.5-8.5)
Aesthetic	**Iron** (dissolved) (0.78 mg/L) above DGV (0.3) **Turbidity** (13 NTU) above DGV (5)	**Aluminium** (total) (0.70 mg/L) above DGV (0.2) **Iron** (total) (6.0 mg/L) above DGV (0.3) **Manganese** (total) (0.16 mg/L) above DGV (0.1) **TSS** (23 mg/L) above DGV (10) **Turbidity** (29–36 NTU) above DGV (5)
Non-Potable	***E. coli*** (36 CFU/100ml) above DGV (1) **Iron** (dissolved) (0.78 mg/L) above DGV (0.3) **pH** (6.3) below DGV (6.5-8.5) **Turbidity** (13 NTU) above DGV (5)	**Aluminium** (total) (0.70 mg/L) above DGV (0.2) ***E. coli*** (100 CFU/100ml) above DGV (1) **Iron** (total) (6.0 mg/L) above DGV (0.3) **pH** (6.24) below DGV (6.5-8.5) **Turbidity** (29–36 NTU) above DGV (5)
Recreation	**Ammonia** (0.04 mg/L) above DGV (0.01) ***E. coli*** (36 CFU/100ml) above DGV (1) **Iron** (dissolved) (0.78 mg/L) above DGV (0.3) **MBAS** (0.23 mg/L) above DGV (0.2) **pH** (6.3) below DGV (6.5-8.5)	**Aluminium** (total) (0.70 mg/L) above DGV (0.2) **Ammonia** (0.05 mg/L) above DGV (0.01) ***E. coli*** (100 CFU/100ml) above DGV (1) ***Enterococci*** (98 CFU/100ml) above DGV (60-100) **Iron (total)** (6.0 mg/L) above DGV (0.3) **Manganese** (total) (0.16 mg/L) above DGV (0.1) **MBAS** (0.2 mg/L) equal to DGV (0.2)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock		***E. coli*** (100 CFU/100ml) equal to DGV (100)
Agriculture	***E. coli*** (36 CFU/100ml) above DGV (10) **Iron** (dissolved) (0.78 mg/L) above long-term DGV (0.2) **Phosphorus** (0.07 mg/L) above long-term DGV (0.05)	***E. coli*** (100 CFU/100ml) above DGV (10) **Iron** (total) (6.0 mg/L) above long-term DGV (0.2)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (0.06 mg/L) above DGV (0.027) **Conductivity** (430–484 mg/L) above DGV (300) **DO** (49%) below DGV (>80%) **Iron** (dissolved) (0.78 mg/L) above DGV (0.14) **PFOS** (0.0006 ug/L) above air-breathing DGV (0.0005) **pH** (6.3) below DGV (6.5-8.0) **Phosphorus** (0.07 mg/L) above DGV (0.065) **Vanadium** (dissolved) (0.084 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.006 mg/L) above DGV (0.0024)	**Aluminium** (total) (0.70 mg/L) above DGV (0.027) **Chromium** (total) (0.002 mg/L) above DGV (0.00095) **Cobalt** (total) (0.002 mg/L) above DGV (0.0014) **Conductivity** (1,176–1,300 mg/L) above DGV (300) **Copper** (total) (0.002 mg/L) above DGV (0.001) **DO** (59.3%) below DGV (>80%) **Lead** (total) (0.001 mg/L) equal to DGV (0.001) **PFOS** (0.0005 ug/L) equal to air-breathing DGV (0.0005) **pH** (6.24) below DGV (6.5-8.0) **Turbidity** (29–36 NTU) above DGV (5)

		Vanadium (total) (0.007 mg/L) above DGV (0.006)
Wastewater	***E. coli*** (36 CFU/100ml) above criteria (10) **pH** (6.3) below DGV (6.5-8.5)	***E. coli*** (100 CFU/100ml) above criteria (10) **pH** (6.24) below DGV (6.5-8.5)
	Sediment Samples	
	2025 – Leachable Concentrations	**2024 – Total Concentrations**
Detections	**Detected:** pesticides, metals, nutrients **Undetected:** PFAS, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients, hydrocarbons **Undetected:** PFAS, pesticides, herbicides, surfactants, volatiles
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Cobalt** (dissolved) (0.01 mg/L) above DGV (0.006) **pH** (6.4) below DGV (6.5-8.5)	No exceedances of the DGVs Limited DGVs exist
Aesthetic	**Aluminium** (dissolved) (0.98 mg/L) above DGV (0.2) **Iron** (dissolved) (2.0 mg/L) above DGV (0.3)	
Non-Potable	**Aluminium** (dissolved) (0.98 mg/L) above DGV (0.2) **Iron** (dissolved) (2.0 mg/L) above DGV (0.3) **pH** (6.4) below DGV (6.5-8.5)	
Recreation	**Aluminium** (dissolved) (0.98 mg/L) above DGV (0.2) **Iron** (dissolved) (2.0 mg/L) above DGV (0.3)	
	2025 – Primary Industries Exceedances	
Livestock		
Agriculture	**Iron** (dissolved) (2.0 mg/L) above long-term DGV (0.2) **Phosphorus** (0.19 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (0.98 mg/L) above DGV (0.027) **Boron** (dissolved) (0.24 mg/L) above DGV (0.09) **Cobalt** (dissolved) (0.01 mg/L) above DGV (0.0014) **Copper** (dissolved) (0.08 mg/L) above DGV (0.001) **Dieldrin** (0.01 ug/L) equal to DGV (0.01) **Iron** (dissolved) (2.0 mg/L) above DGV (0.14) **Lead** (dissolved) (0.001 mg/L) equal to DGV (0.001) **Nitrogen** (1.3 mg/L) above DGV (1.2) **Nitrogen** (1.3 mg/L) above Swan Canning target (1) **pH** (6.4) below DGV (6.5-8.0) **Phosphorus** (0.19 mg/L) above DGV (0.065) **Phosphorus** (0.19 mg/L) above Swan Canning target (0.1) **Zinc** (dissolved) (0.25 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		
Looking Downstream		

<table>
<tr><th>Name</th><th colspan="7">Lower Pumpback Dam</th></tr>
<tr><td>Waterway</td><td colspan="7">Mandoon Bilya (Helena River) – lower catchment</td></tr>
<tr><td>Location</td><td colspan="7">-31.94179, 116.07608 – in river channel, immediately downstream of Lower Pumpback Dam</td></tr>
<tr><td>Elevation</td><td colspan="7">40.8 m AHD</td></tr>
<tr><td>WIR Ref</td><td colspan="7">Not applicable</td></tr>
<tr><td>Locality</td><td colspan="7">Shire of Mundaring – City of Kalamunda boundary</td></tr>
<tr><td>Rationale</td><td colspan="7">The dam is a public Drinking source that collects water which is then pumped up to Mundaring Weir.
Water Corporation will not allow BNAA to sample the dam or any watercourse within 200 m upstream of it.</td></tr>
<tr><td></td><td colspan="7">Field Observations</td></tr>
<tr><td></td><td>Conductivity</td><td>Salinity</td><td>DO</td><td>pH</td><td>Redox</td><td>TDS</td><td>Turbidity</td></tr>
<tr><td>Sept 2025</td><td>322 uS/cm</td><td>-</td><td>44.9 %</td><td>6.41</td><td>57.0 mV</td><td>209 mg/L</td><td>-</td></tr>
<tr><td>Sept 2024</td><td>443 uS/cm</td><td>210 ppm</td><td>27.6 %</td><td>6.49</td><td>83.1 mV</td><td>325 mg/L</td><td>12.2 NTU</td></tr>
<tr><td></td><td colspan="3">September 2025</td><td colspan="4">September 2024</td></tr>
<tr><td>Field Notes</td><td colspan="3">• Low flow, 150 mm depth, more water volume than 2024 event, water at base of dam in concrete pool.
• Yellow/brown colour water, clear, organic sheen on surface.
• Much organic material in water.
• No bird song apart from white cockatoos flying over.
• No frog noises, no visible tadpoles, frogs or fish.
• Carters freshwater mussel shells (up to 70 mm) on bank.
• Mosquitoes, march flies, many flies.
• Vegetation as per 2024 incl. paperbark and river gums lining channel and jarrah/marri forest adjacent, zamia palm, hibbertia and much trymalium in flower.
• Many weeds, especially on the bank adjacent Water Corporation facility incl cotton bush, blackberry, fumitory, bridal creeper, grasses, radium weed.
• Litter removed including drinks bottles, tennis ball, plastic.
• Debris on banks – evidence of high flows, including organic material, branches and rubbish.
• No response from Water Corporation re access, walked around compound, many slip/trip hazards and razor wire on fence. Need to improve access.
• Refer iNaturalist for complete record of species.</td><td colspan="4">• Very low flow, brown/orange colour, organic rainbow sheen, strong iron-like smell, some floating organic matter, orange algae, lots of debris and fallen branches in water.
• Large black/blue pipe in river channel, appears to be for release of water from LPD but unsure if pipe takes from dam or blue metal lined concrete pool at base of dam wall, blue metal pool had shallow water in it.
• Black/blue pipe not flowing at time of sampling, sample taken from first river pool downstream of pipe outlet, no apparent surface water connection from blue metal pool and sample site at time of sampling.
• Many weeds e.g. fumitory, grassy weeds, oxalis, cotton bush, watsonia, veldt daisy, bamboo, blackberry, possible aquatic weeds. Very overgrown and neglected.
• Native vegetation of jarrah and marri forest, river gums, large paperbarks, melaleuca, trymalium, bracken.
• Tiny fish, no visible frogs or tadpoles, no frog noises.
• Dragonflies, march flies, honey bees, mosquitoes, wardong (ravens), 28 parrot, song birds, Carters freshwater mussels.
• Some litter on banks e.g. plastic, tyres.
• Difficult access, steep slope, tall weeds and trip hazards. Razor wire on Water Corporation facility fence.</td></tr>
<tr><td></td><td colspan="7">Water Samples</td></tr>
<tr><td>Detections</td><td colspan="3">Detected: PFAS, metals, nutrients, surfactants, microbes
Undetected: pesticides, herbicides, hydrocarbons</td><td colspan="4">Detected: PFAS, metals, nutrients, microbes
Undetected: pesticides, herbicides, hydrocarbons, surfactants, volatiles</td></tr>
<tr><td></td><td colspan="3">2025 – Human Health Exceedances</td><td colspan="4">2024 – Human Health Exceedances</td></tr>
<tr><td>Drinking</td><td colspan="3">E. coli (15 CFU/100ml) above DGV (detection)
Enterococci (4 CFU/100ml) above DGV (detection)
pH (6.41) below DGV (6.5-8.5)</td><td colspan="4">E. coli (150 CFU/100ml) above DGV (detection)
Enterococci (82 CFU/100ml) above DGV (detection)
pH (6.49) below DGV (6.5-8.5)</td></tr>
<tr><td>Aesthetic</td><td colspan="3">Iron (dissolved) (1.2 mg/L) above DGV (0.3)
Manganese (dissolved) (0.12 mg/L) above DGV (0.1)
Turbidity (9.8 NTU) above DGV (5)</td><td colspan="4">Iron (total) (3.4 mg/L) above DGV (0.3)
Manganese (total) (0.28 mg/L) above DGV (0.1)
Turbidity (12-17 NTU) above DGV (5)</td></tr>
<tr><td>Non-Potable</td><td colspan="3">E. coli (15 CFU/100ml) above DGV (1)
Iron (dissolved) (1.2 mg/L) above DGV (0.3)
pH (6.41) below DGV (6.5-8.5)
Turbidity (9.8 NTU) above DGV (5)</td><td colspan="4">E. coli (150 CFU/100ml) above DGV (1)
Iron (total) (3.4 mg/L) above DGV (0.3)
pH (6.49) below DGV (6.5-8.5)
Turbidity (12-17 NTU) above DGV (5)</td></tr>
<tr><td>Recreation</td><td colspan="3">Ammonia (0.03 mg/L) above DGV (0.01)
E. coli (15 CFU/100ml) above DGV (1)
Iron (dissolved) (1.2 mg/L) above DGV (0.3)
Manganese (dissolved) (0.12 mg/L) above DGV (0.1)
MBAS (0.50 mg/L) above DGV (0.2)
pH (6.41) below DGV (6.5-8.5)</td><td colspan="4">E. coli (150 CFU/100ml) above DGV (1
Enterococci (82 CFU/100ml) above DGV (60-100)
Iron (total) (3.4 mg/L) above DGV (0.3)
Manganese (total) (0.28 mg/L) above DGV (0.1)
pH (6.49) below DGV (6.5-8.5)</td></tr>
<tr><td></td><td colspan="3">2025 – Primary Industries Exceedances</td><td colspan="4">2024 – Primary Industries Exceedances</td></tr>
<tr><td>Livestock</td><td colspan="3"></td><td colspan="4">E. coli (150 CFU/100ml) above DGV (100)</td></tr>
<tr><td>Agriculture</td><td colspan="3">E. coli (15 CFU/100ml) above DGV (10)
Iron (dissolved) (1.2 mg/L) above long-term DGV (0.2)
Phosphorus (0.06 mg/L) above long-term DGV (0.05)</td><td colspan="4">E. coli (150 CFU/100ml) above DGV (10)
Iron (total) (3.4 mg/L) above long-term DGV (0.2)
Manganese (total) (0.28 mg/L) above long-term DGV (0.2)</td></tr>
<tr><td></td><td colspan="3">2025 – Ecosystem Exceedances</td><td colspan="4">2024 – Ecosystem Exceedances</td></tr>
<tr><td>Freshwater Ecosystem 99% Species Protection</td><td colspan="3">Conductivity (320-322 mg/L) above DGV (300)
DO (44.9%) below DGV (>80%)
Iron (dissolved) (1.2 mg/L) above DGV (0.14)
PFOS (0.0010 ug/L) above air-breathing DGV (0.0005)
pH (6.41) below DGV (6.5-8.0)
Vanadium (dissolved) (0.006 mg/L) equal to DGV (0.006)
Zinc (dissolved) (0.011 mg/L) above DGV (0.0024)</td><td colspan="4">Boron (total) (0.13 mg/L) above DGV (0.09)
Conductivity (443–460 mg/L) above DGV (300)
DO (2.76 mg/L) below SWIRC lower limit (>4)
DO (27.6%) below DGV (>80%)
PFOS (0.002 ug/L) above air-breathing DGV (0.0005)
pH (6.49) below DGV (6.5-8.0)</td></tr>
</table>

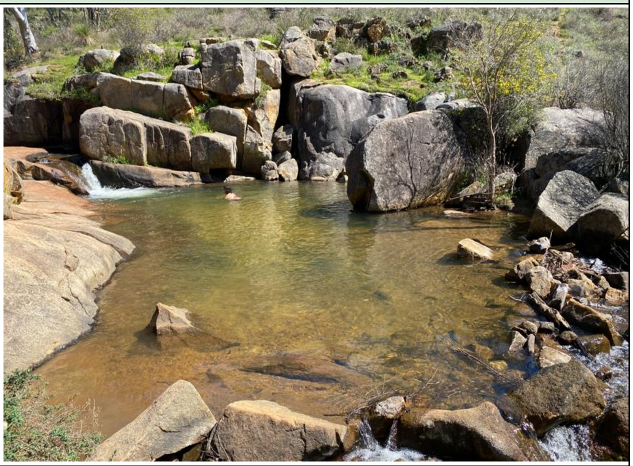
Wastewater	***E. coli*** (15 CFU/100ml) above criteria (10) **pH** (6.41) below DGV (6.5-8.5)	***E. coli*** (150 CFU/100ml) above criteria (10) **pH** (6.41) below DGV (6.5-8.5)
	Sediment Samples	
	2025 – Leachable Concentrations	**2024 – Total Concentrations**
Detections	**Detected:** PFAS, metals, nutrients **Undetected:** pesticides, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients, hydrocarbons **Undetected:** PFAS, pesticides, herbicides, surfactants, volatiles
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Iron** (dissolved) (3.1 mg/L) above DGV (14) **Lead** (dissolved) (0.002 mg/L) above DGV (0.01) **pH** (6.1) below DGV (6.5-8.5)	No exceedances of the DGVs Limited DGVs exist
Aesthetic	**Aluminium** (dissolved) (13 mg/L) above DGV (0.2) **Iron** (dissolved) (3.1 mg/L) above DGV (0.3)	
Non-Potable	**Aluminium** (dissolved) (13 mg/L) above DGV (0.2) **Iron** (dissolved) (3.1 mg/L) above DGV (0.3)	
Recreation	**Aluminium** (dissolved) (13 mg/L) above DGV (0.2) **Iron** (dissolved) (3.1 mg/L) above DGV (0.3) **Lead** (dissolved) (0.002 mg/L) above DGV (0.05)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (13 mg/L) above DGV (3.6)	
Agriculture	**Aluminium** (dissolved) (13 mg/L) above long-term DGV (5) **Iron** (dissolved) (3.1 mg/L) above long-term DGV (0.2) **Phosphorus** (0.13 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (13 mg/L) above DGV (0.027) **Boron** (dissolved) (0.33 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.005 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.005 mg/L) above DGV (0.00095) **Copper** (dissolved) (0.005 mg/L) above DGV (0.001) **Iron** (dissolved) (3.1 mg/L) above DGV (0.14) **Lead** (dissolved) (0.002 mg/L) above DGV (0.001) **PFOS** (0.0040 ug/L) above air-breathing DGV (0.0005) **pH** (6.41) below DGV (6.5-8.0) **Phosphorus** (0.13 mg/L) above DGV (0.065) **Phosphorus** (0.13 mg/L) above Swan Canning target (0.1) **Vanadium** (dissolved) (0.007 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.059 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		
Looking Downstream		

Name	Rocky Pool
Waterway	Piesse Brook – middle catchment
Location	-31.95366, 116.07148 – at the large lower pool
Elevation	85.9 m AHD
WIR Ref	Not applicable – the nearest WIR site (6161250) is 175 m upstream
Locality	City of Kalamunda
Rationale	Major tributary that flows into the Lower Pumpback Dam. Downstream of Bickley Valley, Pickering Brook and Kalamunda town centre. Known swimming spot (noting that swimming is prohibited under the *Country Areas Water Supply Act* By-Laws 1957). Within Kalamunda National Park, long term restoration site of the Friends of Piesse Brook.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	367 uS/cm	-	97.8 %	7.48	94.0 mV	239 mg/L	-
Sept 2024	416 uS/cm	200 ppm	96.9 %	7.43	145.2 mV	271 mg/L	0.3 NTU

	September 2025	September 2024
Field Notes	• Flowing, clear, colourless, approx. 800-1000 mm depth. • No foam, organic sheen or floating debris visible. • No frogs, tadpoles or fish visible in the pool, frog noises heard in the channel adjacent the pool. • Aquatic insects swimming in the water. • Insect noises (cricket, cicada?). • Many song birds, 2 x Carnaby's cockatoo flying over. • Vegetation as 2024 incl. some wandoo, saligna, Drummonds wattle in flower, zamia palm, Darwinia citriodora, fuchsia grevillea, white myrtle, hibbertia, much trymalium in flower (strong scent). • Evidence of historical watsonia infestations – old bulb casing, none found alive/growing. • Paddock weeds, cape weed, cape tulip, pimpernel, wood sorrel, oxalis, Guildford grass, woundwort, oats, grasses. • Access has become more difficult due to erosion of the steep slope accessing the pool. • Vehicle track is washed out with deep rivets – 4WD essential. • Some litter removed - food/drink packets and nappies. • **Refer iNaturalist for complete record of species.**	• Strong flowing water, almost fully clear and colourless, no sheen or floating debris. • Some weeds on banks and granite rocks e.g. fumitory, grassy weeds, gazania, capeweed. • Good native vegetation in surrounding forest e.g. river gums, melaleuca, marri and jarrah trees, trymalium and diverse understory species. • No visible fish, frogs or tadpoles. No frog noises. • Many dragonflies, honey bees, orange/white/black butterflies, white butterflies, kulbardi (magpie), 28 parrots and unidentified bird song. Waalitj (eagle) soaring above and blue wren on access track. • Very little litter. • Easy enough to access from walking trail on east bank of brook, approx. 1.7 km from car park. 4WD vehicle required on access track due to wash out. • Many people using the area recreationally – 7 groups of walkers and 3 groups swimming in the pool. • Several groups walking dogs including one off-leash and swimming in the pool.
Water Samples		
Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons	**Detected**: PFAS, metals, nutrients, microbes **Undetected**: pesticides, herbicides, hydrocarbons, surfactants, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (140 CFU/100ml) above DGV (detection) ***Enterococci*** (23 CFU/100ml) above DGV (detection)	***E. coli*** (82 CFU/100ml) above DGV (detection) ***Enterococci*** (59 CFU/100ml) above DGV (detection)
Aesthetic		
Non-Potable	**BOD** (11 mg/L) above DGV (10) ***E. coli*** (140 CFU/100ml) above DGV (1)	***E. coli*** (82 CFU/100ml) above DGV (1)
Recreation	**Ammonia** (0.04 mg/L) above DGV (0.01) ***E. coli*** (140 CFU/100ml) above DGV (1) **MBAS** (0.59 mg/L) above DGV (0.2)	***E. coli*** (82 CFU/100ml) above DGV (1)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock	***E. coli*** (140 CFU/100ml) above DGV (100)	
Agriculture	***E. coli*** (140 CFU/100ml) above DGV (10)	***E. coli*** (82 CFU/100ml) above DGV (10)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (0.09 mg/L) above the DGV (0.027) **Conductivity** (367–390 mg/L) above DGV (300) **Nitrate** (1.3 mg/L) above DGV (0.64-1.0) **Nitrogen** (1.3 mg/L) above DGV (1.2) **Nitrogen** (oxidised) (1.3 mg/L) above DGV (0.15) **PFOS** (0.0025 ug/L) above air-breathing DGV (0.0005) **PFOS** (0.0025 ug/L) above aquatic animal DGV (0.02) **Zinc** (dissolved) (0.005 mg/L) above DGV (0.0024)	**Aluminium** (total) (0.06 mg/L) above the DGV (0.027) **Conductivity** (416–440 mg/L) above DGV (300) **Nitrate** (1.4 mg/L) above DGV (0.64-1.0) **Nitrogen** (1.5 mg/L) above DGV (1.2) **Nitrogen** (oxidised) (1.4 mg/L) above DGV (0.15) **PFOS** (0.0021 ug/L) above air-breathing DGV (0.0005)
Wastewater	***E. coli*** (140 CFU/100ml) above criteria (10)	***E. coli*** (82 CFU/100ml) above criteria (10)
Sediment Samples		
	2025 – Leachable Concentrations	**2024 – Total Concentrations**

Detections	**Detected:** metals, nutrients **Undetected:** PFAS, pesticides, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients, hydrocarbons **Undetected:** PFAS, pesticides, herbicides, surfactants, volatiles
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Cobalt** (dissolved) (0.009 mg/L) above DGV (0.006) **Iron** (dissolved) (35 mg/L) above DGV (14) **Lead** (dissolved) (0.015 mg/L) above DGV (0.01) **Vanadium** (dissolved) (0.091 mg/L) above DGV (0.086)	No exceedances of the DGVs Limited DGVs exist
Aesthetic	**Aluminium** (dissolved) (6.2 mg/L) above DGV (0.2) **Iron** (dissolved) (35 mg/L) above DGV (0.3)	
Non-Potable	**Aluminium** (dissolved) (6.2 mg/L) above DGV (0.2) **Iron** (dissolved) (35 mg/L) above DGV (0.3)	
Recreation	**Aluminium** (dissolved) (6.2 mg/L) above DGV (0.2) **Iron** (dissolved) (35 mg/L) above DGV (0.3)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (6.2 mg/L) above DGV (3.6)	
Agriculture	**Aluminium** (dissolved) (6.2 mg/L) above long-term DGV (5) **Iron** (dissolved) (35 mg/L) above short-term DGV (10) **Iron** (dissolved) (35 mg/L) above long-term DGV (0.2) **Phosphorus** (0.14 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (6.2 mg/L) above DGV (0.027) **Boron** (dissolved) (0.26 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.034 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.034 mg/L) above DGV (0.00095) **Cobalt** (dissolved) (0.009 mg/L) above DGV (0.0014) **Copper** (dissolved) (0.018 mg/L) above DGV (0.001) **Iron** (dissolved) (35 mg/L) above DGV (0.14) **Lead** (dissolved) (0.015 mg/L) above DGV (0.001) **Nickel** (dissolved) (0.019 mg/L) above DGV (0.008) **Phosphorus** (0.14 mg/L) above DGV (0.065) **Phosphorus** (0.14 mg/L) above Swan Canning target (0.1) **Vanadium** (dissolved) (0.091 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.15 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		
Looking Downstream		

Name	Pipe Bridge
Waterway	Mandoon Bilya (Helena River) – middle catchment
Location	-31.93825, 116.12176 – under the pipe crossing, access via pipe track
Elevation	86.1 m AHD
WIR Ref	6161604
Locality	Shire of Mundaring – City of Kalamunda boundary
Rationale	Upstream of Lower Pumpback Dam and downstream of Mundaring Weir. Historically identified as high public health significance due to elevated metals and hydrocarbons detected in the 1980s.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	391 uS/cm	-	64.9 %	6.66	72.8 mV	254 mg/L	-
Sept 2024	509 uS/cm	250 ppm	94.4 %	6.73	132.4 mV	331 mg/L	1.1 NTU

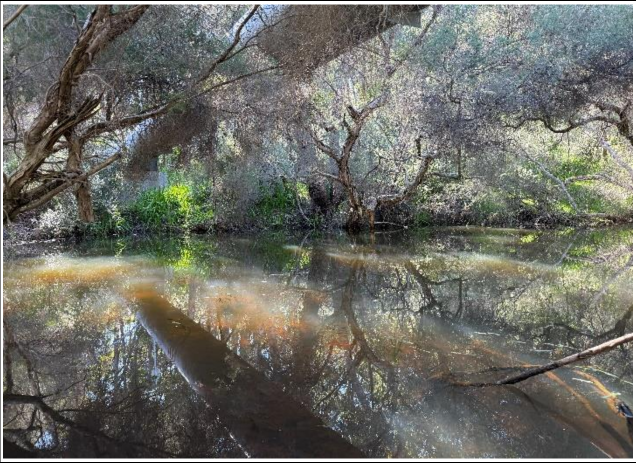
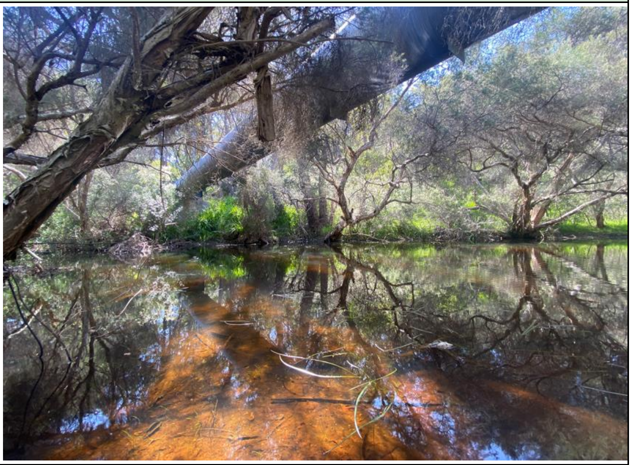
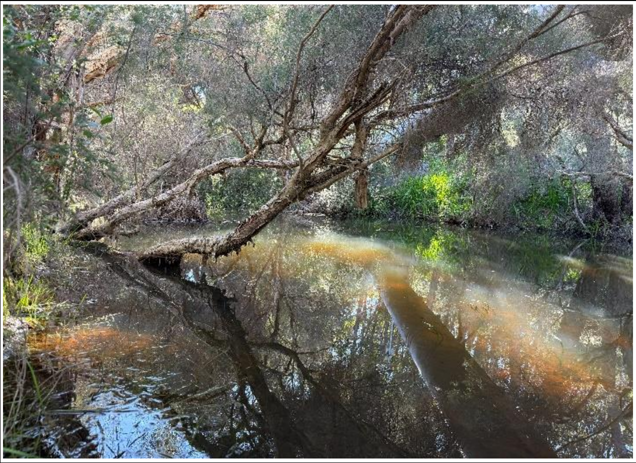
	September 2025	September 2024
Field Notes	• Flowing, clear, colourless, approx. 600-700 mm depth. • Slight organic sheen on surface. • Algae on channel bottom, organic material in water. • Aquatic plants – ribbon plant, unsure if local. • Song birds, large orange/white/black butterfly, yonga (kangaroo) and weitj (emu) poo, frogs calling. • Wasp nests on pipe, mosquitoes, March flies. • Bubbles coming from river bed. • Vegetation as per 2024 incl. much trymalium in flower (sweet strong scent). • Weeds including watsonia, pink and yellow oxalis, cape tulip flowering, white iris looking bulbs, grassy weeds coming from adjacent paddock to the south. • Waalitj (eagle) flying above between here and Cobblers Pool. • **Refer iNaturalist for complete record of species.**	• Flowing water, almost clear and colourless, no sheen or floating debris. • Some weeds on banks e.g. fumitory, grassy weeds, watsonia, possible aquatic weeds. • Native vegetation in surrounding forest e.g. river gums, mature paperbarks, melaleuca, marri and jarrah trees, trymalium, acacia saligna, white myrtle, and diverse understory species. • No visible fish, frogs or tadpoles. Frog noises. Bubbles observed from river bed when taking sample. • Many dragonflies, mosquitoes, unknown bird calls. • Very easy to access from trail on south bank of river. • Vehicle access difficult on management track between Mundaring Weir and LPD, washed out and eroded. • Cyclist asked if access was allowed for recreation.

Water Samples

Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (64 CFU/100ml) above DGV (detection) ***Enterococci*** (7 CFU/100ml) above DGV (detection)	***E. coli*** (12 CFU/100ml) above DGV (detection) ***Enterococci*** (11 CFU/100ml) above DGV (detection) **Thermophilic Amoeba** (detected) above DGV (detection)
Aesthetic	**Turbidity** (6.4 NTU) above DGV (5)	**Iron** (total) (0.90 mg/L) above DGV (0.3)
Non-Potable	***E. coli*** (64 CFU/100ml) above DGV (1) **Turbidity** (6.4 NTU) above DGV (5)	***E. coli*** (12 CFU/100ml) above DGV (1) **Iron** (total) (0.90 mg/L) above DGV (0.3)
Recreation	**Ammonia** (0.03 mg/L) above DGV (0.01) ***E. coli*** (64 CFU/100ml) above DGV (1) **MBAS** (0.21 mg/L) above DGV (0.2)	***E. coli*** (12 CFU/100ml) above DGV (1) **Iron** (total) (0.90 mg/L) above DGV (0.3) **MBAS** (0.4 mg/L) above DGV (0.2)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock		
Agriculture	***E. coli*** (64 CFU/100ml) above DGV (10) **Iron** (dissolved) (0.28 mg/L) above long-term DGV (0.2) **Phosphorus** (0.05 mg/L) equal to long-term DGV (0.05)	***E. coli*** (12 CFU/100ml) above DGV (10) **Iron** (total) (0.90 mg/L) above long-term DGV (0.2) **Phosphorus** (0.06 mg/L) above long-term DGV (0.05)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (0.12 mg/L) above the DGV (0.027) **Conductivity** (391–400 mg/L) above DGV (300) **DO** (64.9%) below DGV (>80%) **Iron** (dissolved) (0.28 mg/L) above DGV (0.14) **Nitrogen** (2.3 mg/L) above DGV (1.2) **PFOS** (0.0007 ug/L) above air-breathing DGV (0.0005)	**Aluminium** (total) (0.09 mg/L) above the DGV (0.027) **Conductivity** (509–540 mg/L) above DGV (300) **PFOS** (0.0006 ug/L) above air-breathing DGV (0.0005)
Wastewater	***E. coli*** (64 CFU/100ml) above criteria (10)	***E. coli*** (12 CFU/100ml) above criteria (10)

Sediment Samples

	2025 – Leachable Concentrations	**2024 – Total Concentrations**
Detections	**Detected:** metals, nutrients **Undetected:** PFAS, pesticides, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients, hydrocarbons **Undetected:** PFAS, pesticides, herbicides, surfactants, volatiles
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Aluminium** (dissolved) (45 mg/L) above DGV (20) **Iron** (dissolved) (18 mg/L) above DGV (14)	**TRH C10-C40** (1,310 mg/kg) above DGV (280) Limited DGVs exist
Aesthetic	**Aluminium** (dissolved) (45 mg/L) above DGV (0.2) **Iron** (dissolved) (18 mg/L) above DGV (0.3)	
Non-Potable	**Aluminium** (dissolved) (45 mg/L) above DGV (0.2) **Iron** (dissolved) (18 mg/L) above DGV (0.3)	

Recreation	**Aluminium** (dissolved) (45 mg/L) above DGV (0.2) **Iron** (dissolved) (18 mg/L) above DGV (0.3)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (45 mg/L) above DGV (3.6)	
Agriculture	**Aluminium** (dissolved) (45 mg/L) above short-term DGV (20) **Aluminium** (dissolved) (45 mg/L) above long-term DGV (5) **Iron** (dissolved) (18 mg/L) above short-term DGV (10) **Iron** (dissolved) (18 mg/L) above long-term DGV (0.2) **Phosphorus (**0.09 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (45 mg/L) above DGV (0.027) **Boron** (dissolved) (0.20 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.026 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.026 mg/L) above DGV (0.00095) **Copper** (dissolved) (0.003 mg/L) above DGV (0.001) **Iron** (dissolved) (18 mg/L) above DGV (0.14) **Lead** (dissolved) (0.005 mg/L) above DGV (0.001) **Phosphorus** (0.09 mg/L) above DGV (0.065) **Vanadium** (dissolved) (0.052 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.11 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		
Looking Downstream		

Name	Cobblers Pool
Waterway	Mandoon Bilya (Helena River) – middle catchment
Location	-31.94693, 116.13484 – at large river pool, access via track crossing
Elevation	92.8 m AHD
WIR Ref	Not applicable – nearest WIR site (6167034) is 360 m downstream
Locality	Shire of Mundaring – City of Kalamunda boundary
Rationale	Upstream of Lower Pumpback Dam and downstream of Mundaring Weir. Large permanent river pool. Downstream of Gunjin Gully tributary confluence.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	459 uS/cm	-	62.9 %	6.49	73.2 mV	298 mg/L	-
Sept 2024	591 uS/cm	290 ppm	69.3 %	6.44	171.1 mV	384 mg/L	2.2 NTU

	September 2025	September 2024
Field Notes	• Flowing, clear, colourless, appears cloudy green from surface. • Large pool on Mandoon channel, too deep to measure. • Flowing across road at approx. 50-100 mm depth. • No foam, sheen or floating debris visible. • Tiny fish (Gambusia?), frog noises in adjacent creek. • Blue tongue lizard in adjacent bush. • Song birds, march flies. • Big paperbark trees and river gums, white myrtle, saligna, red bottlebrush, trymalium and hibbertia in flower, cowslip orchids flowering. • Arum lily, much watsonia in adjacent bush, gladioli, Guildford grass. • Easy access from adjacent track. • Litter and plastic/glass bottles removed. • **Refer iNaturalist for complete record of species.**	• Flowing water, almost clear and colourless, no sheen or floating debris, pool appears greenish from surface. • Weeds on banks e.g. fumitory, grassy weeds, watsonia, arum lily, wavy gladioli, possible aquatic weeds. • Native vegetation in surrounding forest e.g. river gums, mature paperbarks, melaleuca, marri and jarrah trees, trymalium, acacia saligna, white myrtle, and diverse understory species. • Small fish. No visible frogs or tadpoles. Frog noises from adjacent Gunjin Gully (not in pool). • Bubbles observed from pool bed when taking sample. • Many dragonflies, butterflies, mosquitoes, song birds. • Very easy to access from adjacent track. • Vehicle access difficult on management track between Mundaring Weir and Lower Pumpback Dam – very washed out and eroded. 4WD essential.

Water Samples

Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes, pesticides **Undetected**: herbicides, hydrocarbons	**Detected**: PFAS, metals, nutrients, hydrocarbons, surfactants, microbes **Undetected**: pesticides, herbicides, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (12 CFU/100ml) above DGV (detection) ***Enterococci*** (9 CFU/100ml) above DGV (detection) **pH** (6.49) below DGV (6.5-8.5)	**Aluminium** (total) (0.23 mg/L) above the DGV (0.2) ***E. coli*** (12 CFU/100ml) above DGV (detection) ***Enterococci*** (19 CFU/100ml) above DGV (detection) **pH** (6.44) below DGV (6.5-8.5)
Aesthetic	**Iron** (dissolved) (0.32 mg/L) above DGV (0.3) **Turbidity** (7 NTU) above DGV (5)	**Aluminium** (total) (0.23 mg/L) above the DGV (0.2) **Iron** (total) (1.0 mg/L) above DGV (0.3)
Non-Potable	***E. coli*** (12 CFU/100ml) above DGV (1) **Iron** (dissolved) (0.32 mg/L) above DGV (0.3) **pH** (6.49) below DGV (6.5-8.5) **Turbidity** (7 NTU) above DGV (5)	**Aluminium** (total) (0.23 mg/L) above the DGV (0.2) ***E. coli*** (12 CFU/100ml) above DGV (1) **Iron** (total) (1.0 mg/L) above DGV (0.3) **pH** (6.44) below DGV (6.5-8.5)
Recreation	***E. coli*** (12 CFU/100ml) above DGV (1) **Iron** (dissolved) (0.32 mg/L) above DGV (0.3) **MBAS** (0.55 mg/L) above DGV (0.2) **pH** (6.49) below DGV (6.5-8.5)	***E. coli*** (12 CFU/100ml) above DGV (1) **Iron** (total) (1.0 mg/L) above DGV (0.3) **MBAS** (0.3 mg/L) above DGV (0.2) **pH** (6.44) below DGV (6.5-8.5)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock		
Agriculture	***E. coli*** (12 CFU/100ml) above DGV (10) **Iron** (dissolved) (0.32 mg/L) above long-term DGV (0.2)	***E. coli*** (12 CFU/100ml) above DGV (10) **Iron** (total) (1.0 mg/L) above long-term DGV (0.2) **Phosphorus** (0.06 mg/L) above long-term DGV (0.05)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (0.10 mg/L) above DGV (0.027) **Conductivity** (459-470 mg/L) above DGV (300) **DO** (62.9%) below DGV (>80%) **Iron** (dissolved) (0.32 mg/L) above DGV (0.14) **PFOS** (0.0013 ug/L) above air-breathing DGV (0.0005) **pH** (6.49) below DGV (6.5-8.0) **Zinc** (dissolved) (0.007 mg/L) above DGV (0.0024)	**Aluminium** (total) (0.23 mg/L) above the DGV (0.027) **Conductivity** (591-630 mg/L) above DGV (300) **DO** (69.3%) below DGV (>80%) **PFOS** (0.001 ug/L) above air-breathing DGV (0.0005) **pH** (6.44) below DGV (6.5-8.0)
Wastewater	***E. coli*** (12 CFU/100ml) above criteria (10)	***E. coli*** (12 CFU/100ml) above criteria (10)

Sediment Samples

	2025 – Leachable Concentrations	2024 – Total Concentrations

Detections	**Detected:** metals, nutrients **Undetected:** PFAS, pesticides, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients, pesticides, hydrocarbons **Undetected:** PFAS, herbicides, surfactants, volatile organics
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Iron** (dissolved) (4 mg/L) above DGV (14)	
Aesthetic	**Aluminium** (dissolved) (2.7 mg/L) above DGV (0.2) **Iron** (dissolved) (4 mg/L) above DGV (0.3)	
Non-Potable	**Aluminium** (dissolved) (2.7 mg/L) above DGV (0.2)	
Recreation	**Aluminium** (dissolved) (2.7 mg/L) above DGV (0.2) **Iron** (dissolved) (4 mg/L) above DGV (0.3)	
	2025 – Primary Industries Exceedances	
Livestock		
Agriculture	**Iron** (dissolved) (4 mg/L) above long-term DGV (0.2) **Phosphorus** (0.11 mg/L) above long-term DGV (0.05)	**TRH C10-C40** (880 mg/kg) above DGV (280) Limited DGVs exist
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (2.7 mg/L) above DGV (0.027) **Boron** (dissolved) (0.23 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.002 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.002 mg/L) above DGV (0.00095) **Copper** (dissolved) (0.003 mg/L) above DGV (0.001) **Iron** (dissolved) (4 mg/L) above DGV (0.14) **Lead** (dissolved) (0.001 mg/L) equal to DGV (0.001) **Phosphorus** (0.11 mg/L) above DGV (0.065) **Phosphorus** (0.11 mg/L) above Swan Canning target (0.1) **Zinc** (dissolved) (0.05 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		
Looking Downstream		

Name	**LookSee Pool**
Waterway	Mandoon Bilya (Helena River) – middle catchment
Location	-31.94991, 116.14592 – at large river pool, access via pipe track
Elevation	108.0 m AHD
WIR Ref	Not applicable – nearest WIR site (6163844) is 55 m downstream
Locality	Shire of Mundaring – City of Kalamunda boundary
Rationale	Large permanent river pool. Downstream of Bourkes Gully tributary. Near to DWER Healthy Rivers site HRDSMW (WIR 6163844).

	Field Observations						
	Conductivity	**Salinity**	**DO**	**pH**	**Redox**	**TDS**	**Turbidity**
Sept 2025	419 uS/cm	-	68.2 %	6.61	89.3 mV	319 mg/L	-
Sept 2024	648 uS/cm	310 ppm	70.5 %	6.52	152.0 mV	421 mg/L	2.1 NTU

	September 2025	**September 2024**
Field Notes	• Flowing, clear, colourless, appears cloudy green from surface. • Large pool on Mandoon channel, too deep to measure. • Steep banks, difficult to access. • Slight organic sheen on surface. • Small fish visible, frogs calling. • Insect noises (cricket/cicada?), mosquitoes, honey bees. • Large white/orange/black butterfly, dragonflies. • Numerous song birds, currawong in distance. • Vegetation as per 2024 incl. large mature paperbarks and river gums, many reeds along water's edge, bracken, saligna, hibbertia and trymalium flowering, native clematis (old man's beard). • Weeds – arum lily, watsonias, bridal creeper, olive, large citrus tree, paddock weeds, plantain, Guildford grass. • **Refer iNaturalist for complete record of species.**	• Flowing water, light brown colour, slight organic rainbow sheen, plant material/bark floating on surface. • Weeds on banks e.g. fumitory, grassy weeds, watsonia, arum lily, possible aquatic weeds. • Native vegetation in surrounding forest e.g. river gums, mature paperbarks, melaleuca, marri and jarrah trees, trymalium, acacia saligna, white myrtle, diverse understory species, wagyl whiskers (reeds). • No visible fish, frogs or tadpoles. No frog noises. • Lots of insect noises (crickets/cicada?). Mosquitoes, unknown bird calls. • Difficult access, very heavily vegetated, steep banks. • Vehicle access difficult on management track between Mundaring Weir and Lower Pumpback Dam – very washed out and eroded. 4WD essential.
	Water Samples	
Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes, pesticides **Undetected**: herbicides, hydrocarbons	**Detected**: PFAS, pesticides, metals, nutrients, surfactants, microbes **Undetected**: herbicides, hydrocarbons, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (10 CFU/100ml) above DGV (detection) ***Enterococci*** (9 CFU/100ml) above DGV (detection)	***E. coli*** (13 CFU/100ml) above DGV (detection) ***Enterococci*** (7 CFU/100ml) above DGV (detection)
Aesthetic	**Turbidity** (5.6 NTU) above DGV (5)	**Aluminium** (0.22 mg/L) above DGV (0.2) **Iron** (total) (1.2 mg/L) above DGV (0.3)
Non-Potable	***E. coli*** (10 CFU/100ml) above DGV (1) **Turbidity** (5.6 NTU) above DGV (5)	**Aluminium** (total) (0.22 mg/L) above DGV (0.2) ***E. coli*** (13 CFU/100ml) above DGV (1) **Iron** (total) (1.2 mg/L) above DGV (0.3)
Recreation	***E. coli*** (10 CFU/100ml) above DGV (1) **MBAS** (0.53 mg/L) above DGV (0.2)	**Aluminium** (0.22 mg/L) above DGV (0.2) ***E. coli*** (13 CFU/100ml) above DGV (1) **Iron** (total) (1.2 mg/L) above DGV (0.3)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock		
Agriculture	***E. coli*** (10 CFU/100ml) above DGV (10) **Iron** (dissolved) (0.22 mg/L) above long-term DGV (0.2)	***E. coli*** (13 CFU/100ml) above DGV (10) **Iron** (total) (1.2 mg/L) above long-term DGV (0.2) **Phosphorus** (0.06 mg/L) above long-term DGV (0.05)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (0.09 mg/L) above DGV (0.027) **Conductivity** (419–560 mg/L) above DGV (300) **DO** (68.2%) below DGV (>80%) **Iron** (dissolved) (0.22 mg/L) above DGV (0.14) **PFOS** (0.0012 ug/L) above air-breathing DGV (0.0005)	**Aluminium** (total) (0.22 mg/L) above DGV (0.027) **Conductivity** (648-700 mg/L) above DGV (300) **DO** (70.5%) below DGV (>80%) **Zinc** (total) (0.005 mg/L) above DGV (0.0024)
Wastewater	***E. coli*** (10 CFU/100ml) above criteria (10)	***E. coli*** (13 CFU/100ml) above criteria (10)
	Sediment Samples	
	2025 – Leachable Concentrations	**2024 – Total Concentrations**
Detections	**Detected:** metals, nutrients **Undetected:** PFAS, pesticides, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients, hydrocarbons **Undetected:** PFAS, pesticides, herbicides, surfactants, volatiles
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking		**TRH C10-C40** (910 mg/kg) above DGV (280)
Aesthetic	**Aluminium** (dissolved) (18 mg/L) above DGV (0.2) **Iron** (dissolved) (7.4 mg/L) above DGV (0.3)	
Non-Potable	**Aluminium** (dissolved) (18 mg/L) above DGV (0.2)	Limited DGVs exist

	Iron (dissolved) (7.4 mg/L) above DGV (0.3)	
Recreation	**Aluminium** (dissolved) (18 mg/L) above DGV (0.2) **Iron** (dissolved) (7.4 mg/L) above DGV (0.3)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (18 mg/L) above DGV (3.6)	
Agriculture	**Aluminium** (dissolved) (18 mg/L) above long-term DGV (5) **Iron** (dissolved) (7.4 mg/L) above long-term DGV (0.2) **Phosphorus** (0.08 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (18 mg/L) above DGV (0.027) **Boron** (dissolved) (0.21 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.012 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.012 mg/L) above DGV (0.00095) **Copper** (dissolved) (0.003 mg/L) above DGV (0.001) **Iron** (dissolved) (7.4 mg/L) above DGV (0.14) **Lead** (dissolved) (0.003 mg/L) above DGV (0.001) **Phosphorus** (0.08 mg/L) above DGV (0.065) **Vanadium** (dissolved) (0.030 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.054 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		
Looking Downstream		

Name	Piesse Culvert
Waterway	Piesse Brook – middle catchment
Location	-32.03306, 116.13711 – at Patterson Rd-Bracken Rd culvert
Elevation	252.3 m AHD
WIR Ref	6161254
Locality	City of Kalamunda
Rationale	Major tributary that flows into the Lower Pumpback Dam. Furthest upstream location on Piesse Brook that is accessible via public land. Surrounded by agricultural and rural properties in the townsite of Pickering Brook.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	398 uS/cm	-	75.3 %	6.60	86.6 mV	258 mg/L	-
Sept 2024	420 uS/cm	200 ppm	101.4 %	6.91	182.7 mV	273 mg/L	0.6 NTU

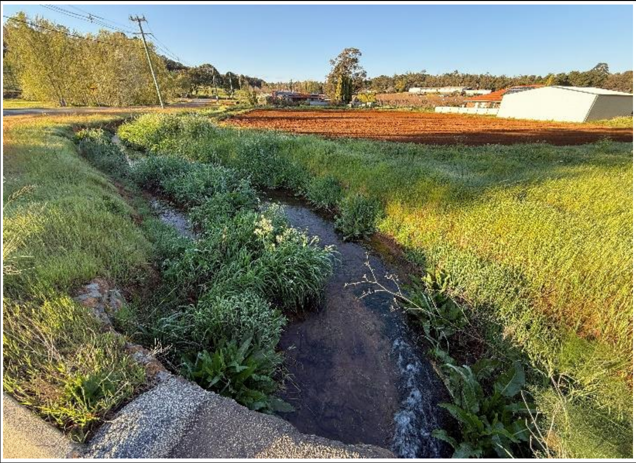
	September 2025	September 2024
Field Notes	• Flowing, clear, colourless, approx. 180 mm depth. • Channel seems wider and less defined than 2024. • No organic seen, foam or floating debris. • Some green algae on channel bottom. • Some floating aquatic plants with very small leaves. • Two frog species calling, no visible tadpoles or fish. • Many birds – 9 Carnaby's Cockatoo flying over, 2 white cockatoos, magpie lark. • No native understorey or trees. • Many weeds on banks – blue periwinkle, brassicas, dock leaves, blowfly grass, fennel or dill infestation upstream. • Busy road, many cars and school bus. • Downstream property has recently been ploughed. • **Refer iNaturalist for complete record of species.**	• Flowing water, almost clear and colourless, no sheen, some algae and floating aquatic plants on surface. • Weeds on banks e.g. fumitory, grassy weeds, vinca, brassicas, wild oats, possible aquatic weeds. • Prickly pear cactus infestation growing upstream on private property. • No native understory or trees. • Eroded banks, broken pipe in watercourse, possible drainage from private property? • No visible fish, frogs or tadpoles. Loud frog noises. • Ducks, freshwater snails. Small flock of Carnaby's black cockatoos drinking from brook on arrival. • Easy to access from Patterson Road. Traffic hazard. • Local resident interested in sampling.

Water Samples

Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons	**Detected**: PFAS, metals, nutrients, pesticides, surfactants, microbes **Undetected**: herbicides, hydrocarbons, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (130 CFU/100ml) above DGV (detection) ***Enterococci*** (49 CFU/100ml) above DGV (detection)	***E. coli*** (84 CFU/100ml) above DGV (detection) ***Enterococci*** (69 CFU/100ml) above DGV (detection)
Aesthetic		
Non-Potable	***E. coli*** (130 CFU/100ml) above DGV (1)	***E. coli*** (84 CFU/100ml) above DGV (1)
Recreation	***E. coli*** (130 CFU/100ml) above DGV (1) **MBAS** (0.54 mg/L) above DGV (0.2)	***E. coli*** (84 CFU/100ml) above DGV (1) ***Enterococci*** (69 CFU/100ml) above DGV (60-100) **MBAS** (0.3 mg/L) above DGV (0.2)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock	***E. coli*** (130 CFU/100ml) above DGV (100)	
Agriculture	***E. coli*** (130 CFU/100ml) above DGV (10) **Nitrogen** (5.7 mg/L) above long-term DGV (5)	***E. coli*** (84 CFU/100ml) above DGV (10) **Nitrogen** (6.9 mg/L) above long-term DGV (5)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Conductivity** (398-430 mg/L) above DGV (300) **Copper** (dissolved) (0.003 mg/L) above DGV (0.001) **DO** (75.3%) below DGV (>80%) **Nitrate** (5.7 mg/L) above DGV (0.64-1.0) **Nitrogen** (5.7 mg/L) above DGV (1.2) **Nitrogen** (5.7 mg/L) above Swan Canning target (1) **Nitrogen** (oxidised) (5.7 mg/L) above DGV (0.15) **Zinc** (dissolved) (0.010 mg/L) above DGV (0.0024)	**Aluminium** (total) (0.09 mg/L) above DGV (0.027) **Conductivity** (420-450 mg/L) above DGV (300) **Copper** (total) (0.003 mg/L) above DGV (0.001) **Nitrate** (6.9 mg/L) above DGV (0.64-1.0) **Nitrogen** (6.9 mg/L) above DGV (1.2) **Nitrogen** (6.9 mg/L) above Swan Canning target (1) **Nitrogen** (oxidised) (6.9 mg/L) above DGV (0.15) **Zinc** (total) (0.007 mg/L) above DGV (0.0024)
Wastewater	***E. coli*** (130 CFU/100ml) above criteria (10)	***E. coli*** (84 CFU/100ml) above criteria (10)

Sediment Samples

	2025 – Leachable Concentrations	**2024 – Total Concentrations**
Detections	**Detected:** metals, nutrients **Undetected:** PFAS, pesticides, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients, pesticides, surfactants **Undetected:** PFAS, herbicides, hydrocarbons, volatiles
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Lead** (dissolved) (0.012 mg/L) above DGV (0.01)	**Copper** (total) (86 mg/kg) above DGV (65) **DDE** (0.05 mg/kg) above DGV (0.0014-0.0022) **DDT** (0.03 mg/kg) above DGV (0.0012-0.0016) Limited DGVs exist
Aesthetic	**Aluminium** (dissolved) (19 mg/L) above DGV (0.2) **Iron** (dissolved) (4.9 mg/L) above DGV (0.3)	
Non-Potable	**Aluminium** (dissolved) (19 mg/L) above DGV (0.2) **Iron** (dissolved) (4.9 mg/L) above DGV (0.3)	
Recreation	**Aluminium** (dissolved) (19 mg/L) above DGV (0.2)	

	Iron (dissolved) (4.9 mg/L) above DGV (0.3)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (19 mg/L) above DGV (3.6)	
Agriculture	**Aluminium** (dissolved) (19 mg/L) above long-term DGV (5) **Iron** (dissolved) (4.9 mg/L) above long-term DGV (0.2) **Nitrogen** (12 mg/L) above long-term DGV (5) **Phosphorus** (0.27 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (19 mg/L) above DGV (0.027) **Chromium** (dissolved) (0.036 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.036 mg/L) above DGV (0.00095) **Cobalt** (dissolved) (0.003 mg/L) above DGV (0.0014) **Copper** (dissolved) (0.033 mg/L) above DGV (0.001) **Iron** (dissolved) (4.9 mg/L) above DGV (0.14) **Lead** (dissolved) (0.012 mg/L) above DGV (0.001) **Nickel** (dissolved) (0.011 mg/L) above DGV (0.008) **Nitrogen** (12 mg/L) above DGV (1.2) **Nitrogen** (12 mg/L) above Swan Canning target (1) **Phosphorus** (0.27 mg/L) above DGV (0.065) **Phosphorus** (0.27 mg/L) above Swan Canning target (0.1) **Vanadium** (dissolved) (0.072 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.060 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		
Looking Downstream		

Name	Salty Pool
Waterway	Mandoon Bilya (Helena River) – upper catchment
Location	-31.93913, 116.51495 – at seasonal river pool, access via Pony Rd
Elevation	257.1 m AHD
WIR Ref	Not applicable
Locality	Shire of York
Rationale	Furthest upstream location on Mandoon Bilya with sufficient water to sample. Downstream of salinity-impacted Wundabiniring Brook.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	11,194 uS/cm	-	31.9 %	6.32	41.1 mV	7,280 mg/L	-
Sept 2024	8,274 uS/cm	4,620 ppm	46.9 %	6.58	218.2 mV	5,390 mg/L	0.7 NTU

	September 2025	September 2024
Field Notes	• Flowing, clear, very slight brown, 800 mm depth in pool, very shallow in adjacent channel, slight organic sheen. • Aquatic insects, tadpoles, no visible fish or frog noises. • Dragonflies, song birds, wattle, wardong (raven), duck, honey bees, mosquitoes, no insect noises. • Vegetation as per 2024 incl. prickly moses wattle, zamia palm, blue daisies, wallaby grass, reeds on water's edge. • Weeds as per 2024 incl. pimpernel and Guildford grass. • Puff ball and dog poo fungus, yonga poo. • Motorbikes riding past, tracks across river channel. • Traffic cone and litter removed from channel. • **Refer iNaturalist for complete record of species.**	• Flowing water, almost colourless, clear. • Very slight organic sheen, some floating debris/plants. • Weeds on banks e.g. fumitory, grassy weeds, oats, lavender, cape tulip, cape weed, possible aquatic weeds. • Native vegetation in surrounding forest e.g. river gums, paperbarks, wandoo, balga, diverse understory. • No visible fish, frogs or tadpoles. No frog noises. • Many dragonflies, march flies, mosquitoes, swimming aquatic insects. Flock of unknown small white/black birds. Lots of unidentified song birds. Kangaroo poo. • Easy access from Pony Road, 4WD essential. • Motorbike tracks across river channel.

Water Samples

	2025	2024
Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (35 CFU/100ml) above DGV (detection) ***Enterococci*** (58 CFU/100ml) above DGV (detection) **pH** (6.32) below DGV (6.5-8.5)	***E. coli*** (24 CFU/100ml) above DGV (detection) ***Enterococci*** (63 CFU/100ml) above DGV (detection) **Thermophilic Amoeba** (detected) above DGV (detection)
Aesthetic	**Chloride** (4,100 mg/L) above DGV (250) **Hardness** (2,000 mg/L) above DGV (200) **Manganese** (dissolved) (0.22 mg/L) above DGV (0.1) **Sodium** (1,500 mg/L) above DGV (180) **TDS** (5,300–7,280 mg/L) above DGV (600)	**Chloride** (2,500 mg/L) above DGV (250) **Hardness** (1,700 mg/L) above DGV (200) **Iron** (total) (0.53 mg/L) above DGV (0.3) **Manganese** (total) (0.22 mg/L) above DGV (0.1) **Sodium** (1,000 mg/L) above DGV (180) **TDS** (5,200–5,390 mg/L) above DGV (600)
Non-Potable	**Chloride** (4,100 mg/L) above DGV (250) ***E. coli*** (35 CFU/100ml) above DGV (1) **pH** (6.32) below DGV (6.5-8.5)	**Chloride** (2,500 mg/L) above DGV (250) ***E. coli*** (24 CFU/100ml) above DGV (1) **Iron** (total) (0.53 mg/L) above DGV (0.3)
Recreation	**Ammonia** (0.06 mg/L) above DGV (0.01) **Chloride** (4,100 mg/L) above DGV (400) ***E. coli*** (35 CFU/100ml) above DGV (1) **Hardness** (2,000 mg/L) above DGV (500) **Manganese** (dissolved) (0.22 mg/L) above DGV (0.1) **MBAS** (0.84 mg/L) above DGV (0.2) **pH** (6.32) below DGV (6.5-8.5) **Sodium** (1,500 mg/L) above DGV (300) **TDS** (5,300–7,280 mg/L) above DGV (1,000) **TSS** (12 mg/L) above DGV (10)	**Ammonia** (0.03 mg/L) above DGV (0.01) **Chloride** (2,500 mg/L) above DGV (400) ***E. coli*** (24 CFU/100ml) above DGV (1) ***Enterococci*** (63 CFU/100ml) above DGV (60-100) **Hardness** (1,700 mg/L) above DGV (500) **Iron** (total) (0.53 mg/L) above DGV (0.3) **Manganese** (total) (0.22 mg/L) above DGV (0.1) **MBAS** (1.4 mg/L) above DGV (0.2) **Sodium** (1,000 mg/L) above DGV (300) **TDS** (5,200–5,390 mg/L) above DGV (1,000)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock	**Magnesium** (520 mg/L) above DGV (125) **TDS** (5,300–7,280 mg/L) above DGV (500)	**Magnesium** (340 mg/L) above DGV (125) **TDS** (5,200–5,390 mg/L) above DGV (500)
Agriculture	**Chloride** (4,100 mg/L) above DGV (175) ***E. coli*** (35 CFU/100ml) above DGV (10) **Iron** (dissolved) (0.29 mg/L) above long-term DGV (0.2) **Manganese** (dissolved) (0.22 mg/L) above long-term DGV (0.2) **Phosphorus** (0.07 mg/L) above long-term DGV (0.05) **Sodium** (1,500 mg/L) above DGV (115)	**Chloride** (2,500 mg/L) above DGV (175) ***E. coli*** (24 CFU/100ml) above DGV (10) **Iron** (0.53 mg/L) above long-term DGV (0.2) **Manganese** (total) (0.22 mg/L) above long-term DGV (0.2) **Sodium** (1,000 mg/L) above DGV (115)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Conductivity** (11,000–11,194 mg/L) above DGV (300) **Copper** (dissolved) (0.002 mg/L) above DGV (0.001) **DO** (3.18%) below SWIRC lower limit (>4) **DO** (31.9%) below DGV (>80%) **Fluoride** (0.5 mg/L) above DGV (0.29) **Iron** (dissolved) (0.29 mg/L) above DGV (0.14) **Nitrogen** (1.1 mg/L) above Swan Canning target (1) **pH** (6.32) below DGV (6.5-8.0)	**Conductivity** (8,274-8,600 mg/L) above DGV (300) **DO** (46.9%) below DGV (>80%) **Fluoride** (0.5 mg/L) above DGV (0.29) **Iron** (total) (0.53 mg/L) above DGV (0.14) **Zinc** (total) (0.005 mg/L) above DGV (0.0024)

	Phosphorus (0.07 mg/L) above DGV (0.065) **Phosphorus** (reactive) (0.07 mg/L) above DGV (0.04)	
Wastewater	***E. coli*** (35 CFU/100ml) above criteria (10)	***E. coli*** (24 CFU/100ml) above criteria (10)
	Sediment Samples	
	2025 – Leachable Concentrations	**2024 – Total Concentrations**
Detections	**Detected:** metals, nutrients **Undetected:** PFAS, pesticides, herbicides, hydrocarbons, MBAS	**Detected:** metals, nutrients, hydrocarbons **Undetected:** PFAS, pesticides, herbicides, MBAS, volatiles
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking	**Cobalt** (dissolved) (0.006 mg/L) equal to DGV (0.006) **Iron** (dissolved) (27 mg/L) above DGV (14) **Lead** (dissolved) (0.012 mg/L) above DGV (0.01)	
Aesthetic	**Aluminium** (dissolved) (14 mg/L) above DGV (0.2) **Iron** (dissolved) (27 mg/L) above DGV (0.3)	
Non-Potable	**Aluminium** (dissolved) (14 mg/L) above DGV (0.2) **Iron** (dissolved) (27 mg/L) above DGV (0.3)	
Recreation	**Aluminium** (dissolved) (14 mg/L) above DGV (0.2) **Iron** (dissolved) (27 mg/L) above DGV (0.3)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (14 mg/L) above DGV (3.6)	
Agriculture	**Aluminium** (dissolved) (14 mg/L) above long-term DGV (5) **Iron** (dissolved) (27 mg/L) above short-term DGV (10) **Iron** (dissolved) (27 mg/L) above long-term DGV (0.2) **Phosphorus** (0.16 mg/L) above long-term DGV (0.05)	**TRH C10-C40** (990 mg/kg) above DGV (280) Limited DGVs exist
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (14 mg/L) above DGV (0.027) **Boron** (dissolved) (0.46 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.028 mg/L) above DGV (0.00095). **Chromium III** (dissolved) (0.028 mg/L) above DGV (0.00095) **Cobalt** (dissolved) (0.006 mg/L) above DGV (0.0014) **Copper** (dissolved) (0.01 mg/L) above DGV (0.001) **Iron** (dissolved) (27 mg/L) above DGV (0.14) **Lead** (dissolved) (0.012 mg/L) above DGV (0.001) **Nickel** (dissolved) (0.016 mg/L) above DGV (0.008) **Nitrogen** (1.1 mg/L) above DGV (1.2) **Nitrogen** (1.1 mg/L) above Swan Canning target (1) **Phosphorus** (0.16 mg/L) above DGV (0.065) **Phosphorus** (0.16 mg/L) above Swan Canning target (0.1) **Zinc** (dissolved) (0.21 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		

Looking Downstream		

Name	**Beraking Yarra**
Waterway	Beraking Brook – upper catchment
Location	-32.18171, 116.43514 – immediately downstream of Yarra Rd culvert.
Elevation	262.0 m AHD
WIR Ref	6161259
Locality	Shire of Beverley
Rationale	Major tributary of the Darkin River that flows into Mundaring Weir. Upstream of any private property and cleared land. Located in the upper headwaters of the Mandoon catchment. Reflective of background conditions.

Field Observations

	Conductivity	Salinity	DO	pH	Redox	TDS	Turbidity
Sept 2025	143 uS/cm	-	43.1 %	6.70	81.2 mV	93 mg/L	-
Sept 2024	162 uS/cm	80 ppm	36.4 %	6.91	187.9 mV	105 mg/L	5.1 NTU

	September 2025	**September 2024**
Field Notes	• Flowing, yellow colour, clear, approx. 1 m deep. • White foam coming from bridge culvert. • Organic sheen, much organic material in water. • Channel definition good downstream but lost upstream. • Water pooling upstream of bridge culvert due to debris. • Native vegetation in surrounding forest as 2024 – Drummonds wattle, white myrtle and cowslip orchids flowering, daisies and saligna starting to flower. • Song birds, active ant mounds, mosquitoes, march flies. • Bubbles observed from river bed. • Big tadpoles, no frog noises. • Much sediment erosion from road into waterway. • Car stopped to ask directions after attending bush rave. • Litter/cans removed. • **Refer iNaturalist for complete record of species.**	• Flowing, slight brown/yellow colour. • No sheen or foam, some floating debris/plant material. • Very few weeds on banks e.g. grassy weeds, possible aquatic weeds. • Native vegetation in surrounding forest e.g. river gums, mature paperbarks, melaleuca, marri, jarrah, balga, trymalium, much acacia saligna, white myrtle, hakea, diverse understory, wagyl whiskers (reeds). • No visible fish, frogs or tadpoles. No frog noises. • Dragonflies. Unidentified song birds. • Bubbles observed from river bed. • Small bird nesting or feeding in balga skirt. • Sediment erosion from unsealed road into waterway. • Easy access from Yarra Road.

Water Samples

Detections	**Detected**: PFAS, metals, nutrients, surfactants, microbes, pesticides **Undetected**: herbicides, hydrocarbons	**Detected**: PFAS, metals, nutrients, surfactants, microbes **Undetected**: pesticides, herbicides, hydrocarbons, volatiles
	2025 – Human Health Exceedances	**2024 – Human Health Exceedances**
Drinking	***E. coli*** (130 CFU/100ml) above DGV (detection) ***Enterococci*** (59 CFU/100ml) above DGV (detection)	***E. coli*** (21 CFU/100ml) above DGV (detection) ***Enterococci*** (56 CFU/100ml) above DGV (detection) **Thermophilic Amoeba** (detected) above DGV (detection)
Aesthetic	**Iron** (dissolved) (0.63 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.24 mg/L) above DGV (0.1)	**Iron** (total) (3.0 mg/L) above DGV (0.3) **Manganese** (total) (0.46 mg/L) above DGV (0.1) **Turbidity** (5.14-6.9 NTU) above DGV (5)
Non-Potable	***E. coli*** (130 CFU/100ml) above DGV (1) **Iron** (0.63 mg/L) above DGV (0.3)	***E. coli*** (21 CFU/100ml) above DGV (1) **Iron** (total) (3.0 mg/L) above DGV (0.3) **Turbidity** (5.14-6.9 NTU) above DGV (5)
Recreation	**Ammonia** (0.04 mg/L) above DGV (0.01) ***E. coli*** (130 CFU/100ml) above DGV (1) **Iron** (dissolved) (0.63 mg/L) above DGV (0.3) **Manganese** (dissolved) (0.24 mg/L) above DGV (0.1) **MBAS** (0.69 mg/L) above DGV (0.2)	***E. coli*** (21 CFU/100ml) above DGV (1) **Iron** (3.0 mg/L) above DGV (0.3) **Manganese** (total) (0.46 mg/L) above DGV (0.1) **MBAS** (0.4 mg/L) above DGV (0.2)
	2025 – Primary Industries Exceedances	**2024 – Primary Industries Exceedances**
Livestock	***E. coli*** (130 CFU/100ml) above DGV (100)	
Agriculture	***E. coli*** (130 CFU/100ml) above DGV (10) **Iron** (dissolved) (0.63 mg/L) above long-term DGV (0.2) **Manganese** (dissolved) (0.24 mg/L) above long-term DGV (0.2) **Phosphorus** (0.05 mg/L) equal to long-term DGV (0.05)	***E. coli*** (21 CFU/100ml) above DGV (10) **Iron** (total) (3.0 mg/L) above long-term DGV (0.2) **Manganese** (total) (0.46 mg/L) above long-term DGV (0.2) **Phosphorus** (0.06 mg/L) above long-term DGV (0.05)
	2025 – Ecosystem Exceedances	**2024 – Ecosystem Exceedances**
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (0.15 mg/L) above DGV (0.027) **Copper** (dissolved) (0.005 mg/L) above DGV (0.001) **DO** (43.1%) below DGV (>80%) **Fluoride** (0.3 mg/L) above DGV (0.29) **Iron** (dissolved) (0.63 mg/L) above DGV (0.14) **Nitrogen** (1.2 mg/L) equal to DGV (1.2) **Vanadium** (dissolved) (0.007 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.007 mg/L) above DGV (0.0024)	**Aluminium** (total) (0.18 mg/L) above DGV (0.027) **Cobalt** (total) (0.002 mg/L) above DGV (0.0014) **Copper** (total) (0.001 mg/L) equal to DGV (0.001) **Cyanide** (total) (0.007 mg/L) above DGV (0.004) **DO** (3.85%) below SWIRC lower limit (>4) **DO** (36.4%) below DGV (>80%) **Lead** (total) (0.001 mg/L) equal to DGV (0.001) **Zinc** (total) (0.006 mg/L) above DGV (0.0024)
Wastewater	***E. coli*** (130 CFU/100ml) above criteria (10)	***E. coli*** (21 CFU/100ml) above criteria (10)

Sediment Samples

	2025 – Leachable Concentrations	2024 – Total Concentrations
Detections	**Detected:** metals, nutrients **Undetected:** PFAS, pesticides, herbicides, hydrocarbons, surfactants	**Detected:** metals, nutrients, hydrocarbons **Undetected:** PFAS, pesticides, herbicides, hydrocarbons, surfactants, volatiles
	2025 – Human Health Exceedances	**2024 – Sediment Quality Exceedances**
Drinking		No exceedances of the DGVs Limited DGVs exist
Aesthetic	**Aluminium** (dissolved) (24 mg/L) above DGV (0.2) **Iron** (dissolved) (4.3 mg/L) above DGV (0.3)	
Non-Potable	**Aluminium** (dissolved) (24 mg/L) above DGV (0.2) **Iron** (dissolved) (4.3 mg/L) above DGV (0.3)	
Recreation	**Aluminium** (dissolved) (24 mg/L) above DGV (0.2) **Iron** (dissolved) (4.3 mg/L) above DGV (0.3)	
	2025 – Primary Industries Exceedances	
Livestock	**Aluminium** (dissolved) (24 mg/L) above DGV (3.6)	
Agriculture	**Aluminium** (dissolved) (24 mg/L) above long-term DGV (5) **Iron** (dissolved) (4.3 mg/L) above long-term DGV (0.2) **Nitrogen** (11 mg/L) above long-term DGV (5) **Phosphorus** (0.08 mg/L) above long-term DGV (0.05)	
	2025 – Ecosystem Exceedances	
Freshwater Ecosystem 99% Species Protection	**Aluminium** (dissolved) (24 mg/L) above DGV (0.027) **Boron** (dissolved) (0.25 mg/L) above DGV (0.09) **Chromium** (dissolved) (0.010 mg/L) above DGV (0.00095) **Chromium III** (dissolved) (0.010 mg/L) above DGV (0.00095) **Cobalt** (dissolved) (0.002 mg/L) above DGV (0.0014) **Copper** (0.003 mg/L) above DGV (0.001) **Iron** (dissolved) (4.3 mg/L) above DGV (0.14) **Lead** (dissolved) (0.005 mg/L) above DGV (0.001) **Nitrogen** (11 mg/L) above DGV (1.2) **Nitrogen** (11 mg/L) above Swan Canning target (1) **Phosphorus** (0.08 mg/L) above DGV (0.065) **Vanadium** (dissolved) (0.023 mg/L) above DGV (0.006) **Zinc** (dissolved) (0.61 mg/L) above DGV (0.0024)	
	Photo Record	
	September 2025	**September 2024**
Looking Upstream		
Looking Downstream		

Appendix 6 Laboratory Documentation

Available upon request from admin@bibbul.org

Pickering Brook, upstream of Mundaring Weir

BOORYUL BAH BILYA

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