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Condition of ecological values of the Canning and Southern-Wungong Rivers

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Acknowledgement of Country

We acknowledge the Traditional Owners of Country throughout Australia and their continuing connection to and stewardship of land, sea and community. We pay our respects to them and their cultures and to their Ancestors, Elders and future leaders. Our Indigenous research partnerships are a valued and respected component of National Environmental Science Program research.

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Summary

This report addresses the first component for *Project 3.3: Enhancing the resilience of urban rivers: informing the regional restoration of the Djarlgaroo Beeliar (Canning River, Perth),* funded by the Australian Government's National Environmental Science Program (NESP) Resilient Landscapes Hub. The project aims to support evidence-based decision making for the restoration of the Canning River and its major tributary the Southern-Wungong River in Perth, Western Australia.

The first component of the project aims to assess the current condition of the Canning River, and here we report on a desktop assessment of the status of the condition of ecological values and the key threatening processes that they face.

The specific aims of this report were to:

1. Identify Matters of National Environmental Significance (MNES) and the instream and riparian ecological values within the study area.

2. Identify threatening processes to ecological values within the study area.

3. Collate and summarise available data on the current condition of ecological values and their threats.

4. Identify knowledge gaps and provide recommendations for future research or data collection.

An assessment of the condition of environmental values and threats is contingent on current data collected at an appropriate spatial scale. We therefore sourced data from Government databases and from managers, and collated and summarised the data. For MNES we combined datasets of observations to show current distribution. For broader instream and riparian ecological values we prioritised recent data with high spatial coverage of the study area, filtering out datasets that did not meet the criteria. We identified relevant threats from Commonwealth-listed threatening processes and MNES Conservation Advices and Recovery Plans for MNES. For each threat, we identified relevant datasets where available.

We found that 2 Commonwealth-listed Threatened Ecological Communities (TECs) occur in the study area: Banksia Woodlands of the Swan Coastal Plain and Clay Pans of the Swan Coastal Plain. Records exist for 4 Commonwealth-listed flora species within the study area, but uncertainty is high, with 3 species observed between 1920 and 1982 and only 1, the sedge *Morelatia australiensis,* observed recently, in 2021. Records exist for 8 Commonwealth-listed fauna species, including 4 species in the Federal Government's 110 Priority Species list. These include Carnaby's Cockatoo (*Zanda latirostris*), Chuditch/Western Quoll (*Dasyurus geoffroii*), Numbat (*Myrmecobius fasciatus*), and Quokka (*Setonix brachyurus*). Other Commonwealth-listed species in the area include: Baudin's cockatoo (*Zandia baudinii*), Forest red-tailed cockatoo (*Calyptorhynchus banksii*), Common Greenshank (*Tringa nebularia*) and Carter's freshwater mussel (*Westralunio carteri*). Datasets relating to MNES contained few records within the study area, and many records were decades old. It is uncertain if this is because species no longer occur within the study area, or if it is because there have not been systematic surveys to detect them.

Instream condition was difficult to determine due to the difficulty separating indicators of health from natural longitudinal patterns. For example, pool depth and fish species richness were greater downstream. Furthermore, spatial patterns for some instream values (e.g. branches) did not align with others (e.g. stream cover by canopy). That said, spatial trends and patchiness clearly exist for different instream habitat attributes and can support decision-making. We recommend that summaries of instream condition be tailored for the species of management interest and are mindful of natural longitudinal patterns. There were very limited datasets available to inform our assessment of instream values, and 2 out of the 4 datasets that were available did not cover the entire study area. However, some datasets contained detailed information on habitat features (e.g. presence of branches, leaves and rocks) which may be used to determine a metric of habitat for freshwater biota.

There were sufficient data to inform an assessment of the extent of riparian vegetation and the ecological linkages it provides, although interpretation of 2 key datasets was limited due to them not covering the entire study area and because they were collected 15 years apart. Riparian condition within the study area, assessed as the extent and condition of native vegetation, was generally poor and heavily impacted by weeds and disturbance. The extent of native vegetation was limited to a very narrow band along the river channel and was absent for large parts of the Wungong River. Native vegetation cover was greater in the upper part of the Canning River (Darling Scarp). In the highly cleared and fragmented landscape, the vegetation that remains, including riparian corridors, provides important ecological linkages for biota to move along and between patches.

There are a large number of threats to the ecological values of the study area, with land clearance, changed fire regimes, alien species (including weed invasion), dieback caused by Phytophthora, hydrological change and anthropogenic degradation identified as threats for the majority of values. Threatened flora and fauna, TECs and riparian values were highly impacted by land clearance and weed invasion across most the study area. Instream values are threatened by habitat degradation, hydrological change, pollution (including poor water quality and sedimentation) and exotic fish. However, for the majority of threatening processes we did not identify an available dataset to inform the condition or status of the threat.

Our desktop review identified key knowledge gaps in the information available to inform management decisions that address ecological priorities (particularly MNES) and the threats they face. Due to the lack of current data, systematic flora and fauna surveys are required to identify the presence and condition of MNES within the study area. For instream values, a key recommendation is to combine existing data to provide a metric of habitat condition. Additionally, surveys of aquatic species other than fish are required to determine their distributions within the study area. Surveys of the Southern-Wungong River are required to provide a complete overview of instream habitat condition within the study area. Similarly, an updated survey of riparian vegetation is required on the Canning, to expand the recently completed Wungong survey. Overall, we found a lack of data on ecological values and threats at a spatial scale suitable for an assessment of the study area.

The outcomes of this report provide an overview of the information that is currently available to inform management decisions, including spatial prioritisation of areas to protect, manage and restore (a next step in this NESP RLH Project 3.3). The collation of existing data also allowed for the identification of key knowledge gaps to guide future data collection and research questions.

Indigenous cultural values are considered in an accompanying report: ‘Review of information in the Aboriginal Cultural Heritage Inquiry System for the Canning, Southern and Wungong Rivers’.

Introducing NESP Project 3.3

This report is the first for *Project 3.3: enhancing the resilience of urban rivers: informing the regional restoration of the Djarlgaroo Beeliar (Canning River, Perth)*, funded by the Australian Government's National Environmental Science Program (NESP) Resilient Landscapes Hub. The project aims to inform the implementation and evaluation of restoration work, specifically by providing maps and decision support tools to guide where to protect, where to restore, and what to do at each site.

As part of Australia's international commitment to protecting biodiversity (see Australia's Nature Positive Plan; DCCEEW (2022a)), the Commonwealth (Department of Climate Change, Energy, Environment and Water [DCCEEW]) have established the Urban Rivers and Catchments Program (URCP) which aims to 'restore the health of our urban waterways for native plants and animals, and local communities' (DCCEEW, 2023). This will be achieved by supporting projects that aim to improve riparian habitat, water quality and urban green spaces (DCCEEW, 2023). Through this program, funding has been committed for restoration of the Canning River in Perth, Western Australia. However, in order to prioritise restoration efforts, it is essential to understand the current condition of the river system and key threats (Auditor General Western Australia, 2014).

Matters of National Environmental Significance (MNES) are nationally significant animals, plants, habitats and areas identified under the *EPBC Act 1999.* Given their significance as a national priority, we highlight the MNES identified as occurring in the area, and where possible provide an overview of their condition. We also aimed to address broader ecological values relating to the instream and riparian environments. To address these aims and to inform on-going work as part of NESP RLH Project 3.3, we report on a desktop review of the condition of ecological values, the threats they face and provide a summary of the datasets available to inform this assessment. This initial assessment informs subsequent work, including targeted studies to fill identified knowledge gaps and a spatial prioritisation of ecological values to identify priority areas for management actions.

Report aims and associated outputs

This report is a desktop assessment collating and summarising the available data on the current condition within the study area on the Canning River and its major tributary the Southern-Wungong River.

The specific aims of this report were to:

- Aim 1: Identify Matters of National Environmental Significance (MNES) and the instream and riparian vegetation ecological values within the study area
- Aim 2: Collate and summarise available data on the current condition of ecological values and their threats
- Aim 3: Identify threatening processes to ecological values within the study area
- Aim 4: Identify knowledge gaps and provide recommendations

To address these aims we collated relevant datasets and summarised key attributes within these datasets, with the following outputs:

- Summary of MNES, instream and riparian vegetation condition and relevant threatening processes, and the limitations presented by the data available to inform this assessment
- Identification of key knowledge gaps and recommendations for future research
- Summary of datasets and an assessment of their currency and spatial extent (provided in the appendix)
- ArcGIS database of all data (available on request)

1 Approach and methods

1.1 Study area

The study area includes part of the Canning River and its major tributary, the Southern-Wungong River, running through a highly modified urban space in Perth, Western Australia (Figure 1). The Canning and Wungong River headwaters start on the Darling Plateau, flow down the Scarp and across the Swan Coastal Plain before flushing out to the Indian Ocean. From the Wungong Reservoir, the Wungong River flows into the Southern River at Tonkin Highway; the Southern River then joins the Canning River in Thornlie and from there they join the Swan River Estuary. In the 1800s, the rock bar at the mouth of Swan River was removed using explosives (Riggert, 1978), as well as dredged, , changing the inflow of oceanic tide upstream into the system (Thomson et al., 2001). Kent Street Weir was built in 1926 to prevent saltwater from the estuary pushing further upstream into the Canning River. The study area is focussed on the freshwater section of the Canning River (i.e. upstream of Kent St Weir) up to Canning Dam, and the Southern and Wungong Rivers up to Wungong Reservoir. The study area is defined as a 500 m buffer either side of the mapped water line (Figure 1).

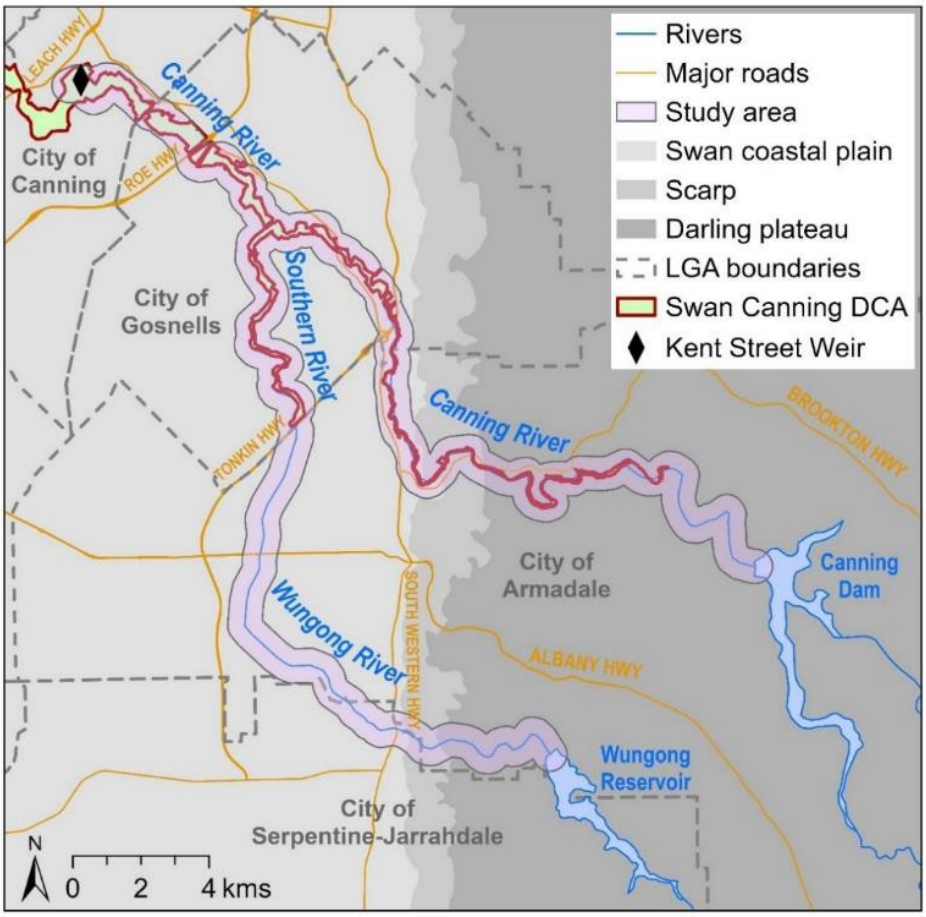

Figure 1 Map of the study area which includes 500 m either side of the Canning and Southern-Wungong Rivers. Key; DCA = Development Control Area; LGA = Local Government Area.

1.2 Data acquisition

We aimed to determine the presence of MNES and the condition of ecological values and their threatening processes across the study area. To address these aims datasets were sourced from relevant agencies. Initially, datasets were located using the Data WA portal (Government of Western Australia, 2024) to access information on the Shared Location Information Platform (SLIP), which is the WA Government's platform for spatial data. The information from SLIP is spatial datasets collected and maintained by state government agencies including Department of Biodiversity, Conservation and Attractions (DBCA), Department of Primary Industry and Development (DPIRD), Western Australian Local Government Association (WALGA), Department of Planning, Lands and Heritage (DPLH) and Department of Water and Environmental Regulation (DWER). Some datasets required permission from the custodian for access: data on threatened flora, fauna and ecological communities and the Riverbank datasets were provided on request. Information on land tenure was accessed using a subscription to SLIP through UWA.

We sought relevant data not listed in the WA Data Portal by contacting research collaborators. Datasets received were from:

- DBCA: Roley Pool Carters mussel point data, Roley Pool dissolved oxygen, Canning Barriers, Canning Pools, Wungong condition surveys; location of stormwater drains, Swan Canning Foreshore Assessment, riparian ecology foreshores, riverbank natural and built foreshores.
- DPIRD (Fisheries): fish data from their database
- Perth NRM: Gnangara Jandakot minimum and predicted groundwater levels by 2030, native vegetation extent including patch size and complexity, patches greater than 1000 and 2000 ha, Naturelink connectivity
- DWER: fish and water quality data from the Healthy River Monitoring program (HRP), water quality data from WIR portal.

In total we identified 57 datasets relating to MNES and ecological values and threats, which were assessed as below.

1.3 Assessment of data

We aimed to systematically assess the condition of ecological values and the threats they face within the study area.

Ecological values assessed were:

- Presence of MNES
- Instream values: habitat and biota
- Riparian vegetation values: vegetation extent & linkages and condition
- Threats as defined in MNES documentation

MNES

We aimed to identify the presence and distribution of MNES within the study area. Datasets used to inform our assessment were primarily records of species from WA Government datasets relating to threatened and priority flora and fauna. Where available, records from additional datasets were

combined to provide more information on the current distribution of species within the study area (e.g. records of Carter's mussel). For each MNES we determined the number and age of records and summarised key information from the relevant conservation advice and listing documents.

Instream and riparian vegetation values

To assess the condition of instream and riparian vegetation ecological values we determined relevant datasets and then systematically assessed them according to the following criteria.

Are the data original? Several datasets initially appeared relevant and recent; however, they were derivations of values from older datasets, often reinterpreted to address a new or different objective. We determined that these datasets do not represent current condition, as they did not contain new data, and we used the original dataset in its place. These newer datasets may be relevant for other purposes (e.g. to inform spatial prioritisation).

When were the data collected? To assess the current condition of the study area, the age of the data is important. We therefore excluded data that were greater than 20 years old.

Do the data cover the study area? We aimed to report on the condition of values across the study area as it is a future aim of NESP Project 3.3. to inform spatial prioritisation. We therefore sought data from across the study area. We visually assessed the spatial coverage of data and excluded datasets that covered less than approximately half of the study area. This cut-off was selected as it allowed for the inclusion of key datasets that were collected for either the Canning River (e.g. the Canning Pools dataset) or the Southern-Wungong River (e.g. the Wungong Riparian Vegetation dataset).

Datasets that met the criteria were included in our assessment of current condition. For each theme we provide an overview of:

- Relevant datasets
- Key information
- Data limitations
- Key knowledge gaps

Threats

Threats to ecological values were identified by reviewing the Conservation Advices, Action Plans and listing documents for MNES. For each threat we identified relevant datasets and summarised key information and knowledge gaps.

1.4 Summary of datasets

A total of 31 datasets were used in our assessment of MNES, instream and riparian values, and threats, which are summarised in Appendix Table A1.

Details on the assessment of all identified datasets is summarised by MNES, instream and riparian ecological values and provided in Appendix Table A2, Table A3 and Table A4.

2 Matters of National Environmental Significance

2.1 Data sources

A total of 20 datasets were used in our assessment of MNES within the study area (Appendix Table A2). Of these there was one with records of TECs, 2 with records on threatened flora and one with records of threatened fauna. There were also species-specific datasets with additional records and 11 datasets relating to resources for Carnaby's Cockatoo.

Datasets on TECs, threatened fauna and flora contain sensitive information about the location of priority flora and fauna, and information should not be made directly available to the general public, although it may be shown in derivations such as distance to a threatened species record.

No relevant data were obtained from Atlas of Living Australia (ALA) and the Protected Matters Search Tool maintained by DCCEEW. Our search of ALA for threatened species within the study area primarily returned records for species not considered threatened or priority in Western Australia (81 out of 83) (Atlas of Living Australia, 2024). Instead, the search identified species that are listed under legislation from other states. In addition, there were records that incorrectly identified species as Commonwealth-listed species under the *EPBC Act 1999*. The search of Protected Matters returned records that were outside of the study area, despite the buffer width for the search of set to zero (DCCEEW, 2024b).

Protected Matters (MNES) were therefore assessed using TEC and threatened flora and fauna datasets from DBCA. For each TEC we provide a brief overview of its presence and distribution in the study area, key information (primarily drawn from Conservation Advices) and data limitations. For threatened flora and fauna species we provide a brief overview of the species present within the study area, key information for each species, and the limitations associated with the datasets.

2.2 Threatened ecological communities (TECs)

Based on the **DBCA-038 Threatened Ecological Communities** dataset, 2 Commonwealth-listed TECs occur within the study area: Banksia Woodlands of the Swan Coastal Plain and Clay Pans of the Swan Coastal Plain.

The mapped area of TECs includes a buffer of variable distances around each TEC. For 2 TECs the buffer intersected the study area, but the actual TEC is further from the river: Muchea Limestone and SCP3a, a community type within *Corymbia calophylla – Kingia australis* woodlands on heavy soils of the Swan Coastal Plain. As these 2 TECs do not occur within the study area, we have excluded them from our assessment.

Table 1 Threatened Ecological Communities (TECs) within the study area. The name is as listed in the DBCA-038 Threatened Ecological Communities dataset, and reflects State-listed communities. The Commonwealth TEC refers to the community listed under the EPBC Act 1999. Key: Banksia WL SCP = Banksia woodland, swan coastal plain.

Name	Commonwealth TEC	Community name	WA listing	Commonwealth listing
Banksia WL SCP	Banksia Woodlands of the Swan Coastal Plain	Banksia woodland of the Swan Coastal Plain ecological community	Priority 3	Endangered
SCP20b	Banksia Woodlands of the Swan Coastal Plain	*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (floristic community type 20b as originally described in Gibson et al. (1994)). Part of the Banksia SCP TEC.	Endangered	Endangered
SCP08	Clay Pans of the Swan Coastal Plain	Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson et al. (1994))	Vulnerable	Critically endangered

Banksia woodland of the Swan Coastal Plain

Image: Rob Davis, (Commonwealth of Australia, 2016)

Key information

The Banksia woodland TEC was listed as Endangered under the *EPBC Act 1999* in 2016. The community is characterised by a distinctive upper canopy of low trees, dominated or co-dominated by *Banksia attenuata* and/or *B. menziesii*. In some locations the community may be dominated or co-dominated by *B. prionotes* or *B. ilicifolia*. There may be an emergent tree layer of Eucalyptus or Allocasuarina. The understorey is generally highly species rich, consisting of a layer of sclerophyllous shrubs and a herbaceous ground layer.

Banksia woodland TEC is now highly fragmented with 82% of patches under 10 ha in size, with a median patch size of 1.6 ha (Department of the Environment & Energy, 2016).

Presence and distribution

The Banksia woodland SCP TEC is the most common TEC in the study area, with 123 mapped locations. Within the study area the Banksia woodland TEC occurs along large parts of the Southern River, with other significant on the Canning and Wungong Rivers.

The floristic community 'SCP20b – *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the SCP' is part of the Commonwealth-listed TEC, and is mapped within the study area).

Data limitations

The spatial data is based on the Commonwealth's 'likely' to occur category in the Conservation Advice. Our assessment did not identify a dataset of the condition of the TEC, and surveys are required to assess occurrence and condition within the study area.

Clay pans of the Swan Coastal Plain

Image: (Commonwealth of Australia, 2017)

Key information

The Clay Pans of the Swan Coastal Plain TEC was listed as Critically Endangered in 2012. The clay pan communities of the Swan Coastal Plain, including SCP08, are characterised by landform and vegetation structural features. The community type occurs in low-lying locations in the landscape, with a clay substrate that forms an impermeable layer which allows for seasonal inundation. The clay pan communities are characterised as the most diverse of the SCP wetlands, containing a number of endemic flora (Commonwealth of Australia, 2017). A key floristic feature is the suite of geophytes and annual flora that grow and flower as inundated clay pans dry over summer (Department of Sustainability, 2012).

Sixty percent of occurrences of the clay pans of the SCP TEC have been reduced to a patch size of less than 10 ha (Commonwealth of Australia, 2017)

Presence and distribution

The SCP08 TEC is part of the Commonwealth-listed Clay Pans of the Swan Coastal Plain TEC. The TEC occurs in one location within the study area (Site ID: Tonkin01). As the location is on private land, the condition and key threats have not been assessed. Within the study area the mapped area of the community covers 4.4 ha out of a total area of 298.1 ha for the SCP08 TEC (Commonwealth of Australia, 2017).

Data limitations

The occurrences of the TEC were identified by Gibson et al. (2005) based on floristic patterning. The recovery plan identifies 114 occurrences of the clay plan communities and includes information on the size of the communities and for many records their condition. However, condition data is not available for the community within the study area (up to 2013). Our assessment did not identify an assessment of condition for the TEC after 2013.

2.3 Threatened flora

Presence and distribution

The presence of Commonwealth-listed flora was determined using 2 datasets provided by DBCA: the **Threatened and Priority Flora** and the **WA Herbarium** datasets. Four flora species listed under the *EPBC Act 1999* have records in the study area: *Banksia mimica, Eleocharis keigheryi, Morelotia australiensis* and *Thelymitra stellata* (Table 2; Figure 2).

Table 2 Threatened flora (EPBC-listed) with records within the study area.

Species	Common name	Database	Commonwealth listing	Year of record
Banksia mimica	Summer honeypot	WAHERB	Endangered	1969, 1972
Eleocharis keigheryi	Keighery's Eleocharis	WAHERB	Vulnerable	1982
Morelotia australiensis	Southern Tetraria	TPFL	Vulnerable	2021
Thelymitra stellata	Star sun-orchid	WAHERB	Endangered	1920

Key information

B. mimica (formerly *Dryandra mimica*) is from the Proteaceae family and is a prostrate shrub with underground stems. The total population size was estimated to be more than 7300 mature plants in 2008, however plants occur in large clumps and may be clones, so number of individuals is uncertain (Department of the Environment, 2008a).

E. keigheryi is from the Cyperaceae family and is a rhizotamous, tufted/clumped perennial herb. The species was known from 15 populations in 2008 (Department of the Environment, 2008b).

M. australiensis (formerly *Tetraria australiensis*) is from the Cyperaceae family and is a perennial tufted herb with stems to 1 m high. The species is not known to flower without a fire trigger (Department of the Environment, 2008c). The species occurs in 11 locations between Perth and the South West capes, with an estimated total population size of 1400 mature individuals in 2008. It was noted that these estimates were unreliable, and there was no published information on more recent surveys (Department of the Environment, 2008c).

T. stellata is a terrestrial orchid that grows up to 25 cm high. The species is uncommon and occurs over a large area (between Three Springs and Pinjarra) and was known from 23 populations in 2008. Most populations are small with fewer than 10 plants (Department of the Environment, 2008d).

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https://florabase.dbca.wa.gov.au/browse/profile/1033</td>
<td>Eleocharis keigheryi
https://florabase.dbca.wa.gov.au/browse/profile/17605</td>
</tr>
</table>

Figure 2 Threatened flora species with records within the study area: *Banksia mimica, Thelymitra stellata, Morelotia australiensis,* and *Eleocharis keigheryi.*

Data limitations

Records for 3 out of 4 species are from the WA Herbarium dataset and are more than 40 years old (Table 2) so current status is unknown. There was one recent threatened flora record in the Threatened and Priority Flora dataset: *Morelotia australiensis* was recorded in 2021 with a population of 19 individual plants. Additionally, datasets are provided with the caveat that they do not represent a comprehensive list of threatened or priority flora within the study area. Targeted surveys are required to determine the status of threatened flora within the study area.

2.4 Threatened fauna

Presence and distribution

The **DBCA037 – Threatened and priority fauna** dataset included records of 8 Commonwealth-listed species, including 4 species in the Federal Government's 110 priority species list (DCCEEW, 2022b): Carnaby's Cockatoo (*Zanda latirostris*); chuditch/ Western Quoll (*Dasyurus geoffroii*); numbat (*Myrmecobius fasciatus*); and, quokka (*Setonix brachyurus*).

Four additional Commonwealth species with records in the study area are: Carter's freshwater mussel (*Westralunio carteri*); Baudin's cockatoo (*Zanda baudinii*); forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*); and the common greenshank (*Tringa nebularia*).

Table 3 Summary of threatened and priority fauna with records within the study area. Data are from the "DBCA-037 Threatened and Priority Fauna dataset". Species highlighted in green indicate species in the Commonwealth Government's 100 priority species list.

Common name	Scientific name	EPBC status	Year of record	Total records
Baudin's cockatoo	*Zanda baudinii*	EN	1998 - 2021	148
Carnaby's cockatoo	*Zanda latirostris*	EN	2000 - 2020	72
Carter's freshwater mussel	*Westralunio carteri*	VU	1969 - 2020	58
Chuditch, western quoll	*Dasyurus geoffroii*	VU	2016	1
Common greenshank	*Tringa nebularia*	EN & MI	1991 - 2002	3
Forest red-tailed black cockatoo	*Calyptorhynchus banksii naso*	VU	2005 - 2023	28
Numbat, walpurti	*Myrmecobius fasciatus*	EN	1975	1
Quokka	*Setonix brachyurus*	VU	2009 - 2011	8
White-tailed black cockatoo	*Calyptorhynchus sp. 'white-tailed black cockatoo'*	-	2016 - 2018	8

Conservation status codes are: EN = Endangered species; VU = Vulnerable; MI = Migratory

Key information

Baudin's cockatoo is listed as Endangered and is a large cockatoo that occurs in temperate forest and woodland dominated by jarrah, marri and karri. There were 148 records for the species in the DBCA-037 dataset, however 114 of these were from 2012. The most recent record was from 2021. Records for the species were generally on the Darling scarp and plateau to the east of Albany Highway, with no records on the Swan Coastal Plain.

Carnaby's cockatoo is listed as Endangered and is a large, white-tailed black cockatoo endemic to the south-west of Western Australia (Figure 3).

Figure 3. Carnaby's cockatoo (Photo credit: Caroline Canham)

There were 72 records of Carnaby's Cockatoo in the DBCA-0037 dataset, with the most recent recorded in 2020. The following datasets include information on the locations of resources for Carnaby's Cockatoo within the study area:

- **DBCA-050, DBCA-051, DBCA-052, DBCA-053, DBCA-064** show Carnaby Roost sites (either confirmed, unconfirmed and with various buffers.
- **DBCA-054, DBCA-055** and **DBCA-063** show data on breeding sites for Carnaby's Cockatoo.
- **DBCA-056** and **DBCA-057** show areas that require investigation as feeding habitat.
- **12-0324FA_(BC)** shows the locations of roosting sites as recorded by volunteers and collated by Birdlife WA, with the most recent data from 2019.

A large proportion of the study area (approximately 75%) includes confirmed Carnaby's breeding area, with further unconfirmed areas on the Wungong River and near the Kent Street weir (Figure 4). There are 3 confirmed Carnaby roost sites, 2 on the Canning and 1 on the Wungong, near the dam. It is also likely that vegetation within the study area provides a food source, with patches of unconfirmed feeding areas, particularly on sections of the river on the Swan Coastal Plain.

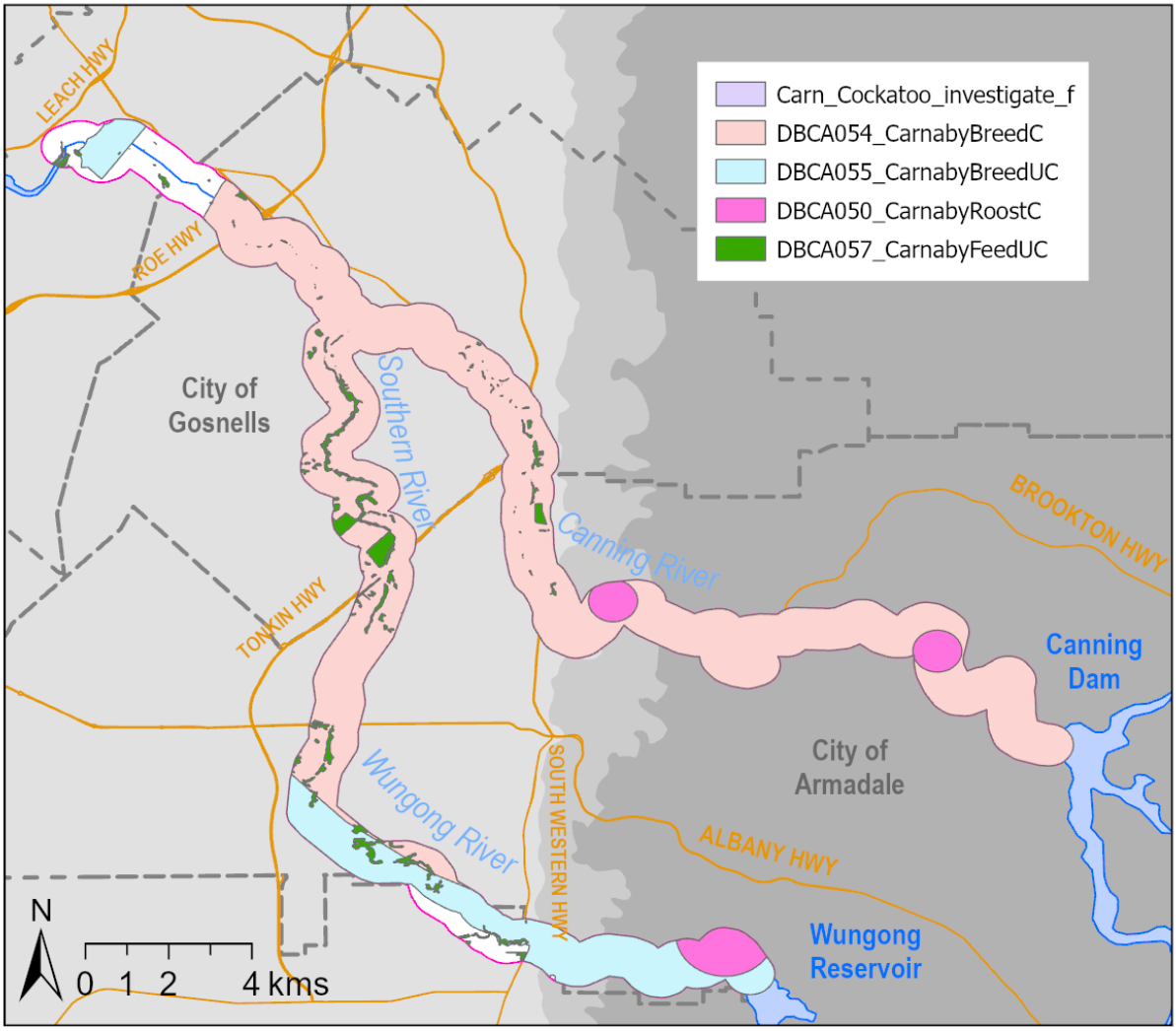


Figure 4 Confirmed and unconfirmed roosting, breeding and feeding locations of Carnaby's cockatoo within the study area.

Carter's freshwater mussel (Figure 5) is listed as Vulnerable at the Commonwealth level. Recent genetic studies identified 3 evolutionary significant units, with populations within the study area likely to belong to *Westralunio carteri* (Klunzinger et al., 2022). Information relating to Carter's mussel has not been updated to reflect this change in taxonomy, thus we report on records of Carter's mussel (*W. carteri*).

Records of Carter's mussel were compiled from the following datasets:

- **DBCA037 – Threatened and priority fauna** (28 records)
- **DBCA Canning Barriers** (10 records)
- **DBCA Canning Pools** (4 records)
- **Fisheries** data extraction (24 records)
- Records in both the Fisheries and DBCA-037 datasets (27 records)
- UWA PhD thesis (J. Middleton, 1 record)
- **DBCA Roley Pools** survey (5 records)

There was a total of 99 records of Carter's mussel within the study area. The earliest record is from 1969, however the majority of observations (n=92) are from the past 25 years, with the most recent records from 2023. The mussel was found to occur along the length of Canning River within the study area. There was also a cluster of observations on the Wungong River approximately 6 km downstream of Wungong Dam.

Figure 5. Carter's Freshwater Mussel. Photo courtesy of DWER

Chuditch (western quoll) is listed as Vulnerable at the Commonwealth-level and are the largest carnivorous marsupial occurring in Western Australia. It is unclear if the species still occurs in the study area, with a single record from 2016 near the Brookton and Albany Highways.

The **common greenshank** was assessed as an Endangered species by the Commonwealth in January 2024. It is also listed as a migratory bird species. The species has a widespread distribution, found in Europe, Africa, Asia, Melanesia, and Australasia. In Australia the species occurs in wetlands in coastal regions. There were 3 records of the species in the study area, with 1 observation 1991 and 2 in 2002.

Forest red-tailed black cockatoo is a subspecies listed as Vulnerable. There was a total of 28 records for the species, occurring across the study area, with the most recent record in 2023. The species is associated with similar habitat as Baudin's cockatoo (Department of Sustainability, 2009), in dense jarrah, marri and karri forest. However, the species has more recently been observed in the Perth metropolitan area on the Swan Coastal Plain (Shephard and Warren, 2019).

Numbat is a small marsupial and is Commonwealth-listed as Endangered. A review of the progress of numbat recovery indicated that they are no longer distributed in the Perth area (Northover et al., 2023). Numbats are considered unlikely to still occur in the study area, with a single record in 1975.

Quokka are a small wallaby listed as Vulnerable at Commonwealth-level. There are 8 records between 2009 and 2011, spread across 2 locations, both on the Darling Scarp. One location is on the Canning and the other on the Wungong River. Quokkas were also recently sighted in the nearby Helena catchment, a tributary to the Swan River (NIT, 2024).

Data limitations

There is limited information on the occurrence and condition for 3 of the 4 Commonwealth's priority species with records in the study area. Chuditch have a single record from 2016 and Quokka have 8 records between 2009 and 2011. It is unclear if these species still occur in the study area, and it is considered unlikely that numbat still occur in the area.

More information is available for the habitat requirements of Carnaby's cockatoo, specifically roosting, breeding and feeding areas (Figure 4). These datasets were last updated in 2018, and the methods document was completed in 2011. It is likely that the information in this dataset was collected between 2011 and 2018. It is unclear if data are regularly updated to reflect the current status of resources for Carnaby's cockatoo.

There was generally limited information available on the presence and distribution of threatened fauna species within the study area. In the absence of targeted surveys, it is difficult to determine if the low number of observations reflects scarcity, or if it is due to low sampling effort and/or lack of a coordinated collection of records. For example, there were 58 records for Carter's mussel in the DBCA-037 Threatened and Priority Species dataset. An additional 41 observations were sourced from datasets provided by DPIRD, DWER, UWA researchers and DBCA Science.

2.5 State-listed priority species

Within the study area there are Threatened and Specially Protected flora and fauna species listed at a State-level, under the Western Australian *Biodiversity and Conservation Act 2016*. Although not considered matters of national environmental significance, they have been identified as key species and a priority for management. We provide a list of flora and fauna species identified within the study area.

There are 13 Priority flora species with records within the study area (Table 4), comprised of 3 Priority 1, two Priority 2, four Priority 3 and four Priority 4 species.

There are few records, with the majority of flora species (10 out of 13) having only one record within the study area. Records are also old, with 10 out of 13 species recorded more than 30 years ago. Surveys are required to determine the current status of priority flora species within the study area.

Table 4. Summary of WA-listed Priority species (listed under the WA *Biodiversity Conservation Act 2016*) with records within the study area showing species.

Species	Database	Conservation code	Year of records	Total no. records
Acacia benthamii	TPFL	Priority 2	2004	1
Acacia lasiocarpa var. bracteolata	TPFL & WAHERB	Priority 1	1980	1
Acacia oncinophylla subsp. patulifolia	WAHERB	Priority 4	1979 to 1992	6
Andersonia sp. Blepharifolia (F. & J.	WAHERB	Priority 2	1978	1
Banksia kippistiana var. paenepeccata	WAHERB	Priority 3	1901	1
Beaufortia purpurea	WAHERB	Priority 3	1992	1
Bolboschoenus fluviatilis	WAHERB	Priority 1	2004	1
Carex tereticaulis	TPFL & WAHERB	Priority 3	2004	1
Drosera occidentalis	WAHERB	Priority 4	1994	1
Drosera oreopodion	WAHERB	Priority 1	1983 to 1991	3
Lasiopetalum bracteatum	WAHERB	Priority 4	1988 to 2005	2
Lasiopetalum glutinosum subsp.	WAHERB	Priority 3	2002	1
Verticordia lindleyi subsp. lindleyi	WAHERB	Priority 4	1969	1

Key; TPFL = Threatened and Priority Flora; WAHERB = Western Australian Herbarium; Priority 1 = poorly known species found on unmanaged land; Priority 2 = poorly known species found in conservation areas; Priority 3 = poorly known species not necessarily under imminent threat; Priority 4 = rare, near threatened and other species in need of monitoring; Threatened = a taxon that retains its 'threatened' status until a new name has been officially endorsed (https://florabase.dbca.wa.gov.au/).

2.6 Knowledge gaps and recommendations for MNES

- Reliable mapping of TECs from on-ground verification.
- Surveys are required to determine the condition of TECs.
- Determine current presence of Commonwealth-listed flora and fauna.
- Maintain monitoring of black cockatoo (Carnaby's, Baudin's and Forest Red-tailed) occurrence and their required resources.
- Improve the addition of records to the Threatened and Priority Flora and Fauna datasets.
- It is known that Carter's mussel occurs in the study area, but data are limited. Systematic surveys could map the current distribution and, if appropriate covariates are collected, could lead to a better, more quantified understanding of the species' requirements.

3 Instream values

3.1 Data sources

A total of 4 datasets relating to instream ecological values were identified and all were included in our assessment (Appendix Table A3). The Canning Pools and Canning Barriers datasets are restricted to the Canning main stem thus no information is available for the Southern-Wungong River. However, they were included in the assessment in the absence of other data, and because they contain valuable information across a large number of sites.

3.2 Summary of condition

Healthy rivers typically have a natural flow regime, diverse physical habitats, native biotic assemblages, considerable bankside vegetation that shades and cools the water and provides trophic inputs (e.g. leaves). Information relating to the condition of instream ecological values was assessed under the following categories:

- Habitat, which includes pool attributes and bankside riparian vegetation
- Native biota

Below, we assess each of these, with consideration to the relevant datasets available (including identifying relevant attributes), key information in the datasets, and data limitations.

Habitat

Relevant datasets

The **Canning Pools** dataset is most relevant. This provides polygon data of river pools along the main stem of the Canning River. Data were collected in field surveys between 2013 and 2016 by DBCA staff. Key attributes pertinent to instream habitat diversity are pool size (length, width, distance), pool depth, instream habitat (leaf debris, rocks, branches), the stream cover of bankside vegetation (north facing). Different sites were sampled at different times of the year.

The **Wungong Riparian Vegetation** dataset is also relevant. The dataset is point data based on field surveys of vegetation condition. Data were collected in 2021. The key attribute is the condition of bankside native vegetation.

Key information

A rapid assessment of instream habitat condition across the study area is hindered by the lack of a summary habitat metric in the datasets assessed, and by the general lack of instream data for the Southern-Wungong River. That said, a visual inspection of habitat attributes indicate that considerable variation exists across the Canning main stem and that spatial patterns exist. For instance, pool depth varies from above 4 m in depth to less than 0.6 m along the Canning River (although it should be noted that sites were sampled at different times of the year which impacts pool size and depth) and pools are generally deepest in the lower reaches of the river (Figure 6). Pools are particularly shallow downstream of Araluen and where the Canning and Southern River join, potentially reflecting high sediment inputs in these locales. North facing stream cover which has

a good potential to shade the water, was greatest in the upper reaches of the river, particularly above Araluen, and towards the bottom of the study area (i.e., downstream of the confluence with the Southern River). In a mismatch to stream cover, branches and leaves were most abundant in mid-section of the study area, around the Tonkin Highway (Figure 7). However, it is important to highlight that some habitat data appears unreliable, for instance branches are recorded as absent from a large section in the upper reaches of the river (Figure 7) which seems unlikely. It should also be noted that where stream cover is greatest, the shading impacts visibility of the riverbed and therefore affects quantification of in-stream habitats. The divergent spatial patterns in habitat among attributes preclude a simple spatial summary of condition for this instream value. Assessing the condition of instream habitat needs to consider the position of a site along the river continuum.

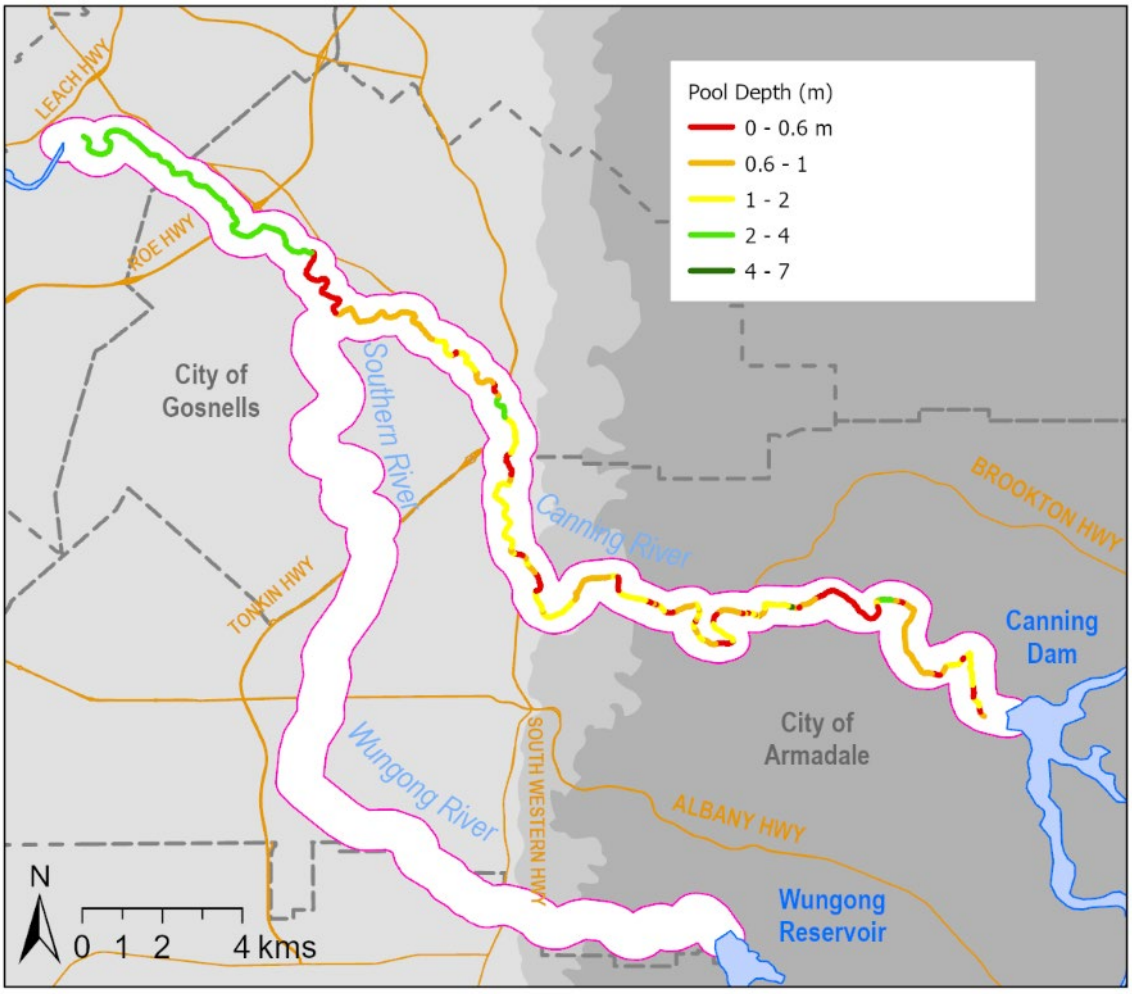


Figure 6 Depth of pools mapped along the Canning River. Data shown are from the Canning Pools dataset.

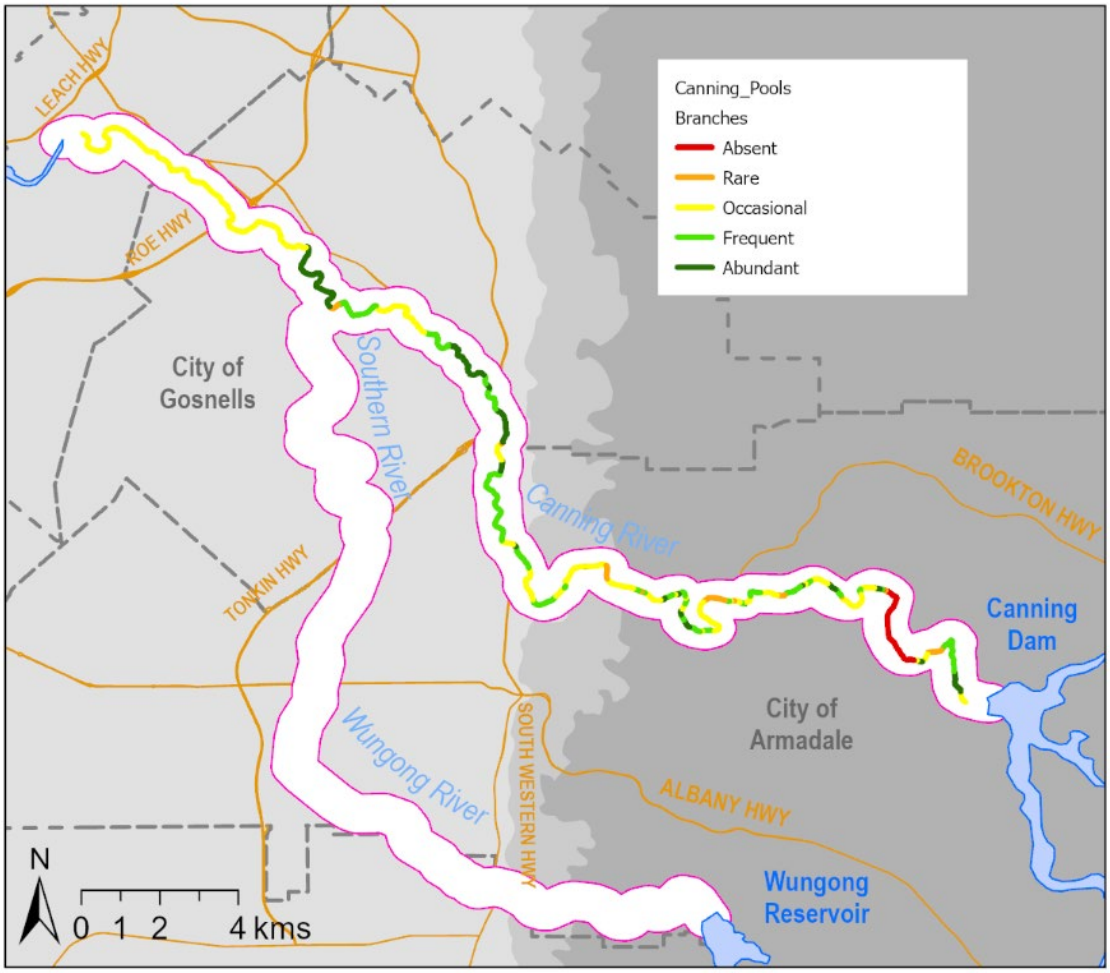


Figure 7 The cover of branches instream for the Canning River. Data shown are from the Canning Pools dataset.

Native biota

Relevant datasets

The **Fisheries data extraction** is the most relevant dataset. This dataset is a compilation of datasets from: data returns associated with Fisheries (DPIRD) licenses; surveys by the DWER Healthy River Program; and data from Leah Beesley (UWA). The data show locations of fish and crayfish species, with information for other incidental species. Observations are point data, with records from 144 sites across the study area, collected between 2000 and 2022. The key attribute is the record of species presence.

The **Canning Barriers** dataset is of relatively minor importance, but it does include notes about the presence of fish species observed above and below barriers. This dataset was compiled from surveys of instream structures within the Canning River upstream of the Kent Street weir. Data were collected in field surveys between 2012 and 2016.

The **Canning Pools** dataset also includes qualitative records (i.e. a comment that a species is present) of fauna and vegetation observed. The majority of this information is for fauna (e.g. fish, crayfish,

waterbirds, frogs, water rats) but there is also some information about instream flora (e.g. *Potamogeton*, *Valisneria*).

Key information

Fish - our desktop assessment indicates that 8 native species of fish occur in the study area: Western pygmy perch (*Nannoperca vittata*); Western minnow (*Galaxias occidentalis*); Freshwater Cobbler (*Tandanus bostocki*); Nightfish (*Bostockia porosa*); Swan River goby (*Pseudogobius olorum*); Southwestern goby (*Afurcagobius suppositus*); Western hardyhead (*Leptatherina wallacei*); Southern black bream (*Acanthopagrus butcheri*); and mullet (*Mugil cephalus*). There is considerably better spatial resolution of fish data for the Canning River compared to the Southern-Wungong (Figure 8), and fish species richness increased downstream in the study area. This longitudinal increase is common in rivers, and in the study system reflects the addition of gobies, hardyhead and black bream. While it is tempting to draw the conclusion that the condition of the fish assemblage is higher low in the study area (due to greater species richness) data from targeted research suggest that the abundance of native species with widespread distributions are greater in the upper reaches (Ryan et al., 2017).

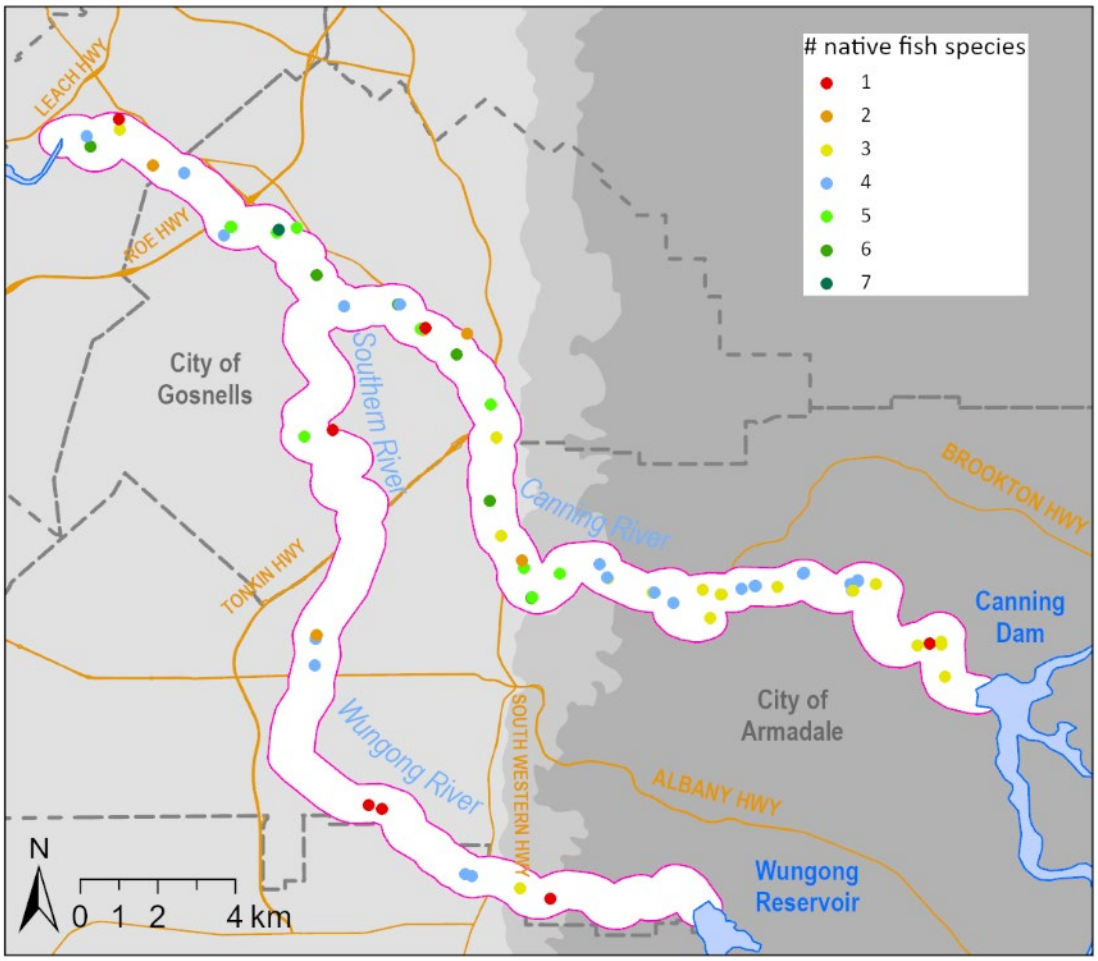


Figure 8 The number of fish species recorded at sites along the Canning and Southern/Wungong Rivers. Data are a compilation of records from DPIRD and recent DWER and UWA surveys. Observational data from the Pools and Barriers data sets are not included.

Crayfish - our desktop assessment indicates that 3 native species of freshwater crayfish inhabit the study area: smooth marron (*Cherax cainii*); gilgie (*Cherax quinquecarinatus*); and, koonac (*Cherax preissii*). Like fish, considerably better spatial resolution exists for the Canning River compared to the Southern-Wungong (Figure 8). Koonacs prefer seasonally inundated wetlands or headwater streams and have only been identified in the lower Wungong River, just downstream of where Armadale Road crosses the river. Marron and gilgies were present along the river, with gilgies tending to dominate downstream of the Canning-Southern River confluence. The condition of crayfish appears relatively uniform across the study area, except for an important hotspot for koonacs in the lower Wungong (Figure 9).

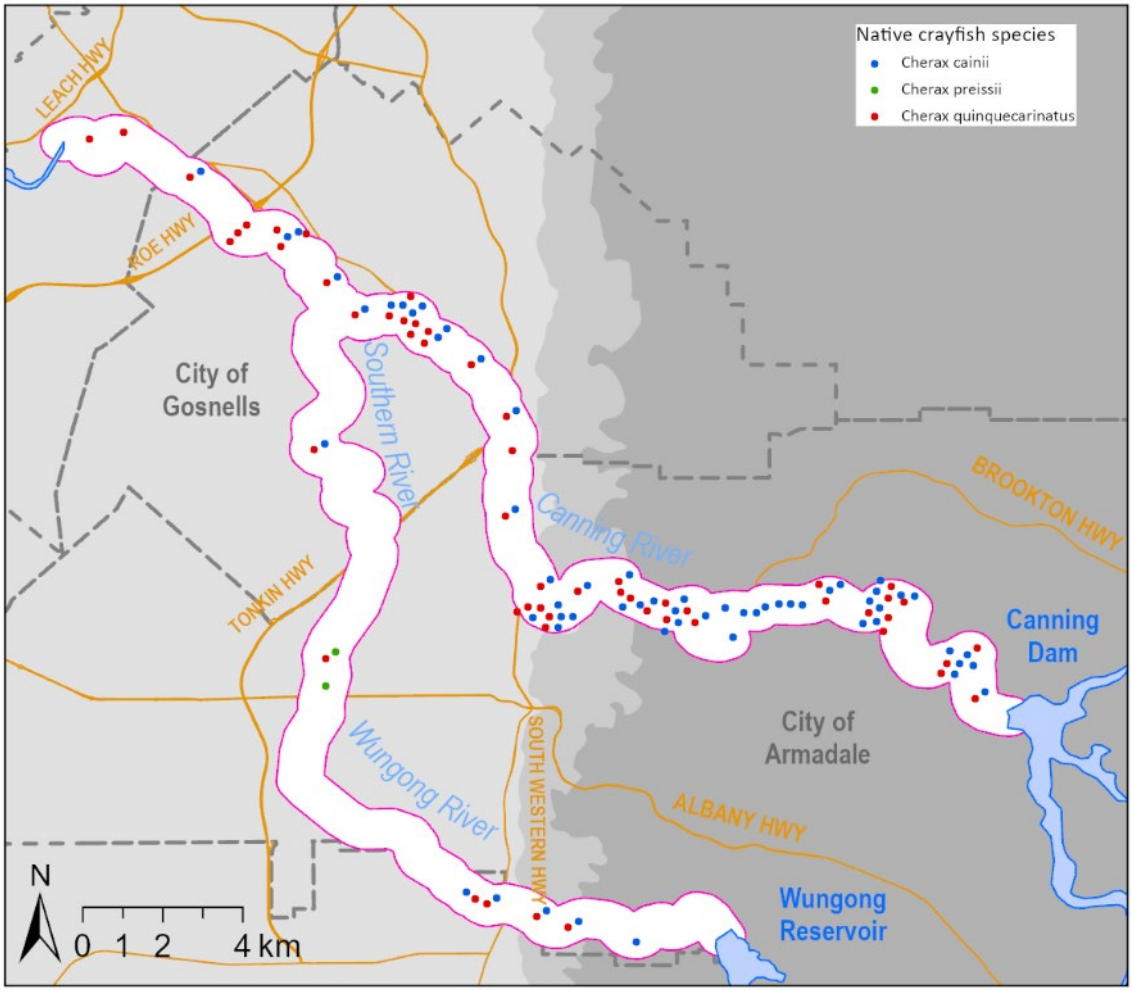


Figure 9 Observations of the three native crayfish in the study area. Observations are jittered by 50 m to allow multiple species caught at the same site to be visible.

Data limitations

There are limited data available to assess the condition of instream values. There is a relative lack of data for the Southern-Wungong River, particularly habitat data. While much of the data are relatively recent, i.e. collected in the last 10 years, the region's severe reduction in rainfall and streamflow may mean that some habitat attributes such as pool depth may now be inaccurate. Information is particularly limited for species other than fish or crayfish, e.g. rakali, turtles, frogs and macroinvertebrates (see Section 2.4 for information about Carter's mussel), and virtually no data are available for native macrophytes.

From a data quality and resolution perspective habitat data are predominantly categorical which reduces data resolution. Biotic data are predominantly 'presence only', but the non-detection of a species at a location does not necessarily indicate that it is absent. This is particularly the case for biotic groups/species observed incidentally or as bycatch (e.g. rakali, frogs, turtles) and for species that are difficult to observe/catch (e.g. fish). Further, the general reliance on 'presence data' means no information is available on abundance, size, age or individual condition which means no insight can be gained into population trajectories or the important ecological processes that sustain populations such as recruitment and survivorship.

3.3 Knowledge gaps / future research

- Surveys on the Southern-Wungong River to provide coverage across the study area. It is recommended that consideration be given to whether similar methodologies used elsewhere (e.g. following the methods in the Canning Pools dataset) are adopted or if methods are updated.
- Data gaps exist for macroinvertebrates, aquatic macrophytes, amphibians, turtles and waterbirds. Surveys are required to determine the current distribution of these biota within the study area.
- Determine meaningful metrics from currently available data, e.g. habitat attributes such as branches, leaves, rocks could be combined into a habitat diversity metric. Summary metrics should be derived so they are meaningful to the position of a site along the river continuum.
- Critically appraise if the habitat attributes currently available in the existing datasets (predominantly the Canning Pools dataset) are relevant to the habitat requirements of fish and crayfish – a critical need is to firstly determine the habitat needs of valued biota in the study area.

4 Riparian values

4.1 Data sources

A total of 24 datasets relating to riparian values were identified, with 1 sourced from Shared Location Information Platform (SLIP) (WA Data Portal), 7 from DBCA Swan Canning Waterways Branch and DBCA Rivers and Estuaries Science Branch, 5 from Perth NRM, and 1 from DWER (Appendix Table A4). However, 16 out of 24 datasets were not considered for further assessment, with many datasets (13) not containing original data (Appendix Table A4). Such datasets often contained useful information, but were a derivation of older datasets, and therefore not considered a representation of the current condition of values in the study area. However, some of these datasets may contain useful attributes for other analyses, such as spatial prioritisation.

Eight datasets were included in our assessment of the current condition of riparian values within the study area (Appendix Table A4).

4.2 Summary of condition

Information relating to the condition of ecological values of the riparian area was assessed under the following categories:

- Vegetation extent and ecological linkages
- Vegetation and riparian condition

Below, we assess each of these, with consideration to the relevant datasets available (including identifying relevant attributes), key information in the datasets, and the reliability of the data.

Vegetation extent and ecological linkages

Mapping and assessing the extent of vegetation is a key part of assessing ecological condition, and is particularly important in cleared, urban landscapes where remnant vegetation is highly fragmented.

Relevant datasets

The **DPIRD-005 Native vegetation extent** dataset shows polygons of native vegetation mapped from orthophotos and satellite imagery acquired between 1996 and 2020. The key attribute relevant to condition is the mapping of extent, which is recorded as polygons. The dataset includes the area for each polygon and comments indicating if the vegetation is native or regrowth.

The **DWER-020 FPM floodplain area** dataset shows the extent of the floodplain within the study area, based on hydrological modelling. The data were most recently updated in 2022. Data are in polygons and the extent type varies from 1 in 10 to 1 in 100 annual exceedance probabilities. The key attribute is the extent of the floodplain.

The **Perth Regional Ecological Linkages** dataset represents links between patches of remnant vegetation judged to be of regional significance in the Perth metropolitan area and mapping was done in 2004. The key attribute is the mapping of linkages, which are polygons with a 500 m buffer.

The **Naturelink Connectivity** dataset shows 'nature-friendly' pathways joining protected natural areas that provide the least risk to species moving across the urban landscape. The dataset was developed in 2020 by Murdoch University and used a 'least cost paths' method to map opportunities for species to move between core vegetation areas. The key attribute is the mapping of the linkages as polylines, with additional information on the type of linkage, the distance to the core habitat and the length of the linkage also available.

Key information

Mapping of native vegetation extent shows that on the Swan Coastal Plain areas of vegetation have been drastically reduced. Along much of the river native vegetation is limited to very narrow strips, or almost no vegetation at all (Figure 10). In addition, the DWER-020 FPM floodplain area dataset indicates the area that would be inundated in flood events, and it likely these areas would be riparian or flood adapted species. This is particularly evident along sections of the Wungong River, where there are floodplain areas that have been mapped, but minimal vegetation (Figure 10).

There are some sections of the river on the SCP with larger areas of vegetation cover, for example the Canning River Regional Park near Kent Street Weir and sections on the Southern River to the north of where Tonkin Highway crosses the river. There is a greater extent of native vegetation on the Darling Scarp and Plateau on the sections closer to Canning and Wungong Dams (Figure 10).

Mapping of ecological linkages shows that the riparian corridor provides connectivity along the river (Figure 11). The Perth regional ecological linkages dataset shows the river and its immediate surroundings as ecological linkages across most of the study area, with the only gap occurring in the approximate area between Brookton Highway and Soldiers Road (Figure 11). The Naturelink dataset shows a similar distribution of linkages along the river, although there are fewer identified than in the Perth regional ecological linkages dataset. This is particularly apparent on the Canning River upstream of Tonkin Highway (Figure 11), where there was only a small section of the study area identified as a linkage using the "least cost path" method of the Naturelink dataset. This may be due to there being greater vegetation cover outside of the river corridor in the upper parts of the study area.

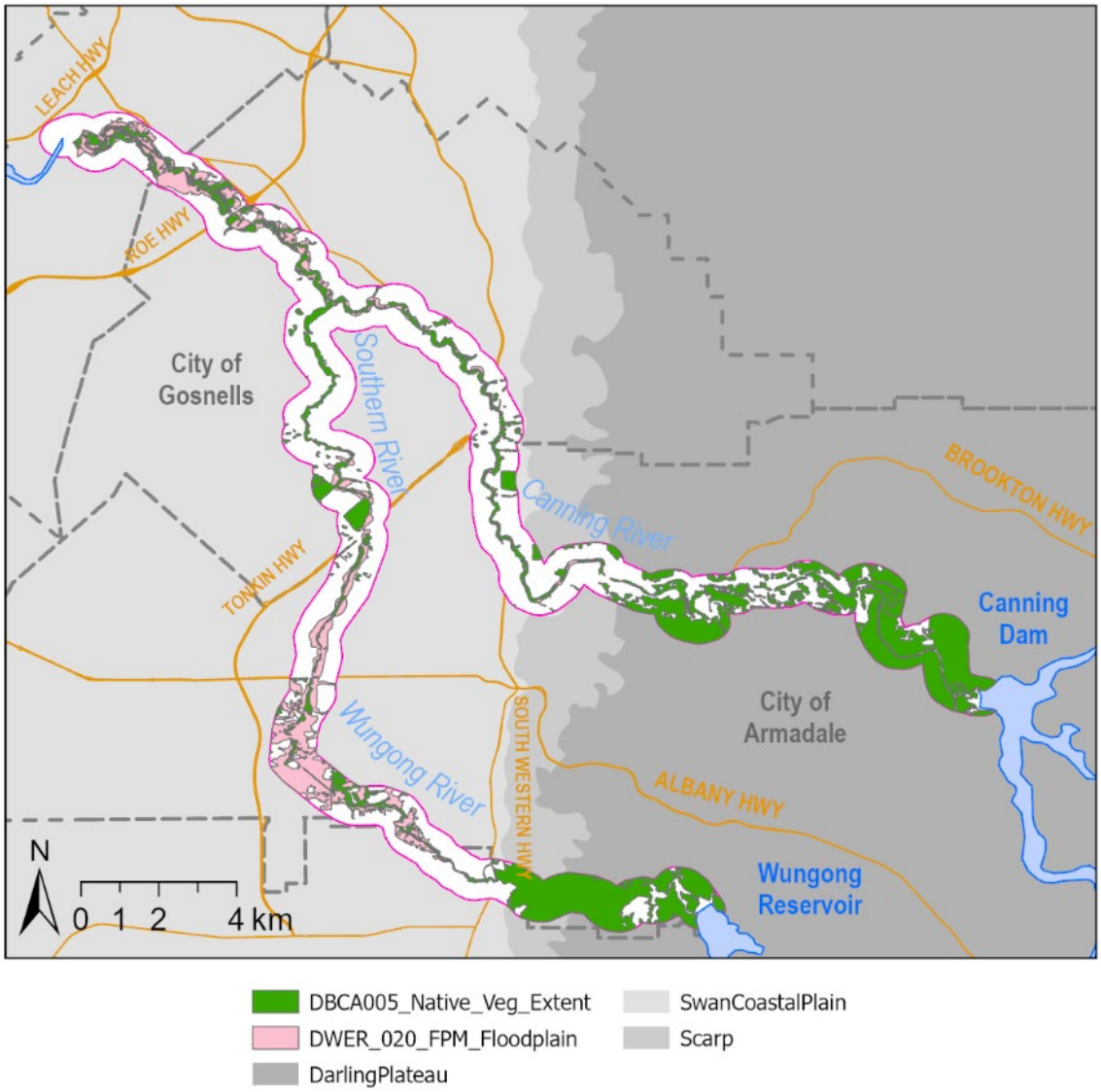


Figure 10 The extent of native vegetation from the DPIRD-005 native vegetation extent dataset. Also shown is the modelled extent of the floodplain from the DWER-020 FPM floodplain area dataset.

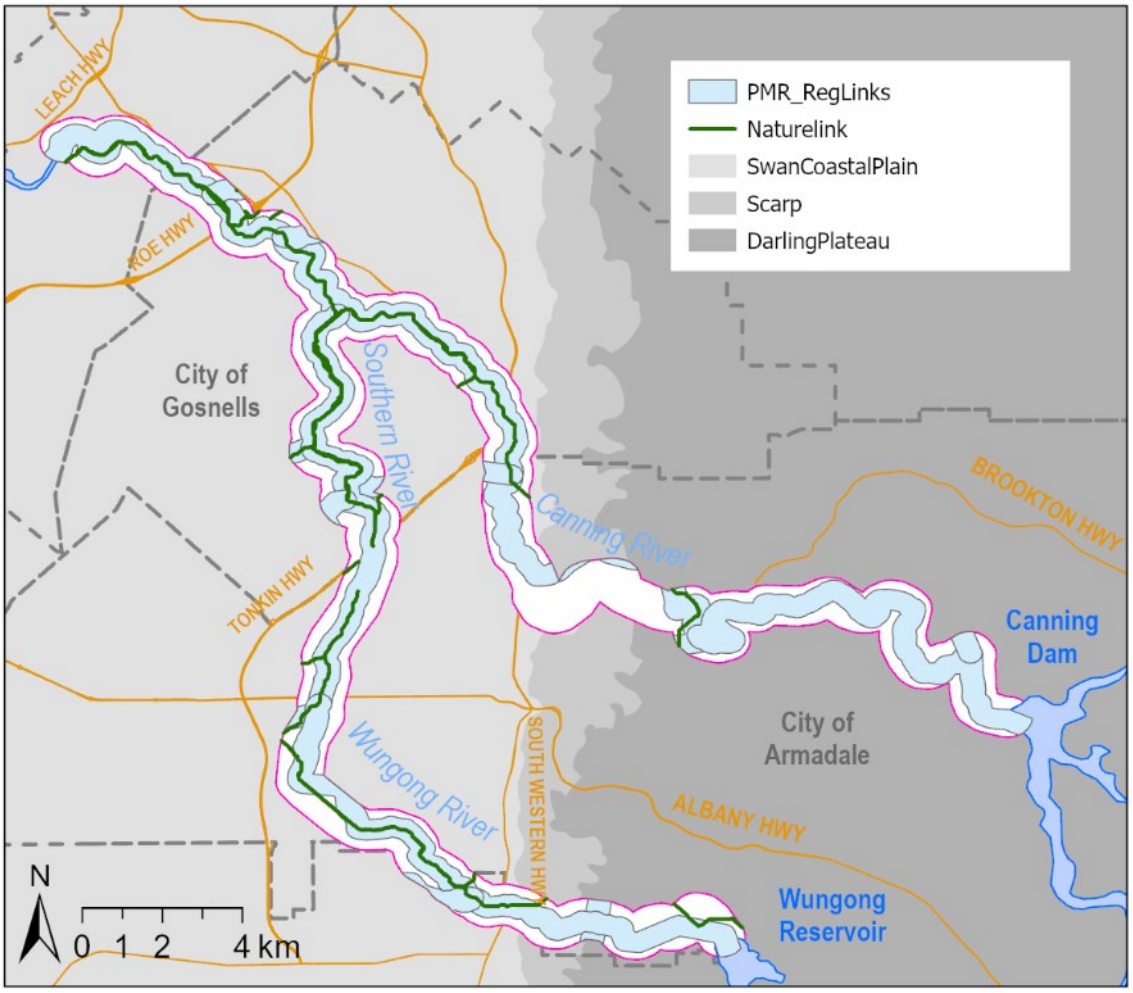


Figure 11 Distribution of ecological linkages as shown in the Perth regional ecological linkages (PMR_Reglinks) and Naturelink connectivity datasets.

Data limitations

The native vegetation extent dataset may be considered reasonably current, last updated in 2020. However, it is unclear when the dataset is due to be updated. At the scale of the study area the resolution of the vegetation extent is sufficient to identify the size, shape and distribution of native vegetation, however more detailed mapping may be required for finer-scale assessments of condition and prioritisation.

The Perth regional ecological linkages dataset is almost 20 years old and may no longer represent the current condition of ecological linkages. However, the Naturelink dataset is relatively current, developed in 2020. There were similarities in the linkages shown in the 2 datasets, despite the difference in age of data and methods to determine the linkage.

Riparian condition

Relevant datasets

There are 4 datasets with information to assess the riparian condition within the study area.

The **Swan and Canning Rivers Foreshore Assessment** dataset (hereafter referred to as FAMS) is a detailed quantification of riparian vegetation condition along the Canning River within the study area. The dataset was derived from field surveys conducted in 2005/2006 and information was assigned to polygons of variables sizes along the river. The dataset includes a total of 187 attributes. Key attributes for interpreting condition include structural layers, dominant and co-dominant species, regeneration, density and weed cover.

The **Wungong Riparian Vegetation** dataset is based on field surveys of vegetation condition, although it uses different methods and scoring to the FAMS dataset. Data were collected in 2021. Key attributes include descriptions of dominant native and weed species, and scores for vegetation loss, vegetation condition and weed cover.

The **DPLH-096 Urban Forest Mesh Blocks** dataset provides data on cover and structure of vegetation based on an analysis of aerial photography. Values are assigned to polygons based on land parcels ('mesh blocks'), which are variable sizes. The dataset was most recently updated using images collected in 2020. Key attributes are the percentage cover of trees by stratum (e.g. 3 to 8 m through to greater than 15 m) and the total percentage of tree cover.

The **Canning Pools** dataset is derived from field surveys conducted between 2013 and 2016 along the Canning River sections of the study area, with no data collected on the Southern and Wungong Rivers. The primary aim of the surveys was to map the locations of pools and determine their depth and the degree of sedimentation, however there was also a qualitative assessment (categories based on a visual assessment) of riparian vegetation. Key attributes are an assessment of over-, mid-, and understorey and cover of native and exotic species, and qualitative descriptions of vegetation (e.g. records of 'blackberry', 'watsonia').

Key information

The datasets assessed show that riparian vegetation in most of the study area is in poor condition. The recent assessment of condition along the Southern and Wungong Rivers scored most sites surveyed as 'poor', although sections of the Wungong within 4 km of the Reservoir were in 'average', and occasionally 'good', condition (Figure 12). The "FAMS" dataset did not provide a summary score of condition, so we use the proportion of native plant species as an indicator of site condition, as it relates to the integrity of vegetation and the pressures it is exposed to at the site. In the area of the Canning River Regional Park (near Kent Street Weir) the proportion of native vegetation was highly variable. There are small polygons showing more than 70% native species, particularly closer to the river. However, there are also larger polygons indicating native species cover of between 0 and 36%. Further upstream on the Canning River (south of where Tonkin Highway crosses) there are more stretches with a greater proportion of native vegetation (50 to 70%). However, the extent of vegetation in this region is very narrow (Figure 12).

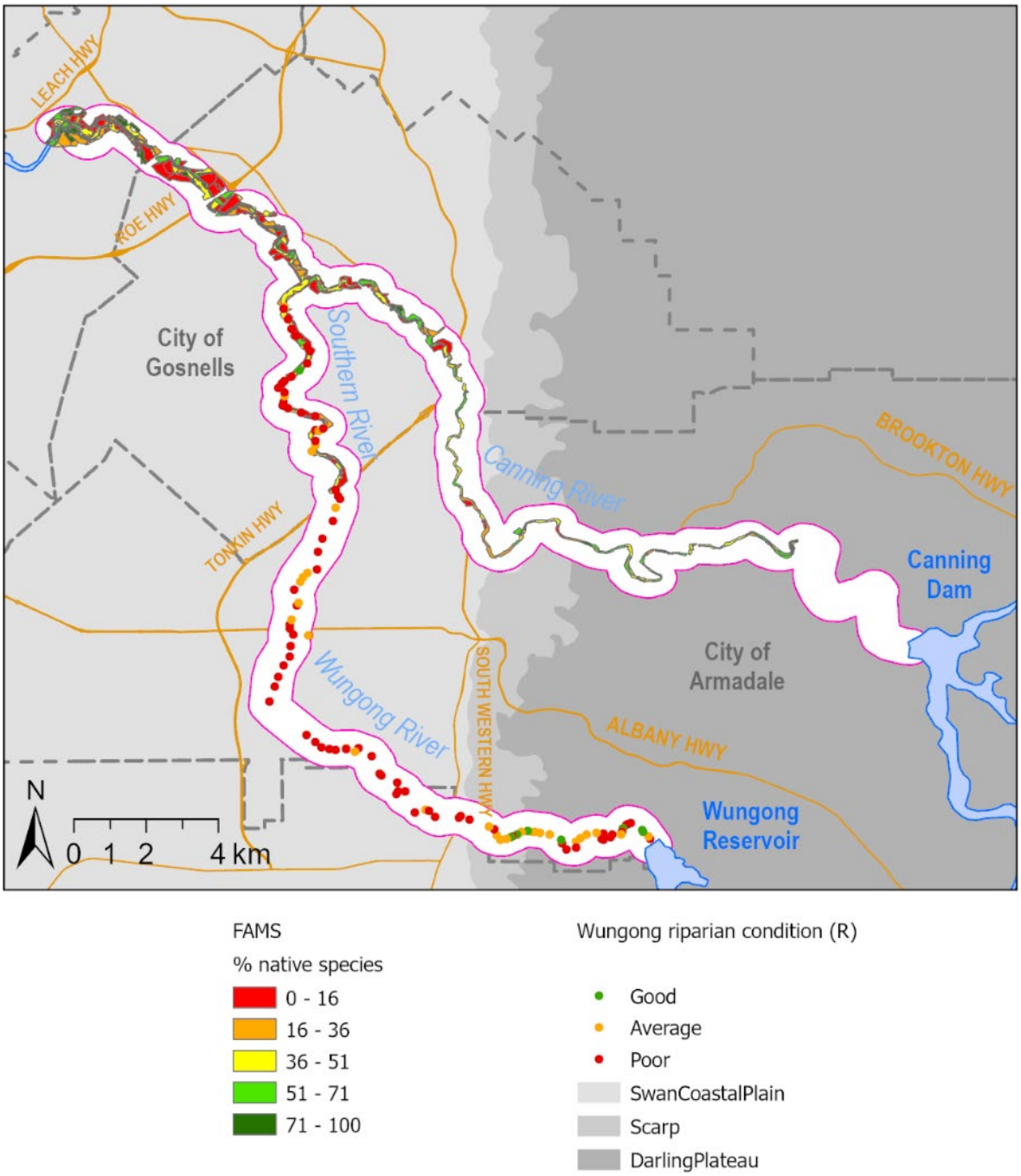


Figure 12 Mapping of the condition of riparian vegetation within the study area. The FAMS dataset covers most of the Canning and part of the Southern River, and the attribute shown is native species as a proportion of total species. The Wungong Riparian Condition dataset shows an estimate of condition as good, average or poor and data are shown for the right bank.

Canopy cover is a key component of vegetation condition, as well as providing important ecological functions including habitat and food resources for fauna. The DPLH-096 Urban Forest Mesh Block dataset indicates that tree cover (assessed as tree cover > 3 m tall) is in the 0 to 20% range for the majority of the study area (Figure 13). The Southern-Wungong River generally has a tree cover of less than 40%, although there is a section in the 60 to 80% tree cover category near the confluence with the Canning (Figure 13). Tree cover is also low along the Canning River, generally less than 40%

although the sections on the Darling Scarp have greater cover, including areas in the 60 to 80% category. The Canning Pools dataset showed a similar pattern with patchy overstorey along most of the Canning, with some section of continous cover (generally to the south east of the intersection with Tonkin Highway; Figure 13).

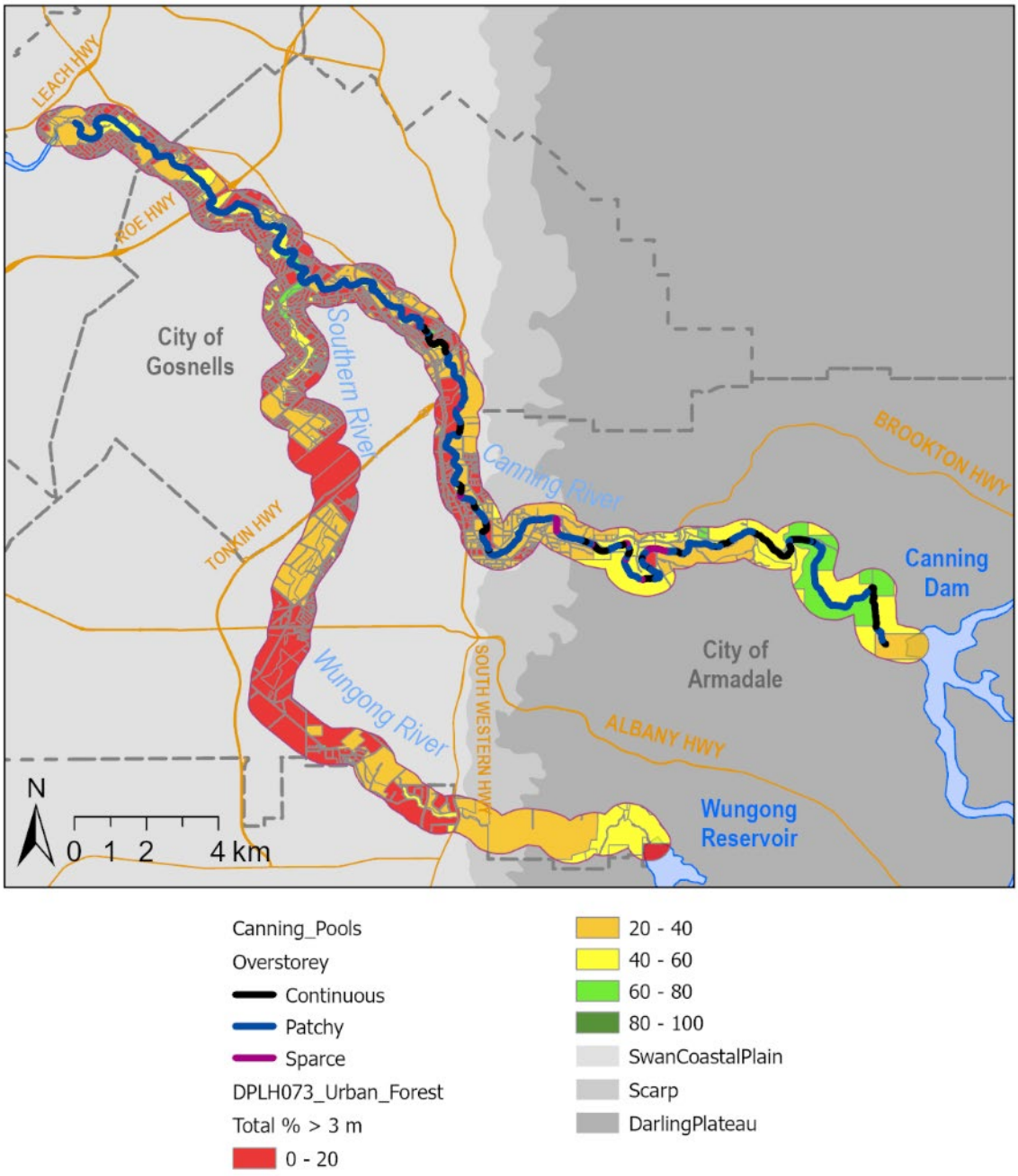


Figure 13 Mapping of canopy cover within the study area. Data shown are the percent cover of trees greater than 3 m tall from the DPLH096 Urban Forest Mesh Blocks 2020. Percent cover refers to the area within a polygon derived from the Urban Mesh Block dataset. Also shown are score categories for the overstorey, and attribute in the Canning Pools dataset.

Data limitations

There has not been any assessment of riparian condition across the entire study area using consistent methods at the same time period. The Wungong Riparian vegetation dataset is recent and is appropriate for the assessment of current condition; however, the survey area did not include the Canning River. It also used a more simplified method of assessment of condition and gave a score for the left and right bank at each site. This differs to the FAMS dataset which covers the Canning River sections not included in the recent condition assessment. The 2 datasets are difficult to merge to provide an overview of vegetation condition due to the different methods. The FAMS data was collected in 2005/2006 and is therefore approximately 18 years old, and it is not known if this provides an accurate representation of current condition.

It should be noted that the condition of vegetation in the Wungong dataset was recorded for the left and the right bank. Generally, data were consistent between the banks, and we have shown data from the right bank for this broader assessment. However, more detailed analysis could assess both banks at sites of interest.

The Urban Forest dataset is a useful resource for investigating canopy cover and vegetation structure and is regularly updated. However, care must be taken when interpreting data because the data are derived from values assigned to land parcels, which may not correspond well with vegetation extent. For instance, land parcels may include large areas of grass and building or roads. Canopy cover (as a proportion) based on the polygons of vegetation extent could provide a more accurate indication of condition within vegetated areas.

The Canning pools dataset is relatively recent and may therefore be considered a good indication of current condition, although it is spatially limited to the Canning River. The information collected is qualitative and categorical (4 rank scores) but is likely sufficient for assessing condition at a broad scale. As canopy cover was assessed while walking along the river, often in the water, this dataset likely provides a good indication of canopy cover for streamside vegetation.

The collection of information on riparian condition has previously been limited in some sections by limitations due to land tenure, with large sections of the river on inaccessible private land. To fill these data gaps, access would need to be arranged.

4.3 Knowledge gaps

- Surveys of the condition of vegetation across the study area using consistent methods.

5 Threats to ecological values

To identify threats to ecological values we reviewed the key threats listed in the Conservation Advice, Recovery Plan or listing documentation for each MNES. For each MNES, as well as broad instream and riparian ecological condition, we identified the corresponding threats, presented as a matrix (Table A5). The phrasing used for threats differed between documents, however there were general categories. In the first instance, we assigned threats to key threatening processes, as listed by the Commonwealth Government. Under the *EPBC Act 1999* key threatening processes have been identified to assist with the management of biodiversity (primarily MNES) (DCCEEW, 2024a). In addition to Commonwealth-listed threatening processes, an additional 12 threats were identified from MNES documents.

Threatening processes

Commonwealth listed

- Competition and land degradation by rabbits
- Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)
- Fire regimes that cause declines in biodiversity
- Land clearance
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants
- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases
- Novel biota and their impact on biodiversity (for example feral bees, myrtle rust)
- Predation by European red fox
- Predation by feral cats
- Predation, habitat degradation, competition and disease transmission by feral pigs

Additional threats identified in MNES documents

- Hydrological change, including declining water table and change in surface water flows
- Salinisation
- Anthropogenic degradation, including pressures in urban environments, road and rail construction and maintenance, illegal flower and seed collecting
- Grazing and trampling including cattle and overgrazing by kangaroos
- Loss of keystone species that support many other species, and loss of host species
- Weed invasion
- Competition for resources from other fauna, for example for nest hollows
- Illegal killing including orchardists shooting cockatoos, and poachers
- Pathogens, other than Phytophthora
- Borers, including the bullseye borer (*Phoracantha acanthocera*). Note that the polyphagous shot-hole borer (*Euwallacea fornicates*) is a recently introduced pest in the Perth area. It is not currently included in recovery documentation, but it is a threat for many native species.
- Pollution, including increased nutrients, heavy metals, herbicides, pesticides, industrial waste, sediments
- Aquatic habitat loss including changes to channel formation

We ranked each threatening processes according to the number of ecological values (MNES and instream and riparian values) that they correspond with, according to their documented Conservation Advices or Recovery Plans. The threats are presented by ranking in Table A6, which also summarises datasets available (or absence of data) for each threat.

Below, we present each threatening process ranked highest to lowest, summarising relevant datasets where available and key information.

Land clearance

Relevant datasets

The **2020 Vegetation retention status for Beard Associations by IBRA regions** is a relevant dataset for showing vegetation within the study area, as well as the percentage of that vegetation association that remains across the bioregion. The dataset combines the DPIRD-006 Pre-European Vegetation Mapping and DPIRD-005 Native Vegetation Extent and IBRA mapping. The key attribute is the percentage remaining Beard vegetation association by IBRA.

The **DPLH-084/85 Perth and Peel Urban Land Development Outlook-Residential/Industrial** datasets show areas of planned for either residential or industrial development over the short, medium and longer terms. The key attribute is the location of planned development areas.

Key information

Land clearance is a Commonwealth-listed threatening process and was the dominant threat to ecological values within the study area, identified for 14 out of 15 MNES in the study area, as well as instream and riparian condition more broadly (Table A6).

The study area includes parts of the Swan Coastal Plain, the most populated and one of the most cleared parts of Western Australia. The 2020 Vegetation retention status for Beard Associations by IBRA regions dataset shows that within the study area, the remnant vegetation on the Swan Coastal Plain has been heavily cleared. Within the Swan Coastal Plain IBRA the Beard vegetation communities have been cleared by more than 75% and any remaining vegetation is part of the cumulative 25% remaining. The DPLH-084 Urban land development outlook – Residential dataset shows future threats to the remaining vegetation on the Swan Coastal Plain within the study area. Large sections on the Southern River near Tonkin Highway are designated for residential development in the longer term (>10 years, noting that the dataset is from 2020/21).

The vegetation on the Darling Scarp is more intact, with large, vegetated areas close to Canning and Wungong Dams. This vegetation community is also well represented within the Jarrah Forest IBRA.

Data limitations

Data appear current and at an appropriate spatial extent and resolution. Ground-truthing could confirm the presence and extent of native vegetation.

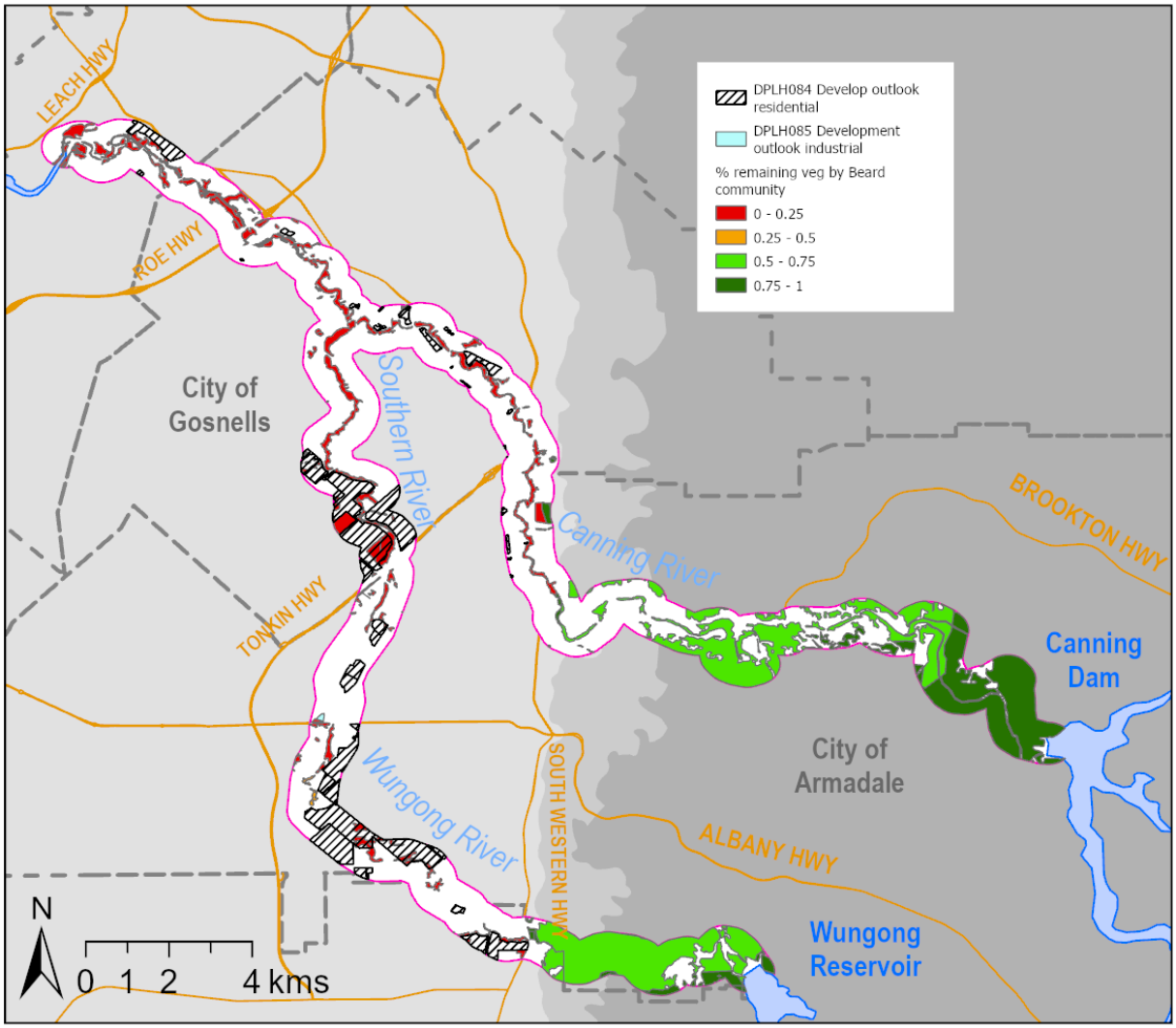


Figure 14 Data relating to the threat of land clearance, showing the percent of remaining vegetation by Beard community (from the dataset 2020 Vegetation retention status for Beard Associations by IBRA regions) and areas of planned development within the study area (from the datasets DPLH-0084 and 0085 development outlook).

Changed fire regime

Relevant datasets

The **DBCA-060 Fire History** dataset is a collection of records of fire events (prescribed burns and wildfires). Records in the study area range from 1937 to July 2023. Key attributes are the location and date of fire, and we have added the additional attribute of time since fire.

The **DBCA-072 to 076** datasets show the length of time after fire required for obligate seeding plant species to become reproductively mature under different climate scenarios. The data helps quantify the risk of population decline of obligate seeding plants with changed fire intervals.

Key information

Changes to fire regimes is a Commonwealth-listed threatening process and was identified as a threat for 9 out of 15 MNES within the study area. The regularity, severity and seasonal timing of fires impacts both flora and fauna. Within the study area the majority of fires over the past 25 years were wildfires (Figure 15). The largest areas burnt were in the areas with greater vegetation cover on the Darling Scarp, burnt by wildfires in the last 10 to 15 years. Small fires have occurred with some regularity in the area near the Kent Street Weir, with 15 fires in the last 15 years (Figure 15). Higher frequency and severity of burning can alter species composition and structure of vegetation and is a threat to ecological values within the study area.

Within the study area the juvenile period (i.e. time to reproduction) for obligate seeding species is predicted to change by between 6 and 11 years compared with recent conditions (from DBCA-0072). Understanding these changes is important for understanding the impact of fire regimes and their impact on obligate seeding species.

Data limitations

The DBCA-060 Fire History dataset is a useful record of fires within the study area. Data could be further analysed to determine fire frequency. To determine the impact of changed fire regimes, data would need to be linked to life history traits of specific ecological values (e.g. time to reproduction for obligate seeding plant species).

More on-ground information could support our understanding of the ecology of obligate seeding plant species and how they are impacted by changing fire regimes and climate change.

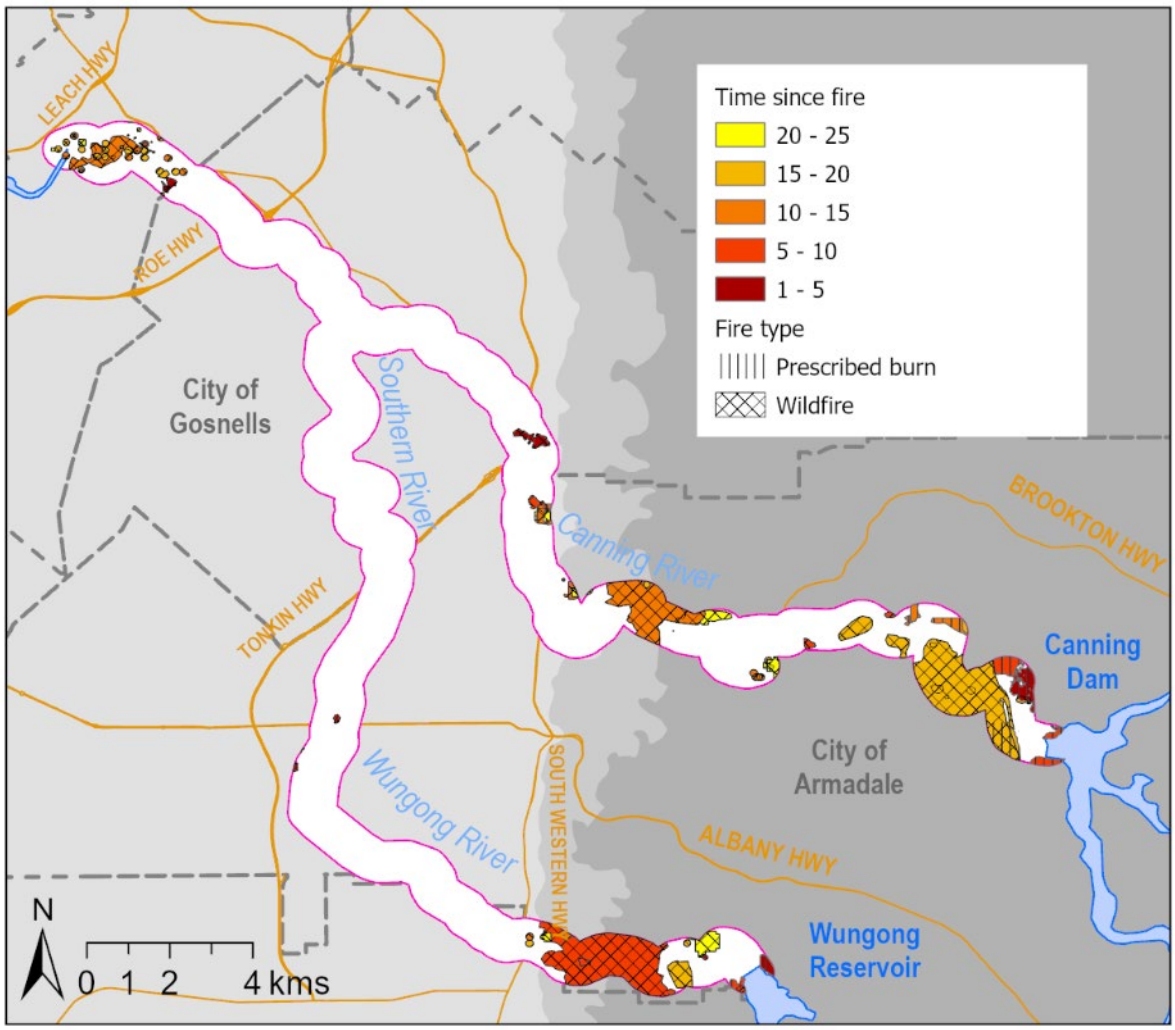


Figure 15 Time since last fire as shown in the DBCA-060 Fire History dataset. Also shown is the cause of fire: wildfire or prescribed burn.

Weed invasion

Relevant datasets

Swan and Canning Rivers Foreshore Assessment (FAMS) dataset was derived from field surveys conducted in 2005/2006 and information was assigned to polygons of variables sizes along the river. The dataset includes a total of 187 attributes. Key attributes relating to weed invasion include: percent weed cover by lifeform (e.g. trees, creepers, herbs), weed species, and total area of weed cover.

The **Wungong Riparian Vegetation** dataset is based on field surveys of vegetation condition, although it uses different methods and scoring to the FAMS dataset. Data were collected in 2021. Key attributes include descriptions of dominant weed species and weed cover.

The **Canning Pools** dataset mapped the locations of pools and determined their depth and the degree of sedimentation, however there was also a qualitative assessment (categories based on a

visual assessment) of riparian vegetation. Key attributes are cover of native and exotic species, and qualitative descriptions of vegetation (e.g. records of blackberry, watsonia).

Key information

Weed invasion was identified as a threatening process for 9 out of 15 MNES within the study area. There is a high percentage of weed cover within the study area, particularly along the Southern-Wungong River and downstream of the confluence on the Canning. In this weed infested area weeds were assessed as extensive (in the Wungong riparian vegetation dataset) and estimated to be between 75 and 100 % cover in the FAMS dataset (Figure 16).

Data limitations

The Wungong Riparian Vegetation dataset is recent and is considered a good reflection of current status of weeds, however the dataset is restricted to the Southern-Wungong River. The Canning pools dataset is relatively recent and may therefore be considered a good indication of current condition, although it is spatially limited to the Canning River. The information collected is qualitative (scores from observations) but is likely sufficient for assessing condition at a broad scale. The scores for weeds generally correspond with the data in the FAMS dataset, which is more detailed, but was collected in 2005/06.

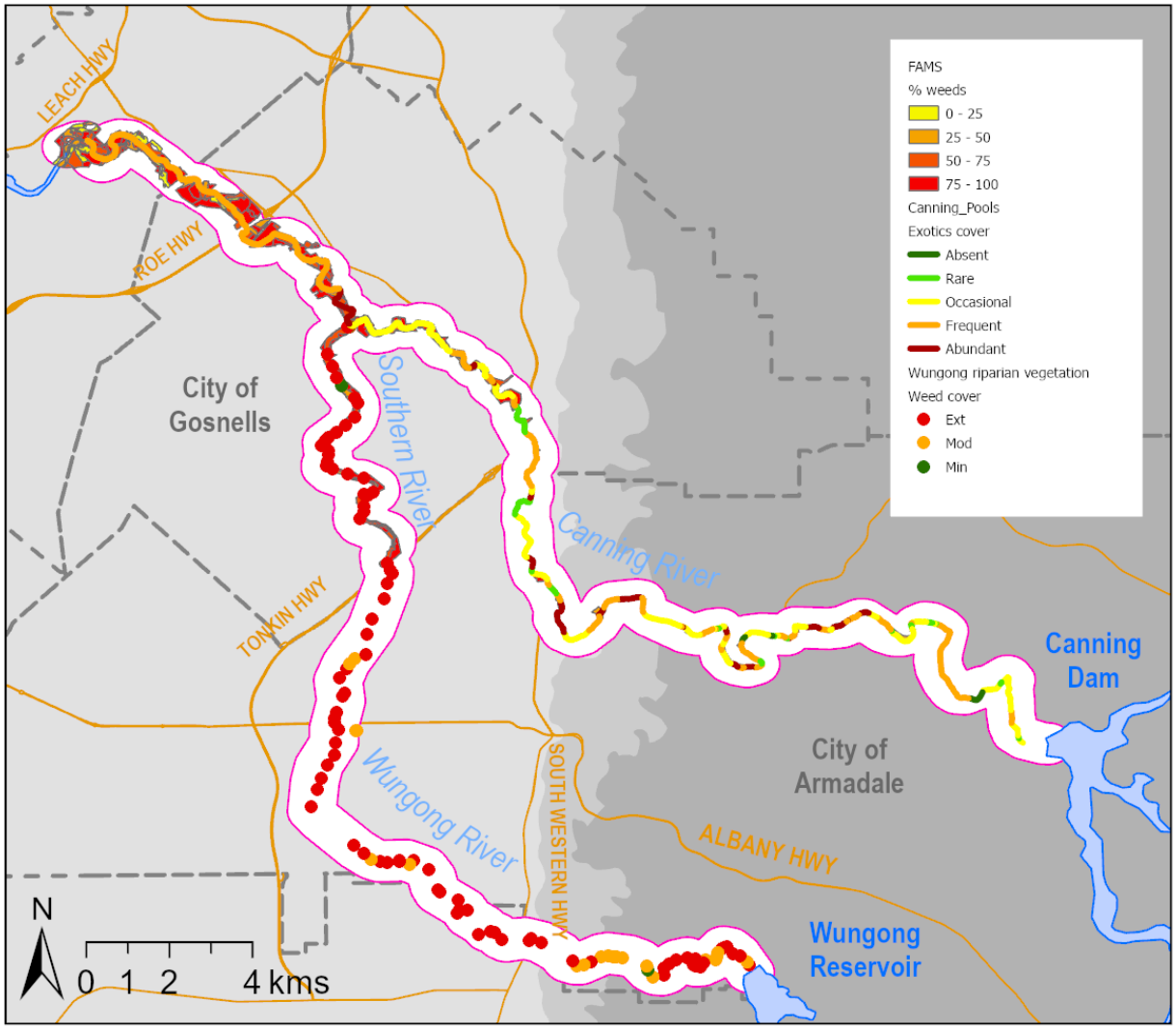


Figure 16 Estimates of the distribution of weeds within the study area as shown in the FAMS, Canning Pools and Wungong Riparian vegetation datasets.

Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)

Relevant datasets

Dieback is a Commonwealth-listed threatening process and was identified as a key threat for 8 out of 15 MNES. We did not identify a dataset that contained information on the locations of dieback within the study area. DBCA indicated that mapping is available for forest areas on the Darling Scarp, but mapped areas were outside of the study area. Local Governments may undertake dieback mapping, and this information may be sought if information is required on a smaller spatial scale than the current assessment. A coordinated approach to dieback mapping across jurisdictions would be required to map the study area.

Hydrological change

Hydrological change was identified as a threatening process for 8 out of 15 MNES. Changes to rainfall and groundwater levels threaten TECs in the study area, and hydrological changes impact ecosystems that provide resources for cockatoos and threatened marsupial species.

Instream ecological values are threatened by changes in flow. The natural flow regimes of the Canning and Southern-Wungong Rivers have been altered by large dams, to the extent that the Canning River's flow below Canning Dam has been reduced by 98% and the flow below Wungong Dam has been reduced by 94% (Storey et al., 2002). These dramatic reductions in flow have reduced channel forming and sediment flushing flows (Storey et al 2002) they have also led to a marked reduction in water depth and channel width along the river, particularly in the lowland reaches. Currently releases of water by the Western Australian Department of Water and Environmental Regulation are assumed to support ecological values, although further information is required to support this. The Southern-Wungong has extensive drains throughout the catchment had natural drainage lines straightened, changing the system from a seasonally flooded landscape to a more urbanised system. Climate change has also impacted the hydrological regime within the study area, with large reductions in rainfall, runoff and streamflow, concomitant with increased temperatures (and thus increased evaporation). Relevant spatial datasets could include change in groundwater levels (historical and future) and change in flood extent and duration.

We did not identify datasets relating to changes in hydrology within the study area. Data is available on river flow from DWER's Water Information Online repository, although only two gauges (Seaforth and Southern River – Anaconda Drive) had data up to 2024. Other gauges within the study area ceased logging data after 2007.

Anthropogenic degradation

Relevant datasets

Swan and Canning Rivers Foreshore Assessment (FAMS) dataset was derived from field surveys conducted in 2005/2006 and information was assigned to polygons of variable sizes along the river. Key attributes related to anthropogenic degradation include weed invasion, disturbance, rubbish, trampling, parking and mowing.

The **Wungong Riparian Vegetation** dataset is based on field surveys of vegetation condition, although it uses different methods and scoring to the FAMS dataset. Data were collected in 2021. Key attributes include pressures, landuse and comments on management issues (e.g. illegal dumping, 4WD and trail bike use).

Key information

The FAMS dataset recorded the presence of disturbance and rubbish as 'false' along the majority of the surveyed area (Figure 17). It is not clear if this is accurate. The Wungong dataset used a different qualitative metric of 'pressures' and where sites overlapped with the FAMS dataset they were rated as 'extensive'. From the available data we conclude that the Wungong-Southern River is impacted to a moderate to extensive amount by anthropogenic pressures.

Data limitations

There is limited spatial overlap between the FAMS and the Wungong Riparian Vegetation dataset. To better understand the impact of anthropogenic threats a survey using the same methods would be required across the study area.

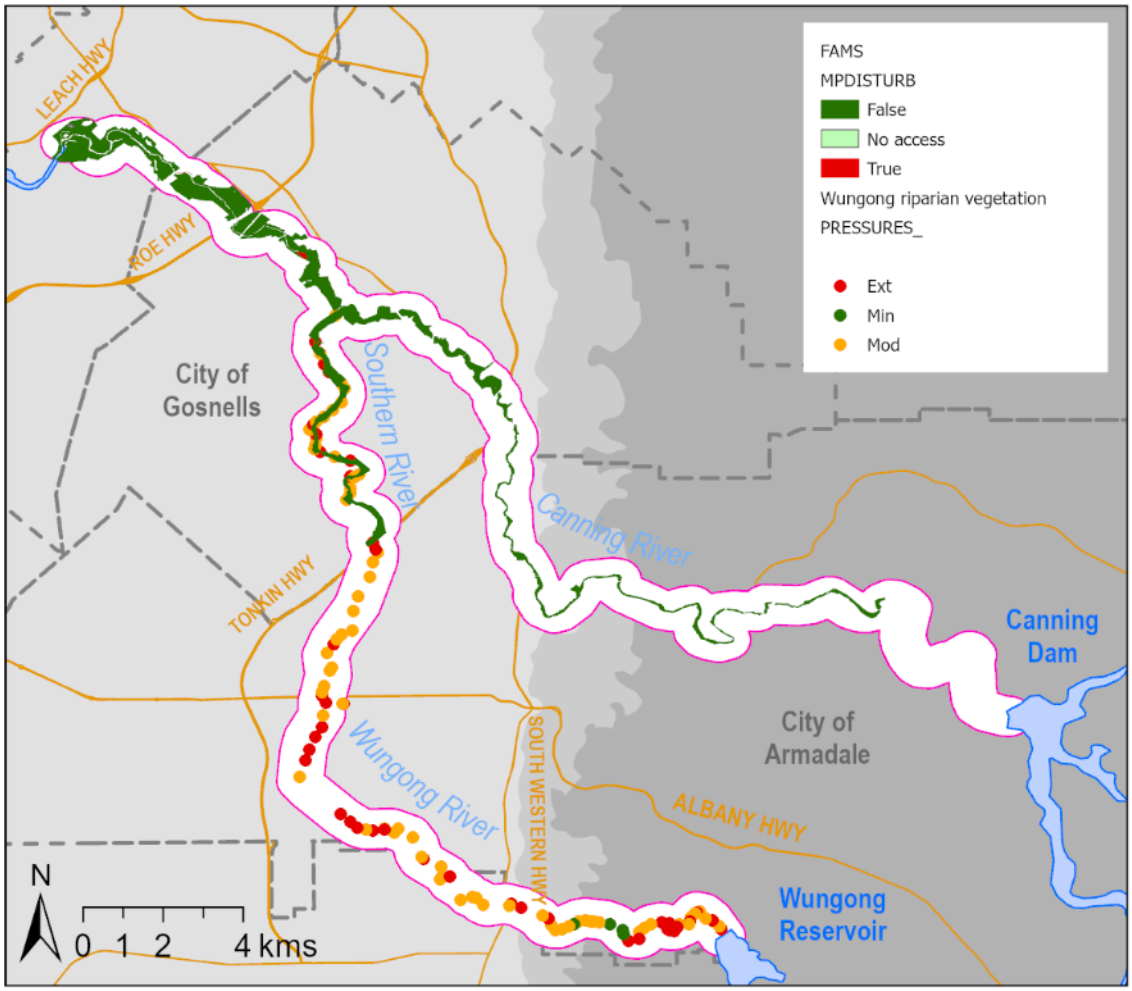


Figure 17 Estimates of anthropogenic degradations, shown as "disturbance" in the FAMS dataset and "pressures" in the Wungong Riparian Vegetation dataset.

Loss of habitat due to climate change

The loss of habitat due to climate change, and the impacts of climate change more generally were identified as a key threatening process for 7 out of 15 MNES.

South-western Australia continues to experience changes in climate including hotter, drier conditions. To assess the impact of climate change on ecological values requires an understanding of the relationships between climatic factors and ecological values. Predictions may then be made about how values will be impacted by change in climate.

We did not identify datasets relating to changes in habitat due to climate change within the study area.

Novel biota (ferals) – dieback, feral bees, rabbits, escaped garden/aquatic plants, foxes, feral cats, feral pigs, pathogens, borer, exotic fish

Threatening processes related to introduced species were combined under 'novel biota' to include introduced species that threaten native ecological values.

Relevant datasets

For the majority of feral species and pests we did not identify datasets that mapped the presence of introduced species that threaten ecological values. However, the **Fisheries data extraction** (compiled from DPIRD, DBCA and UWA researcher data) includes records of exotic fish and crayfish species. Observations are point data, with records from 144 sites across the study area, collected between 2000 and 2022. The key attribute is the record of species presence. The FAMS, Canning Pools and Wungong Riparian Vegetation datasets contained notes on the presence of pigs.

Key information

Nine exotic fish species have been recorded occur across the study area, with between 1 to 5 species found at virtually all surveyed sites (Figure 18). Exotic species with widespread distributions include the mosquitofish (*Gambusia holbrooki*), speckled mosquitofish (*Phalloceros harpagos)* (prior to a taxonomic revision referred to as *Phalloceros caudimaculatus* (Maddern, 2012). We have combined records of P. *harpagos* and *P. caudimaculatus* using the current name), goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), and pearl cichlid (*Geophagus brasiliensis*). Species with restricted distributions include spangled perch (*Leiopotherapon unicolor*), convict cichlid (*Amatitlania nigrofasciata*), redfin perch (*Perca fluviatis*) and Koi carp (*Cyprinus rubrofuscus*). There was a general trend of fewer exotic species in the upper parts of the study area, particularly the upper Canning River. Exotic crayfish were scattered across the system, and were primarily the yabby (*Cherax destructor*). The redclaw crayfish (*Cherax quadricarinatus*) was only recorded from one site in the upper Canning River (Figure 18).

Native terrestrial fauna are threatened by predation from foxes and cats and habitat destruction and displacement by feral pigs and bees. Plant pathogens and pests threaten native plant species, and the loss of key species and plant structure also threatens native fauna.

The introduced fish parasite, anchorworm (*Lernaea cyprinacea*), has been recorded on Canning and Southern-Wungong rivers (Hassan et al., 2008, Lymbery et al., 2010).

Data limitations

Information on the presence of exotic fish species is relatively recent and provides some understanding of their presence in the system. However, there has not been systematic surveys of exotic fish species within the study area.

There are many other feral species that may impact ecological values within the study area, however more information through on-ground surveys is required to determine where these threats are greatest.

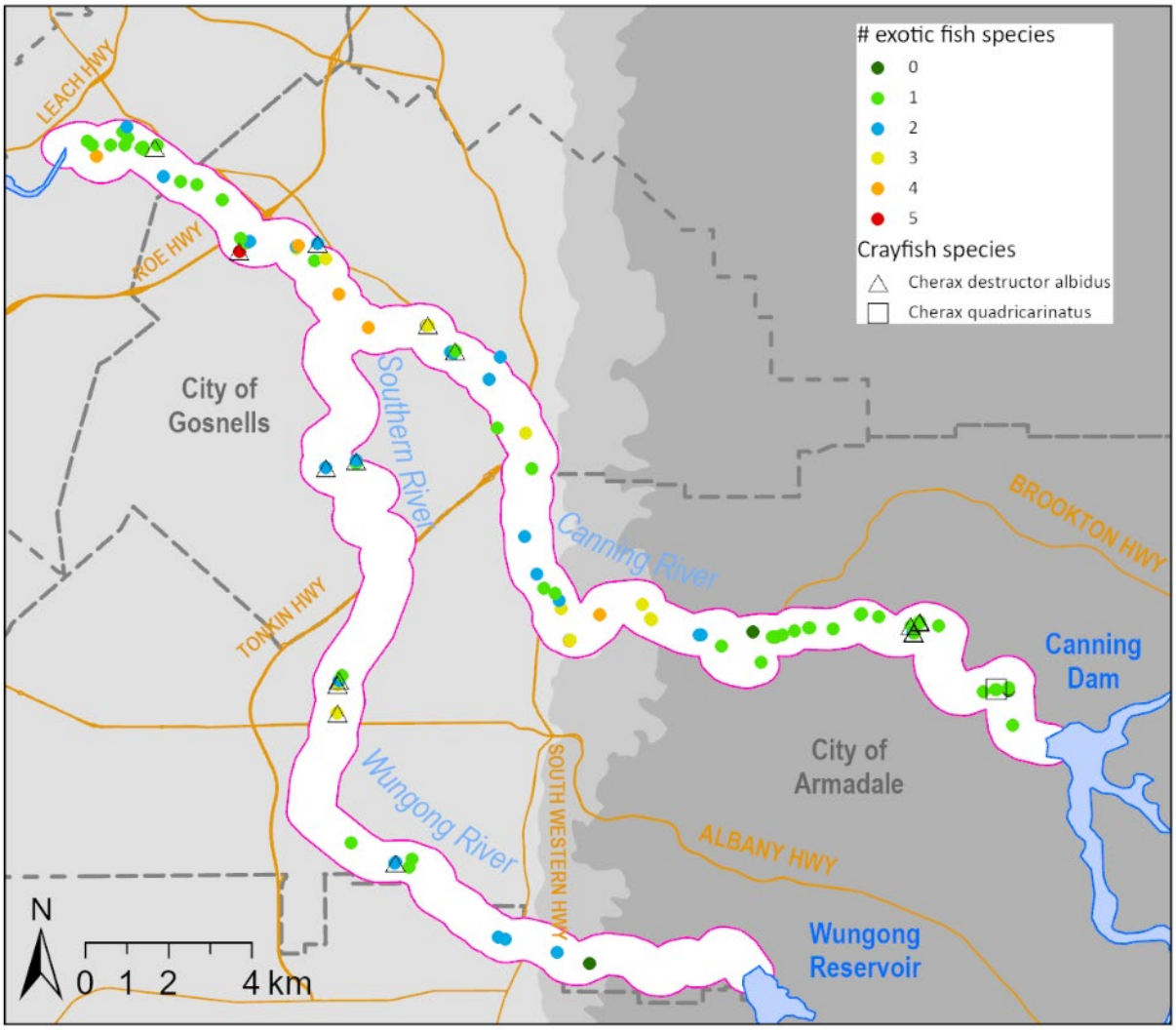


Figure 18 Number of exotic fish species recorded at sites within the study area. Also shown are records of the exotic crayfish species. Data are a compilation of records from DPIRD, DWER and UWA.

Illegal killing

Threatened fauna, including black cockatoo species are threatened by illegal killing by orchardists and by poachers.

We did not identify a relevant dataset for this threat within the study area.

Salinisation

Secondary salinisation is a significant problem in south-western Australia and is a threatening process for 4 out of 15 MNES.

We did not identify a relevant dataset for this threat within the study area.

Loss of keystone / host species

The interconnected nature of the natural world means that the loss of one species can have a marked impact on others, particularly where species have evolved mutualistic or commensal relationships, i.e. one or both species gain resources or services from the other. Conservation Advice for Carter's freshwater mussel notes that the loss of host fish species for the mussel in its juvenile phase is a key threat. For Banksia TECs the loss of key Banksia species may impact species dependent on nectar and pollen for nutrition, such as birds and mammals (bats, possums). Understanding these complex relationships requires further research in the study area.

We did not identify a relevant dataset for this threat within the study area.

Competition

Competition for nesting hollows was identified as a key threat for threatened cockatoo species. Competition may be from novel biota, for example honeybees or introduced birds species (e.g. rainbow lorikeets), as well as from other native birds with similar resource requirements.

We did not identify a relevant dataset for this threat within the study area.

Pollution

Pollution was identified as a key threatening process for 2 out of 15 MNES: Carter's freshwater mussel and common greenshank.

Relevant datasets

The **Canning Pools** dataset is derived from field surveys conducted between 2013 and 2016 along the Canning River sections of the study area, with no data collected on the Southern and Wungong Rivers. The primary aim of the surveys was to map the locations of pools and determine their depth and the degree of sedimentation. The relevant attribute to pollution is the presence of sediment.

The **Wungong Riparian Vegetation** data was collected in 2021. The relevant attributes relate to siltation of the banks and rehabilitation need.

The **Drains** dataset shows the location of stormwater drain outlets and open drains within the study area. It is relevant as these are the key source of pollution to the waterway.

The **WIR_Discrete_Data_Canning_Wungong_July2024_request** contains all water quality data collected and stored on the WA Governments Water Information Reporting (WIR) portal. Data include long-term records of total nitrogen, total organic nitrogen, ammonia, dissolved organic nitrogen, total Kjeldahl nitrogen, total phosphorus, filterable reactive phosphorus, salinity, alkalinity, dissolved organic content, total suspended solids, chlorophyll-a, DOC, TSS, Chl a-c, and polyhydroxyethyl acrylate. There are also snapshot data for different water quality parameters, including water temperature.

The **Acid Sulfate Soil Risk Map** data shows the risk of Potential Acid Sulfate Soil (PASS) materials that may be disturbed by land development activities based on the likelihood of PASS materials occurring

within 3 m of the ground surface. The data was collected in 2006. The relevant attributes are the acid sulfate risk category.

Key information

There were areas with severe sedimentation along the Canning, particularly downstream of Roley Pools (Figure 19). There was less sediment found higher in the study area, closer to Canning Dam. Information about siltation was available for the Wungong-Southern River but the resolution of the information was low, as it was only noted if erosion and siltation posed a management issue.

There are many drains that discharge to the Canning River, with a particularly high density on the Swan Coastal Plain. Few drains were mapped on the Southern River and parts of the Wungong River are still mapped as 'open drains' reflecting the historical use of the river.

Considerable water quality information is available inside the Water Information Reporting system (WIR). Data are available on nutrients (N, P), physical water quality (e.g. oxygen, pH, conductivity, salinity), organic compounds including plant pigments, inorganic compounds (metals, non-metals), hydrocarbons, pesticides and herbicides and other toxins. The majority of data occurs in the lower reaches of the Canning River (Figure 20). We did not perform an appraisal of the various elements of water quality because considerable care needs to be taken when interpreting the data, i.e. nutrient concentrations can vary markedly through time at a single location, and because this level of investigation was beyond the capacity of our project. However, a rapid informal assessment of nutrients indicates that the Wungong-Southern River is more impacted by eutrophication than the Canning.

Data limitations

The Canning Pools dataset gives a good overview of where sediment is deemed to be most severe. The dataset is limited to the Canning River and does not include the Southern-Wungong River part of the study area.

There is considerable water quality data available on WIR but many records are more than 5 years old, which are not a good indicator of current condition (Figure 20). The spatial and temporal coverage of the data is highly variable among water quality attributes in line with the varied aims of the studies for which it was collected.

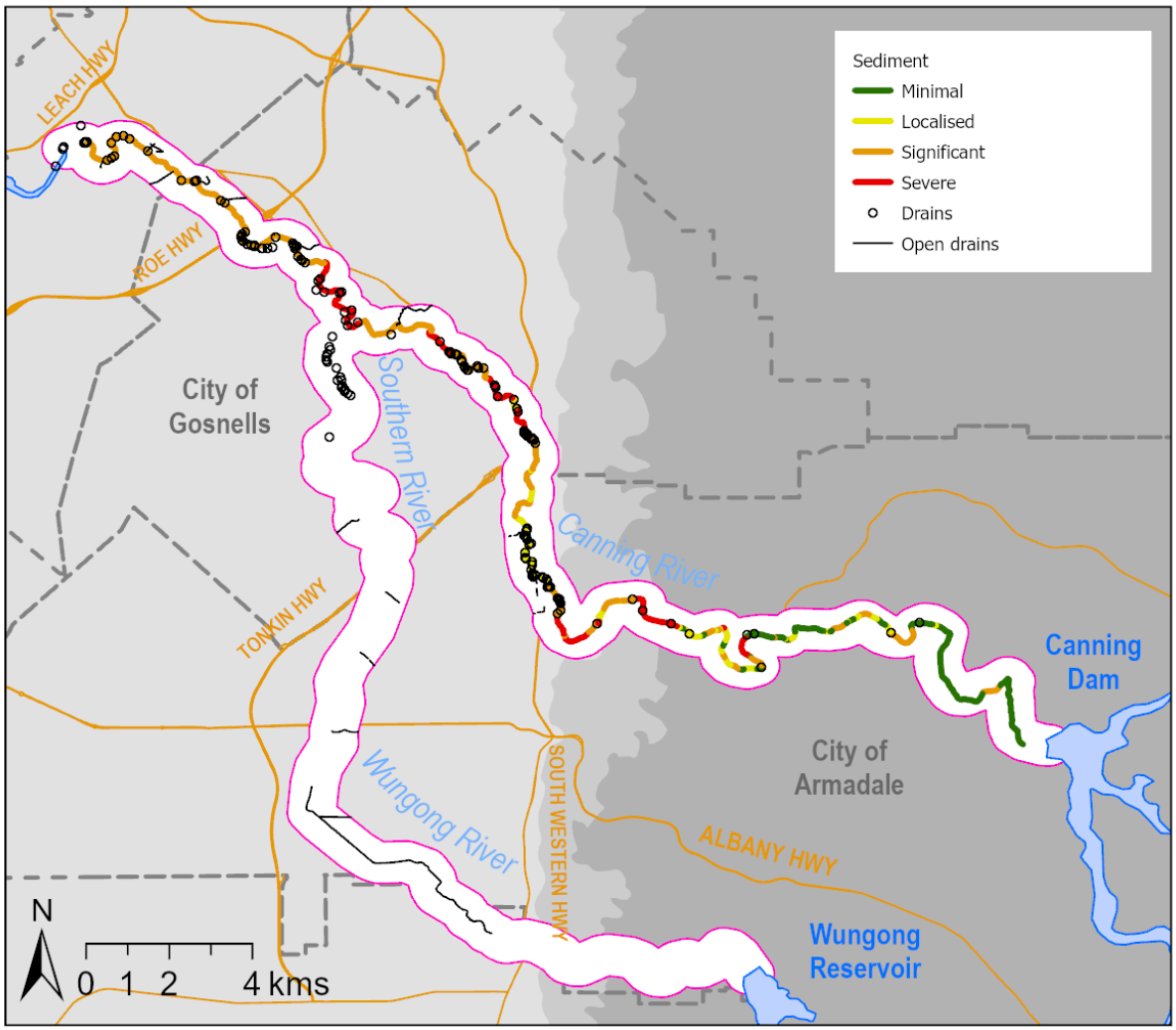


Figure 19 Distribution of sediment along the Canning River, with estimates of how much sediment is present, from the Canning Pools dataset. Also shown the location of drains.

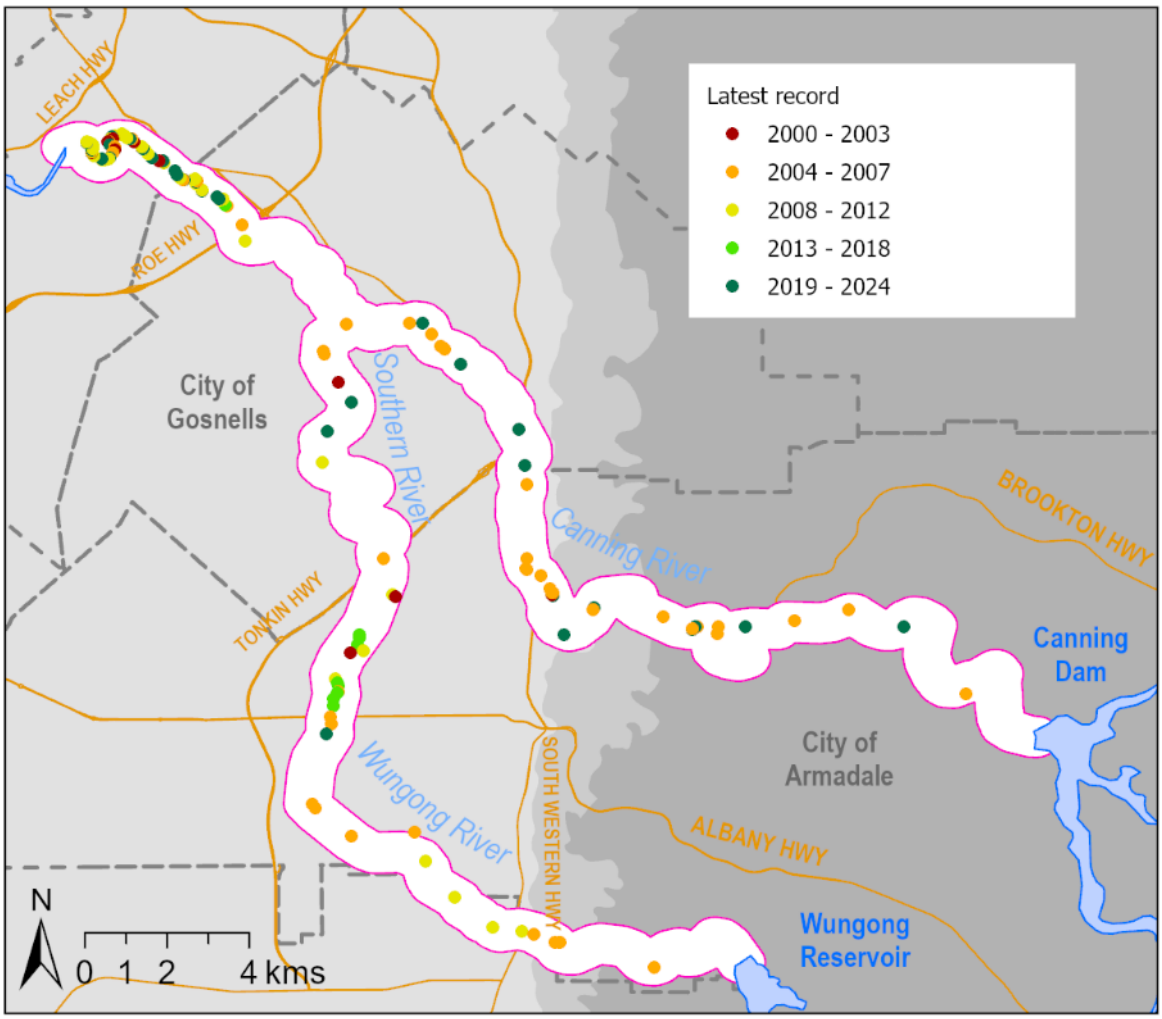


Figure 20 Sites sampled for water quality in the Water Information Reporting system.

Aquatic habitat loss

In an urban river like the Canning, aquatic habitat can be lost on the floodplain due to reduced overbank flows or the construction of levees or regulators. Loss of instream habitat can occur due to sedimentation, bank erosion or the invasion of the channel by non-native plants (e.g. grasses), and reductions in water depth within the channel. While instream barriers may not normally be considered a threat to aquatic habitat, we include them here because by fragmenting the river they can effectively reduce access to aquatic habitat for certain species, particularly those that undertake migrations.

Relevant datasets

The **Canning Barriers** dataset was compiled from surveys of instream structures within the Canning River upstream of the Kent Street weir. Data were collected in field surveys between 2012 and 2016. Key attributes include the presence of barriers and a description.

The **Canning Pools** dataset contains information on threats to instream habitat. Data were collected in field surveys between 2013 and 2016 by DBCA staff. Key attributes include information on

sedimentation, bank erosion / artificial stabilisation (e.g. revetment) and vegetation. Information on vegetation includes both native and non-native species (e.g. arum lilies) and details in the comments section can be used to inform this.

The **Wungong Riparian Vegetation** dataset includes information on siltation (which bank is affected) and comments in the vegetation description mention where non-native grasses invade the stream channel.

Key information

The greatest number of barriers to fish passage on the Canning River exist upstream of where Tonkin Highway crosses the river (Figure 21). Some barriers are natural (e.g. rock waterfalls) but many are artificial. These barriers fragment the river and prevent fish and other aquatic biota from moving along the river and accessing areas of habitat. This is arguably most problematic for the freshwater cobbler (*Tandanus bostocki*) which undertakes an upstream spawning migration in spring (Beesley et al., 2019). However, barriers can also have benefits in urban areas if they prevent the spread of non-native species. Recently, investigations have assessed if the weir at Avocados (upstream of Buckingham Bridge on the Canning River, Kelmscott) could be used to limit the spread of the Pearl Cichlid; however environmental DNA results indicate it is already present above the weir (Morris et al submitted). The threat from sedimentation and erosion appears to be highest between Stocker Rd in the foothills and Bickley Brook on the Coastal Plain. It is difficult to summarise threats to aquatic habitat because the relevance of threats will depend on the ecological value of interest, and in some cases a threat for one species could be a value to another. For instance, bank erosion poses a threat to emergent macrophyte vegetation but can provide habitat for freshwater cobbler (Beesley pers comm).

Data limitations

Data on barriers have only been collected for the Canning River, and further surveys would be required to map the whole study area. Information about erosion, sedimentation and the invasion of the channel by non-native plants varies between the Canning Pools dataset and the Wungong Riparian dataset in line with different aims of these studies. Generally, information content is lower in the Wungong dataset. Where information is noted in ‘comments’ sections of databases the ability of this data to provide a reliable spatial description remains unclear because it is possible that information was noted on an ad hoc basis and reflects recorder interest.

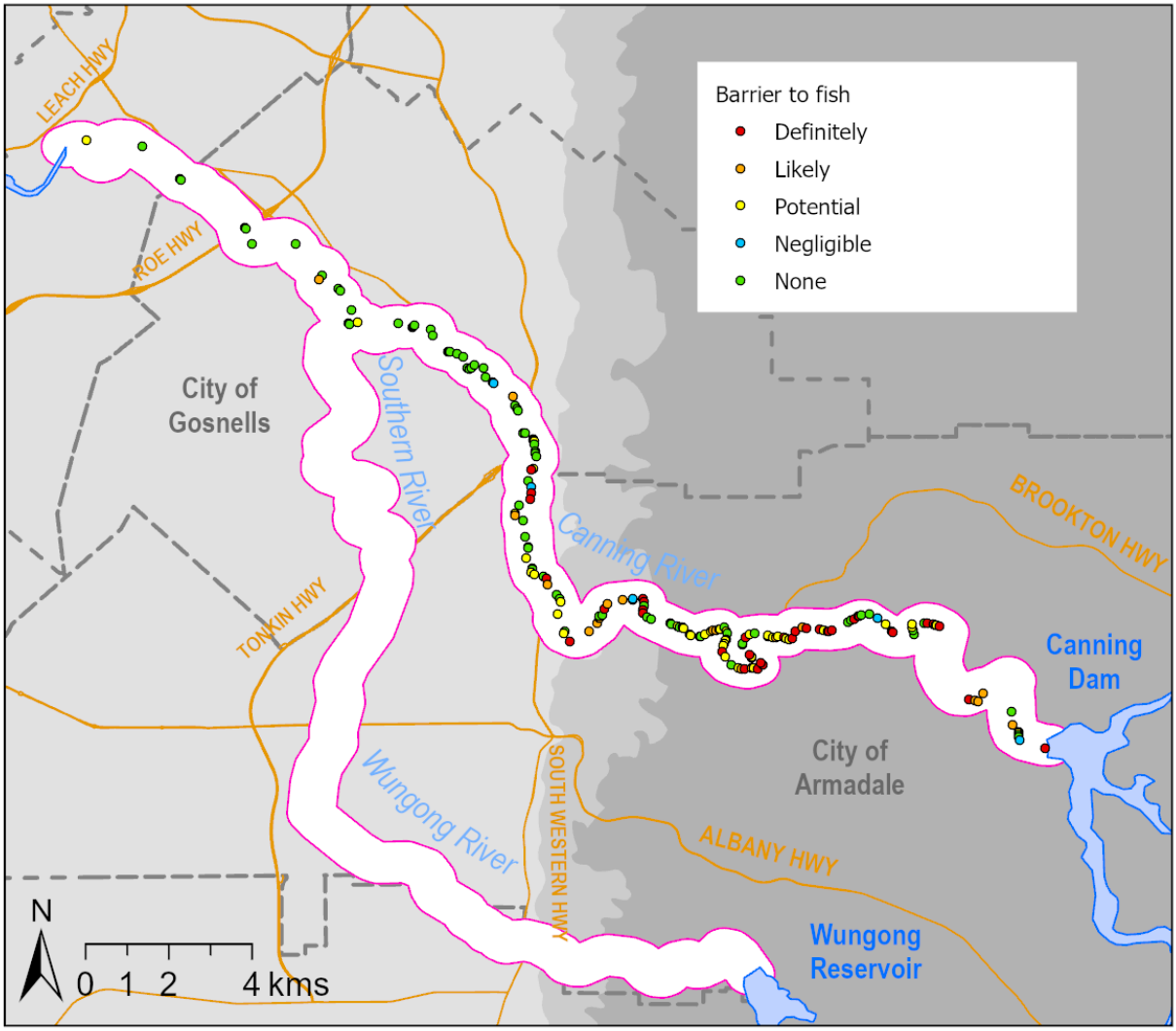


Figure 21 Likelihood of identified instream structure acting as a barrier to fish passage along the Canning River. Data is from the "Canning Barriers" dataset from DBCA Rivers and Estuaries Science.

5.1 Knowledge gaps

Overall, there is limited data available to assess individual threats, with some exceptions (e.g. mapping of weeds). It may not be feasible to recommend collection of data to inform all identified threats. We identified that land clearance, changed fire regimes, weed invasion, dieback caused by Phytophthora, hydrological change and anthropogenic degradation were listed threats for the majority of MNES within the study area, and these may be a focus for data collection efforts. We therefore identified the following key knowledge gaps.

- Surveys of areas with MNES to determine if current extent is accurately mapped, to avoid future losses through land clearance.
- Fire history data is current, but more information on the impact of fire regimes on ecological values may inform management of fire within the study area.

- There is broad information on the presence of weeds across the study area, however methods are inconsistent. Future work is recommended to systematically survey weeds, particularly before and after weed management work, to quantify success or otherwise.
- Dieback mapping is required across the study area. This may involve collating existing information if dieback mapping has been completed by different organisations (e.g. LGAs, Landcare groups). If this data is found to be insufficient (e.g. limited spatial coverage, or it is not current), then systematic surveys of dieback are recommended.
- There is currently limited information on the impacts of hydrological change on the identified ecological values. Research is required to understand the impacts of changed flows on instream biota. In the drying climate the study area is experiencing, research is also required to understand the impacts of increased drought periods and hotter temperatures on vegetation.
- Current information on anthropogenic degradation is available for the Southern-Wungong River, however current information is not available for Canning. Surveys using consistent methods are required to determine the status of anthropogenic degradation across the study area to help prioritise management decisions.

6 Jurisdiction

Although not directly applicable to assessing the ecological condition of the study area, datasets relating to the jurisdiction and land tenure can be important for providing context on historical and future land management decisions. Also, having the datasets summarised in the current report will assist with the next stage of the project, which will demonstrate a process to spatially prioritise areas for management actions.

Relevant Datasets

The **LGATE-217 Cadastre (Polygon)** dataset shows all Crown and Freehold land parcel boundaries. It includes information on "land type" e.g. Crown, Freehold or Easement.

The **LGATE-227 Reserves** dataset shows the lands set aside as Crown Reserve and includes information on vesting and the management body responsible for the care, control and management of the reserve.

The **LGATE-233 Local Government Area Boundaries** shows the extents of Local Government areas.

The **DBCA-011 Legislated Lands and Waters** dataset shows the lands and waters managed by DBCA as defined under relevant Acts.

The **DBCA-012 Lands of Interest** dataset shows all other lands managed by DBCA, but which are not vested under any Act that is administered by DBCA.

The **DBCA-026 Regional Parks** dataset shows open spaces identified as having regionally significant value for conservation, recreation and community use. There is a mix of tenure and landholders.

The **DPLH-054 State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region (Polygon)** dataset shows the areas assigned as "Bush Forever" sites.

Key information

Most of the study area is freehold land, with reserves and Crown also common land types, particularly close to the river channel (Figure 22). The complexity of management responsibilities is demonstrated in the LGATE-227 Reserves data set, which shows that that there are 27 managing organisations for reserves within the study area (although it should be noted that some organisations appear to be listed more than once within the dataset). The main managing organisations for reserves are LGAs and DBCA (including the Conservation and Parks Commission and the Conservation Commission of Western Australia) (Figure 23).

Under the relevant legislation DBCA are responsible for the management of the instream sections of the Canning River up to approximately Roley Pools. The study area also includes parts of regional parks. The Canning River Regional Park is mostly upstream of the Kent Street Weir and includes areas of native vegetation. The Park is in the Canning Local Government area, with large sections under the management of DBCA (Figure 24). There is a large regional park (Wungong Regional Park) that intersects with the study area in the upper Wungong River near the dam, which is also managed by

DBCA. There are smaller sections of regional parks on the Canning River on the Darling Scarp. These, plus some areas immediately downstream of the Canning Dam, are managed by DBCA.

A significant part of the study system is designated as Bush Forever sites, particularly along the river and near Canning and Wungong dams (Figure 25)

Data limitations

Information on jurisdiction and the responsible management bodies is spread across at least 5 datasets. In addition, information on land tenure is not available to the general public and datasets were accessed through a university subscription/agreement.

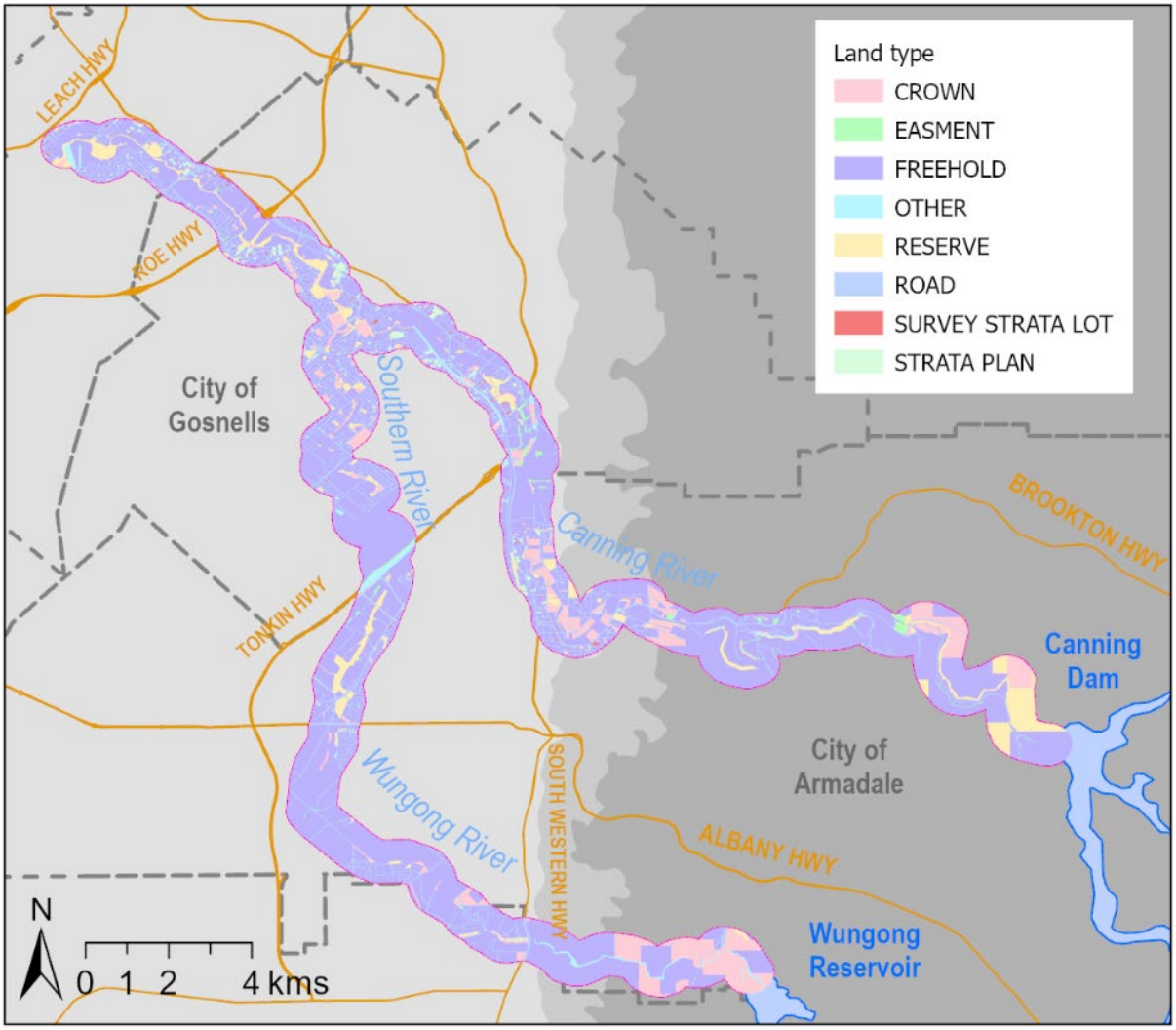
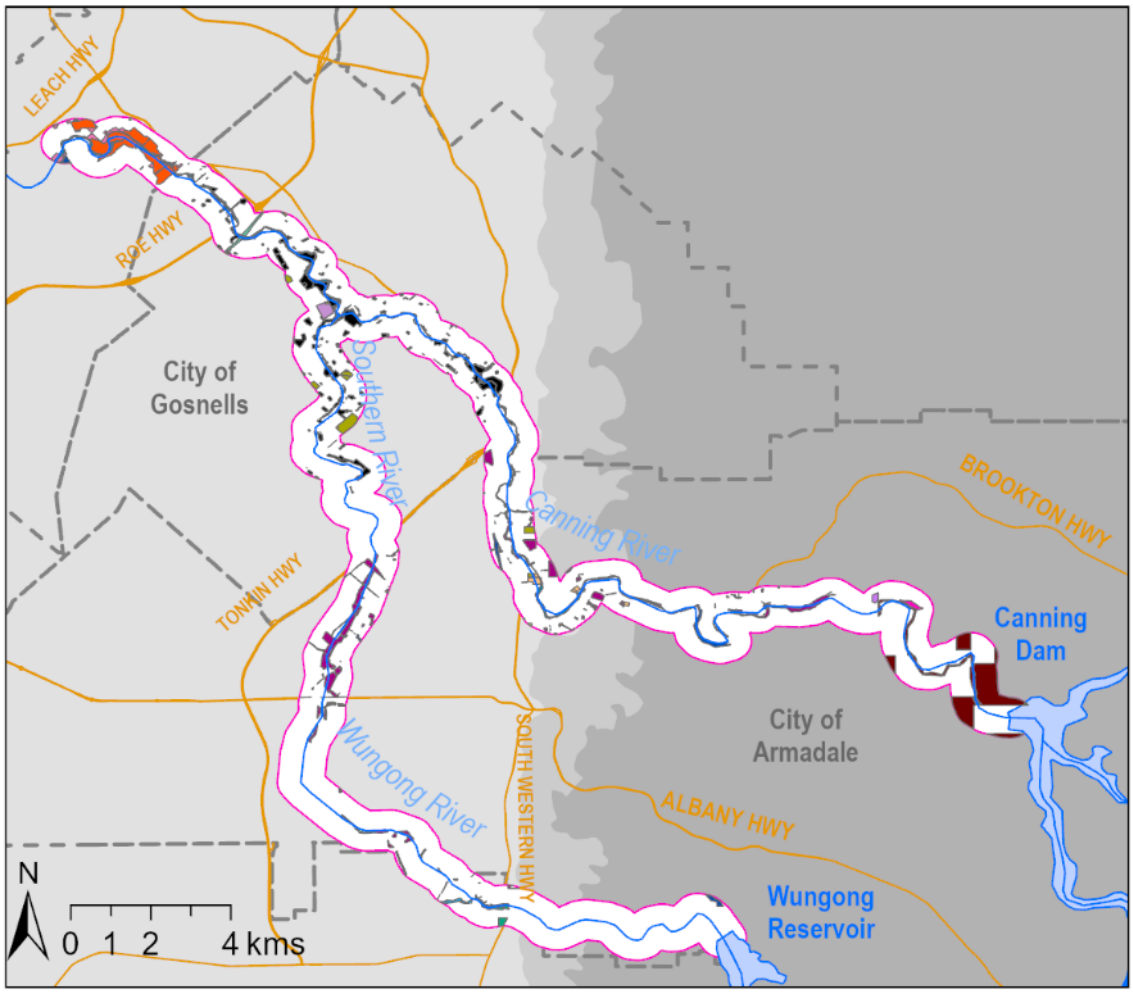


Figure 22 Land type within the study area from the LGATE-217 Cadastre (Polygon) dataset.



Management

- ARALUEN BOTANIC PARK FOUNDATION INC
- ARALUEN TRUST
- CITY OF ARMADALE
- CITY OF CANNING
- CITY OF GOSNELLS
- COMMISSIONER OF MAIN ROADS
- CONSERVATION AND PARKS COMMISSION
- CONSERVATION COMMISSION OF WESTERN AUSTRALIA
- DISABILITY SERVICES COMMISSION
- HOUSING AUTHORITY
- METRO WATER AUTHORITY
- METROPOLITAN WATER AUTHORITY
- MINISTER FOR COMMUNITY SERVICES
- MINISTER FOR EDUCATION
- MINISTER FOR HEALTH
- MINISTER FOR POLICE
- MINISTER FOR WATER RESOURCES
- PUBLIC TRANSPORT AUTHORITY OF WA
- PUBLIC TRANSPORT AUTHORITY OF WESTERN AUSTRALIA
- SHIRE OF SERPENTINE JARRAHDALE
- SHIRE OF SERPENTINE-JARRAHDALE
- SWAN RIVER TRUST
- THE CITY OF ARMADALE
- TOWN OF ARMADALE
- VET (WA) MINISTERIAL CORPORATION
- WATER CORPORATION
- WESTERN AUSTRALIAN PLANNING COMMISSION

Figure 23 Reserves and their management organisations as shown in the LGATE-227 Reserves dataset.

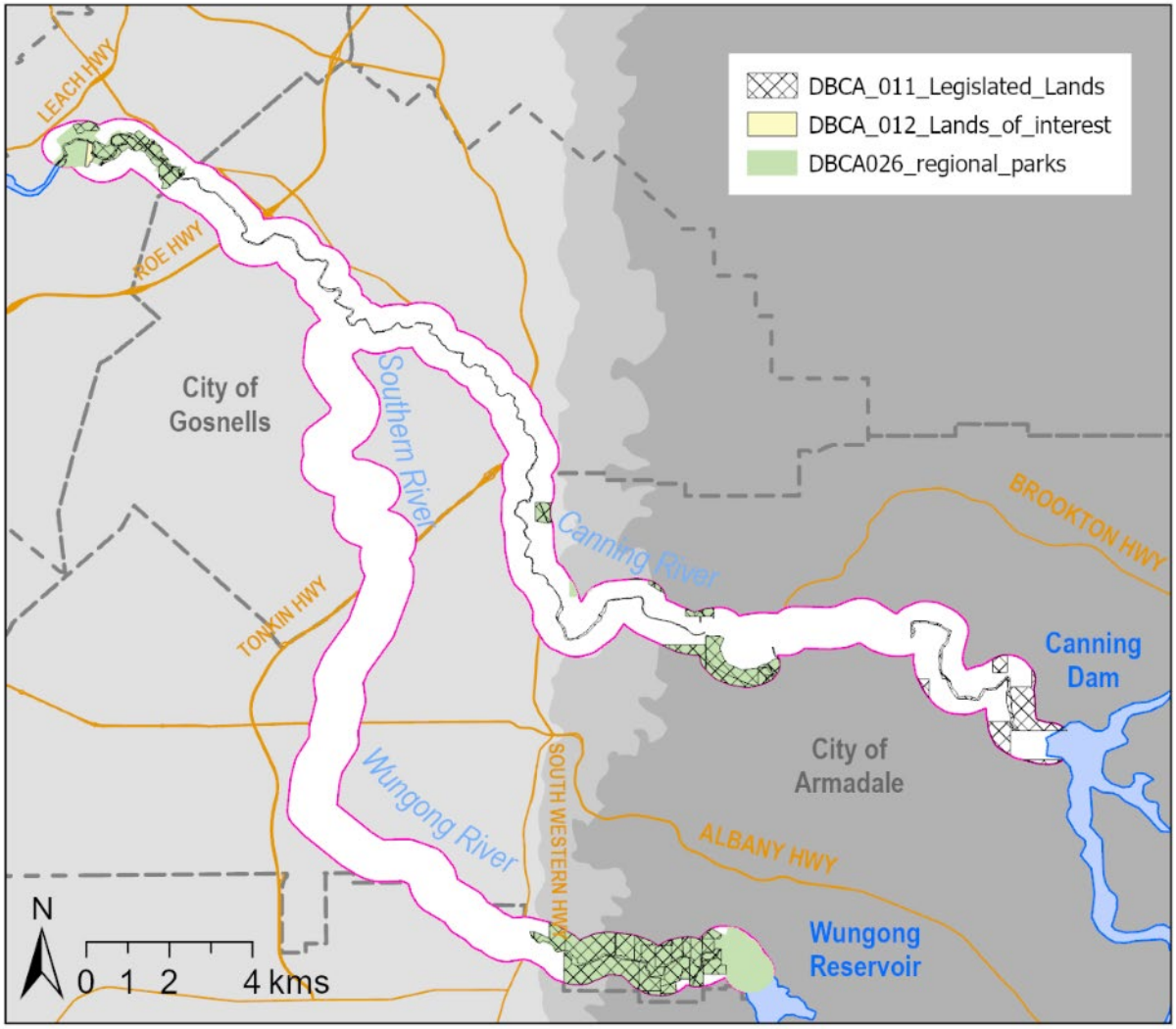


Figure 24 Areas managed by DBCA as identified in the DBCA-011 Legislated Lands, DBCA-012 Lands of Interest and DBCA-026 Regional Parks datasets.

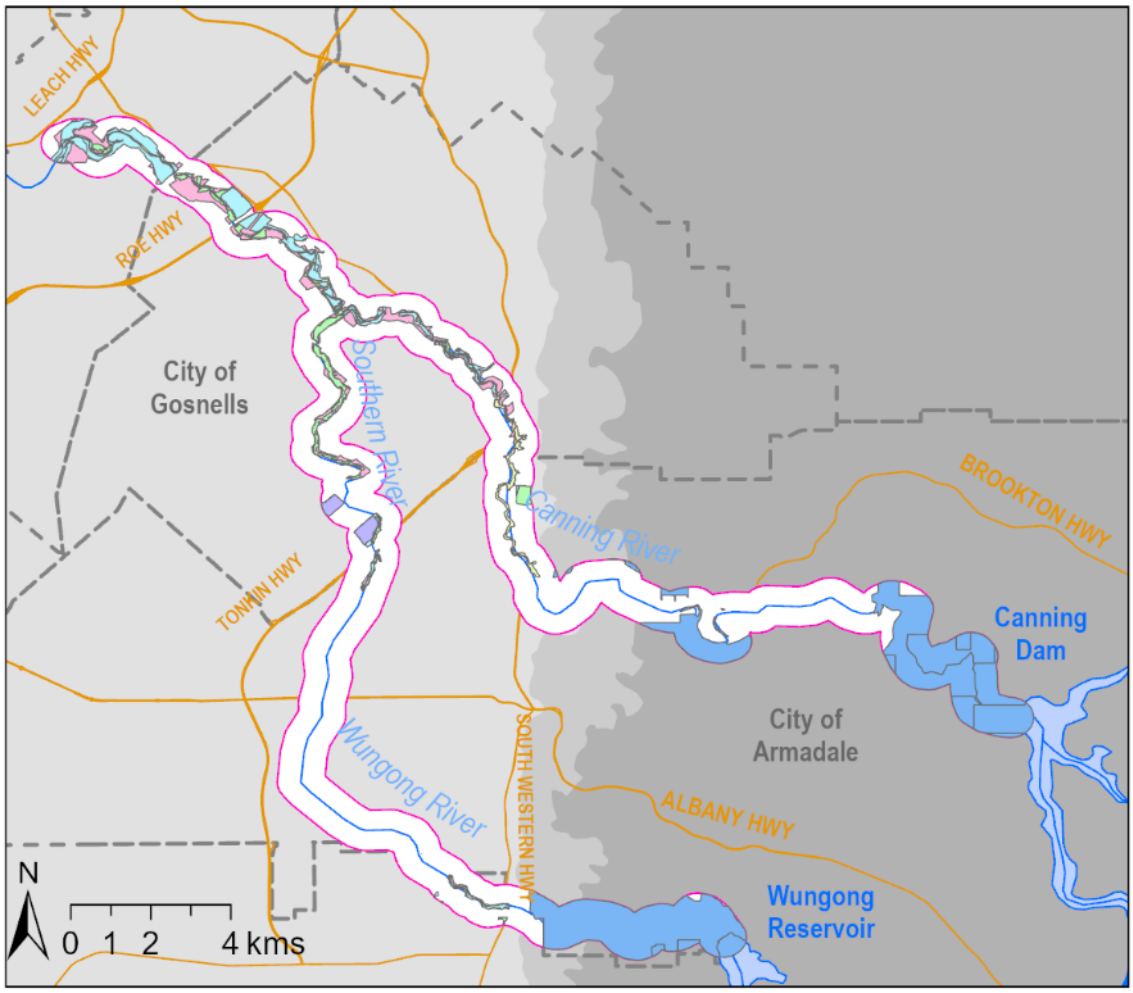


Figure 25 Areas designated as Bush Forever as shown in the DPLH-054 SPP2.8 Bushland Policy for the Perth Metropolitan Region.

7 Summary of condition

7.1 Condition of ecological values

The study area on the Canning River supports a number of Matters of National Environmental Significance (MNES), as well as broader ecological values. There are 2 Commonwealth-listed TECs that occur within the study area: Banksia Woodlands of the Swan Coastal Plain and Clay Pans of the Swan Coastal Plain. The extent of the TECs has been greatly reduced and fragmented, with the majority of patches less than 10 ha, and Banksia woodland TEC having a median patch size of 1.6 ha. There was limited data available to inform our assessment of the condition of the TECs within the study area.

Four Commonwealth-listed flora and 8 fauna species have records within the study area, however there is uncertainty if some species still occur in the study area due to limited data availability. Again, due to limited data availability it was difficult to determine the condition or status of threatened flora and fauna species within the study area. One exception was for Carnaby's Cockatoo, where research and surveys have provided information on the location of resources required for the species (i.e. roosts, food and breeding sites).

The river supports 8 species of native fish and 3 species of freshwater crayfish. Species richness is greater in the lower reaches of the river due to the downstream addition of species where the distribution of estuarine and freshwater species overlap, as typifies most river systems. Maps of species richness and instream habitat are not well suited to identifying the condition of instream values because natural longitudinal changes obscure the ability to clearly identify areas of poor health. That said, spatial trends and patchiness clearly exists for different instream habitat attributes and can support decision making. We recommend that summaries of instream condition be tailored for the species of management interest and are mindful of natural longitudinal patterns.

The riparian values of the study area have been greatly impacted by clearing and urbanisation. Along the river native vegetation is restricted to very narrow strips or almost no vegetation at all. In this cleared landscape strips of riparian vegetation can provide important ecological linkages for biota to move along and between patches of habitat. The vegetation that remains along the river within the study area is generally in a poor condition, impacted by weeds and other pressures.

Like many urban rivers, the study area is impacted by many threats to ecological values. The threats that were common across most ecological values were land clearance, changed fire regime, weed invasion, dieback, hydrological change, anthropogenic-caused degradation and loss of habitat due to climate change. These threats have directly contributed to the MNES requiring listing, as well as the poor condition of the in-stream and riparian ecological values of the study area more broadly.

7.2 Condition of data to inform assessment of ecological values

Our desktop assessment of the condition of ecological values and the threats that they face was dependent on the availability of data. We found that there was limited data available to inform our assessment for most of the ecological values and threats. For many of the datasets that were

available, there were limitations to how they could be interpreted, for example where they did not cover the entire study area or the data was old. We summarise the condition of data availability for each ecological category below.

MNES

We sought to identify the MNES that occur in the study area as their presence would help inform prioritisation of management actions. The TEC dataset provides mapping with buffers, however the mapping is only indicative and the SCP Banksia TEC mapping requires verification. The threatened flora datasets contain many older records (more than 40 years old), and it is uncertain if the species still occur in the study area. Given the lack of recent data, it is also difficult to determine if other threatened flora species occur in the study area. There were similar findings for threatened fauna species, although there were more recent records. Targeted surveys would be required to determine the status of threatened flora and fauna within the study area to update records. Due to the lack of records, as well as the age of many records, it is difficult to determine the current distribution of threatened flora and fauna within the study area. In addition, there was no data available on the current condition of TECs within the study area.

One exception with regards to data availability is the Carnaby's Cockatoo. In addition to records of the occurrence of the species, there are datasets showing the location of roosts, breeding and feeding areas. This critical information provides insight into the resources required by the species.

Instream Values

We sought to determine the broad condition of the instream environments using currently available data. Broadly, we found that there is insufficient information available to assess the condition of instream ecological values.

We found that there were 4 datasets available to inform our assessment of both instream habitat and native biota. The Canning Pools and Wungong Riparian Vegetation datasets contained information relating to instream habitat condition. However, the datasets covered different parts of the study area and data were collected at least 15 years apart and recorded different information. Thus, there is not a consistent overview of the condition of instream habitat within the study area. In addition, future work could determine meaningful metrics on habitat condition from the data that currently exists.

Information relating to the condition of native instream biota was mostly limited to the occurrence of native fish species and Carter's freshwater mussel, with records from various sources rather than systematic surveys to map fish occurrence across the system. Similarly, surveys are required to determine the occurrence of other instream biota, including rakali, frogs, turtles and macroinvertebrates. There was no data available to assess the ecological condition of populations.

Riparian Values

We sought to determine the condition of riparian ecological values by assessing the extent and condition of native vegetation. Broadly, we found that there is sufficient data to assess the extent of

vegetation, but there are inconsistencies in the data available to inform an assessment of the condition of native vegetation across the study area.

We found that the extent of native vegetation and the ecological linkages it provides is well represented in the available datasets. There is also detailed information available on the condition of vegetation in the FAMS and Wungong Riparian Vegetation datasets, however, similar to the instream values, these surveys cover different parts of the study area, used different methods, and were collected 15 years apart. It is therefore uncertain if it is appropriate to combine the datasets to assess current condition.

The Urban Forest dataset is remotely sensed and updated regularly, and provides good information on the structure of vegetation. However, the available datasets calculate metrics by land parcels. A better assessment of vegetation condition would be if the metrics were calculated for the area covered by vegetation extent, or polygons within it.

8 Key knowledge gaps and research needs

Our desktop review identified key gaps in the information available to inform management decisions that address ecological priorities (MNES) and broader ecological values and the threats they face.

8.1 Limited information on the presence of MNES

An accurate understanding of the status, or presence, of MNES is required to inform management decisions that prioritise these biota or communities.

The available datasets contained limited records of MNES. To determine if this is a true reflection of the status of MNES within the study area, systematic flora and fauna surveys are required.

8.2 Limited information on the condition of instream ecological values

An assessment of the current condition of instream ecological values, including the distribution and condition of native biota and the habitats they require, is required to inform management of instream values.

The available datasets contain some information on habitat features, and future work could combine these data to provide a meaningful metric of habitat condition. Surveys of habitat condition are required on the Southern-Wungong River to provide a complete overview of instream habitat condition within the study area. Prior to undertaking further surveys, it is important that decisions first be made about the species of management interest and research undertaken, or knowledge gathered, to identify their habitat requirements, as ultimately these are the attributes that should be assessed across the study area.

The distribution of freshwater species within the study area is currently informed by *ad hoc* data, particularly for species other than fish. Surveys are required to determine distribution of species, including rakali, frogs, turtles and aquatic macrophytes within the study area.

8.3 Improvements to information on riparian values

A current assessment of the condition of riparian values, primarily the extent and condition of vegetation, is required to inform management decisions. For example, a management objective may be to protect and improve areas that are currently in the best condition.

Although there are datasets relating to the condition of riparian values there has not been an assessment of condition across the study area using consistent methods. To understand the distribution of vegetation and the condition it is in, surveys are required across the study area.

8.4 Limited information on the threats

Information on the current condition of key threats is required to inform management decisions to either mitigate threats or prioritise areas with lower threats.

The ecological values within the study area are exposed to many threatening processes. To understand the current status of key threatening processes surveys are required across the study area, focussing on the status of land clearance, weeds, dieback and anthropogenic degradation. Values in the area are also threatened by hydrological change, due to alteration of flow (the river system is dammed), increasing development and urbanisation, and a drying climate resulting in reduced rainfall and hotter temperatures. The impacts on vegetation and instream biota are still not well documented for the study area, and further research is required.

Appendices

Table A 1 Summary of datasets included in our assessment, indicating datasets relevant to MNES, instream and riparian values and threats.

	Dataset	File Name	Relevant values			
			MNES	In-stream	Riparian	Threats
1	DBCA-038 Threatened Ecological Communities	31-0323EC_CanningCatchment_UWA.shp	■			
2	DBCA-036 Threatened and Priority Flora	38-0323FL_TPFL.shp	■			
3	WA Herbarium	38-0323FL_WAHerb.shp	■			
4	DBCA037 – Threatened and priority fauna	12-0324FA.shp	■			
5	DBCA-050 Carnabys Cockatoo Confirmed Roost Sites	DBCA050_CarnabyRoostC.shp	■			
6	DBCA-051 Carnabys Cockatoo Unconfirmed Roost Sites	DBCA051_CarnabyRoostUC.shp	■			
7	DBCA-052 Carnabys Cockatoo Confirmed Roost Sites Buffered 6km	Carn_Cockatoo_conf_roost_buff_6km_DBCA_053.shp	■			
8	DBCA-053 Carnabys Cockatoo Unconfirmed Roost Sites Buffered 6km	Carn_Cockatoo_unconf_roost_buff_6km_DBCA_053.shp	■			
9	DBCA-064 Black Cockatoo Roosting Sites - Buffered	Black_Cockatoo_Roosting_Sites_Buffer_DBCA_064.shp	■			
10	DBCA-054 Carnabys Cockatoo Confirmed Breeding Areas within the Swan Coastal Plain and Jarrah Forest IBRA Regions	DBCA054_CarnabyBreedC.shp	■			
11	DBCA-055 Carnabys Cockatoo Unconfirmed Breeding Areas within the Swan Coastal Plain and Jarrah Forest IBRA Regions	DBCA055_CarnabyBreedUC.shp	■			
12	DBCA-063 Black Cockatoo Breeding Sites - Buffered	Black_Cockatoo_Breeding_Sites_Buffer_DBCA_063.shp	■			
13	DBCA-056 Carnabys Cockatoo Areas requiring investigation as feeding habitat in the Jarrah Forest IBRA Region	Carn_Cockatoo_investigate_feeding_habitats_Jarrah_DBCA_056.shp	■			
14	DBCA-057 Carnabys Cockatoo Areas requiring investigation as feeding habitat in the Swan Coastal Plain (SCP) IBRA Region	Carn_Cockatoo_investigate_feeding_habitats_SCP_DBCA_057.shp	■			
15	Carters Transect Database_Roley Pool 2023	Carters Transect Database_Roley Pool 2023.xls	■			
16	UWA_masters_thesis_Middleton	Jens_invertebrates_updated.xls	■			
17	Canning Pools	Canning_Pools.shp	■	■	■	■
18	Wungong Riparian Vegetation	WSE_Trib_Assx_Start_Points_hosted.shp	■	■	■	■
19	Fisheries Data Extraction	FWFDB Canning Data Extraction_Clipped_plusLeahData_plus DWERdata.xlsx	■	■		■
20	Canning Barriers	CanningBarriers 20230804.shp	■	■		■
21	DPIRD-005 Native vegetation extent	Native_Veg_Extent_DPIRD_005.shp			■	
22	DWER-020 FPM floodplain area	DWER_020_FPM_Floodplain_Area.shp			■	
23	Perth Regional Ecological Linkages	PMR_RegLinks_2004.shp			■	
24	Naturelink Connectivity	all_PA_LCP_linkages.shp			■	
25	Swan and Canning Rivers Foreshore Assessment	Vegetation_unit_ll.shp			■	■
26	DPLH-096 Urban Forest Mesh Blocks	Urban_Forest_Mesh_Blocks_2020_DPLH_096.shp			■	
27	2020 Vegetation retention status for Beard Associations by IBRA regions	Beard_IBRA_postclearing_stats.shp				■
28	DPLH-084/85 Perth and Peel Urban Land Development Outlook-Residential/Industrial	Perth_Peel_Urb_Lnd_Dev_Outlook_2020_2021_Residential_DPLH_084.shp Perth_Peel_Urb_Lnd_Dev_Outlook_2020_2021_Industrial_DPLH_085.shp				■
29	DBCA-060 Fire History	DBCA_Fire_History_DBCA_060.shp				■
30	DBCA-072 to 076 obligate seeding species time after fire	Juv_Period_Slow_Maturing_Plants_Projected_Change_SWofWA_DBCA_072.shp				■
31	Drains	Drain_and_other_points_ll.shp				■
31	Water quality data WIR compiled by NESP	WIR_water_quality_compilation_NESP.shp		■		■

Table A 2 Summary of datasets assessed for inclusion in the assessment of the presence of Matters of National Environmental Significance (MNES) and supporting information. Datasets were assessed based on if they are original data, the area covered by the dataset and the age of the data: green = met criteria; yellow = does not meet criteria, but limitations are acceptable; and, red = does not meet criteria.

#	Dataset	Description	Original data?	Spatial extent	Date / age	Include?
1	DBCA-038 Threatened ecological communities Filename: 31-0323EC_CanningCatchment_UWA.shp Format: shapefile Geometry: polygon	Location of threatened ecological communities. Source: Direct from DBCA	Yes.	Whole area	1994 - 2023	Yes
2	DBCA-036 Threatened and priority flora Filename: 38-0323FL_TPFL.shp (DBCA_036) Format: shapefile Geometry: polygon	Contains sensitive data about the location of threatened flora. Data are point locations & are for planning purposes only. Source: Direct from DBCA	Yes.	Whole area	Historical to 2023	Yes
3	Threatened and priority flora Filename: 38-0323FL_WAHerb.shp Format: shapefile Geometry: polygon	Location of threatened flora. Includes historic & unvalidated information on locations where species have been collected. Source: DBCA via WA herbarium	Yes.	Whole area		Yes
4	DBCA-037 Threatened and priority fauna Filename: 12-0324FA.shp Format: shapefile Geometry: polygon	Contains sensitive data about the location of threatened fauna. Data are point location and are for planning purposes only. Source: Direct from DBCA	Yes.	Whole area	Historical to 2023	Yes
5	DBCA-050 Carnaby's cockatoo confirmed roosting sites Filename: DBCA_050_Carnabys_Cockatoo_Confirmed_Roost _Sites.shp Format: shapefile Geometry: point	Locations of confirmed roosting sites of Carnaby's cockatoo with a 500 m buffer. Source: DBCA through SLIP	Yes.	Whole area	2011-2018	Yes
6	DBCA-051 Carnabys Cockatoo Unconfirmed Roost Sites Filename: DBCA051_CarnabyRoostUC.shp Format: shapefile Geometry: point	Locations of unconfirmed roosting sites of Carnaby's cockatoo. Source: DBCA through SLIP	Yes	Whole area	2011-2018	Yes
7	DBCA-052 Carnabys Cockatoo Confirmed Roost Sites Buffered 6km Filename: Carn_Cockatoo_conf_roost_buff_6km_DBCA_053.shp Format: shapefile Geometry: polygon	Locations of confirmed roosting sites of Carnaby's cockatoo Source: DBCA through SLIP	Yes	Whole area	2011-2018	Yes
8	DBCA-053 Carnabys Cockatoo Unconfirmed Roost Sites Buffered 6km Filename: Carn_Cockatoo_unconf_roost_buff_6km_DBCA_053.shp Format: shapefile Geometry: polygon	Locations of unconfirmed roosting sites of Carnaby's cockatoo Source: DBCA through SLIP	Yes	Whole area	2011-2018	Yes
9	DBCA-064 Black Cockatoo Roosting Sites – Buffered Filename: Black_Cockatoo_Roosting_Sites_Buffer_DBCA_064.shp Format: shapefile Geometry: polygon	Locations of roosting sites of Carnaby's cockatoo Source: DBCA through SLIP	Yes	Whole area	2011-2018	Yes
10	DBCA-054 Carnaby's cockatoo confirmed breeding areas within the Swan Coastal Plain and Jarrah Forest IBRA Regions Filename: DBCA_054_Carnabys_Cockatoo_Confirmed_Breeding_Areas _within_the_Swan_Coastal_Plain_and_Jarrah_Forest_IBRA _Regions.shp Format: shapefile Geometry: polygon	Locations of confirmed breeding areas of Carnaby's cockatoo. Source: DBCA through SLIP	Yes	Whole area	2011-2018	Yes
11	DBCA-055 Carnabys Cockatoo Unconfirmed Breeding Areas within the Swan Coastal Plain and Jarrah Forest IBRA Regions Filename: DBCA055_CarnabyBreedUC.shp Format: shapefile Geometry: point	Unconfirmed locations of breeding area of Carnaby's cockatoo Source: DBCA through SLIP	Yes	Whole area	2011-2018	Yes
12	DBCA-063 Black Cockatoo Breeding Sites – Buffered Filename: Black_Cockatoo_Breeding_Sites_Buffer_DBCA_063.shp Format: shapefile Geometry: polygon	Locations of black cockatoo breeding sites Source: DBCA through SLIP	Yes	Whole area	2011-2018	Yes

#	Dataset	Description	Original data?	Spatial extent	Date / age	Include?
13	DBCA-056 Carnabys Cockatoo Areas requiring investigation as feeding habitat in the Jarrah Forest IBRA Region Filename: Format: shapefile Geometry: point	Areas of probable feeding habitat for Carnaby's cockatoo that require investigation Source: DBCA through SLIP	Yes	Whole area	2011-2018	Yes
14	DBCA 057 Carnabys Cockatoo Areas requiring investigation as feeding habitat in the Swan Coastal Plain (SCP) IBRA Region Filename: Carn_Cockatoo_investigate_feeding_habitats_SCP_DBCA_057.shp Format: shapefile Geometry: polygon	Areas of remnant veg in Swan IBRA that may provide important feeding resources for Carnaby's cockatoo. Source: DBCA through SLIP	Yes	Whole area	2011-2018	Yes
15	12-0324FA_(BC) – Black cockatoo roosting sites Filename: 12-0324FA_(BC).shp Format: Shapefile Geometry: point data	Locations of black cockatoo roost sites as identified by citizen scientists in the Great Cocky count coordinated by Birdlife WA. Source: DBCA threatened fauna	Yes	Whole area	2010-2019	Yes
16	Canning barriers Filename: CanningBarriers 20230804.shp Format: shapefile Geometry: point	Mapping of 197 barriers. Source: DBCA Science	Yes. Derived from field surveys & GIS	Canning only	Unknown start date, ongoing data collection	Yes
17	Fisheries data licence Filename: Fisheries_data_extraction.xls Format: excel spreadsheet Geometry: point	Presence or abundance of fish species at 144 sites. Source: DPIRD	Yes. Derived from data collected from Fisheries permits. UWA & DWER HRP data added	Whole area	2000-2017	Yes
18	Canning pools Filename: Canning_Pools.shp Format: shapefile Geometry: polygon	Pool depth, sedimentation and description from visual estimates at 134 pools. Source: DBCA Science	Yes. Derived from field surveys	Canning only	2013-16	Yes
19	Roley Pool Carter's mussel Filename: Carters_Transect_Database_Roley_Pool_2023.xls Excel spreadsheet format Geometry: point	Field survey of Carter's mussel. 5 sites within a ~ 1km stretch. Source: DBCA Science	Yes. Derived from field surveys	Roley pool only	2023	Yes
20	UWA masters thesis Middleton Filename: Jens_invertebrates_updated.xls Format: excel spreadsheet Geometry: point	Locations of invertebrates collected using a Surber sampler. Undertaken as part of a master's research project examining the association between catchment urbanisation, riparian integrity and macroinvertebrate health. Supervised by Leah Beesley	Yes. Derived from field surveys	One site in Wungong River	2015	Yes
21	Water quality data from WIR compiled by NESP Filename: WIR_Discrete_Data_Canning_Wungong_July2024request.xls Format: excel spreadsheet Geometry: point	Requested and downloaded all water quality data sampled within the study area from 2000 to 2023.	Yes	Whole area	2000-2023	Yes
22	Acid sulfate risk area Filename: DWER-049 Acid Sulfate Soil Risk Map 50K Format: shapefile Geometry: polygon	Data showing the risk of Potential Acid Sulfate Soil (PASS) materials that may be disturbed by land development activities based on the likelihood of PASS materials occurring within 3m of the ground surface.	Yes	Swan coastal plain only	2006	Yes

Table A 3 **Summary of datasets assessed for inclusion in the assessment of the condition of instream ecological values. Datasets were assessed based on if they are original data, the area covered by the dataset and the age of the data. Datasets were assessed based on if they are original data, the area covered by the dataset and the age of the data: green = met criteria; yellow = does not meet criteria, but limitations are acceptable; and, red = does not meet criteria.**

Instream values						
#	**Dataset**	**Description**	**Original data?**	**Spatial extent**	**Date / age**	**Include?**
1	**Canning barriers** Filename: CanningBarriers 20230804.shp Format: shapefile Geometry: point	Mapping of 197 barriers. Source: DBCA Science	Yes. Derived from field surveys & GIS.	Canning only	Unknown start date, ongoing data collection	Yes
2	**Fisheries data licence** Filename: FWFDB Canning Data Extraction_Clipped_plusLeahData_plusDWERdata.xlsx Format: excel spreadsheet Geometry: point	Presence or abundance of fish species at 144 sites. Source: DPIRD	Yes. Derived from data collected from Fisheries permits. UWA & DWER HRP data added.	Whole area	2000-2017	Yes
3	**Roley Pool Carter's mussel** Filename: Carters_Transect_Database_Roley_Pool_2023.xls Format: excel spreadsheet Geometry: point	Field survey of Carter's mussel. 5 sites within a ~ 1km stretch. Source: DBCA Science	Yes. Derived from field surveys.	Roley pools only	2023	Yes – threatened species
4	**Canning pools** Filename: Canning_Pools.shp Format: shathipefile Geometry: polygon	Pool depth, sedimentation and description from visual estimates at 134 pools. Source: DBCA Science	Yes. Derived from field surveys.	Canning only	2013-16	Yes
5	**Wungong riparian vegetation** Filename: WSE_Trib_Assx_Start_Points_hosted.shp Format: shaefile Geometry: point	Vegetation description & condition, and threats (e.g. erosion, weeds, vegetation loss). Source: DBCA Science	Yes. Derived from field surveys.	Southern-Wungong only	2021	Yes

Table A 4 Summary of datasets assessed for inclusion in the assessment of condition of riparian values. Datasets were assessed based on if they are original data, the area covered by the dataset and the age of the data: green = met criteria; yellow = does not meet criteria, but limitations are acceptable; and, red = does not meet criteria.

Riparian values						
#	**Dataset**	**Description**	**Original data?**	**Spatial extent**	**Date / age**	**Include?**
1	**DPIRD-006 Pre-European vegetation** Filename: DPIRD_006_Pre_European_Vegetation.shp Format: shapefile Geometry: polygon	Historic vegetation types across study area. Source: DPIRD through SLIP	Yes. Based on the published and unpublished mapping of J.S. Beard at 1:250,000 scale.	Whole area	1973	Only as an historic record of veg type.
2	**DPIRD-005 Native vegetation extent** Filename: DPIRD_005_Native_Vegetation_Extent.shp Format: shapefile Geometry: polygon	Location of native vegetation, including remnant and regrowth. Source: DPIRD through SLIP	Yes. From Landsat imagery.	Whole area	2019 & 2020	Yes
3	**DPLH-096 Urban forest mesh blocks** Filename: Urban_Forest_Mesh_Blocks_2020_DPLH_096.shp Format: shapefile Geometry: polygon	Vegetation height by strata for exotic and native spp. Source: DPLH through SLIP	Yes. Derived from aerial imagery and reported by urban monitor mosaic.	Whole area	2020	Yes
4	**DPIRD-093 Swan coastal plain remnant vegetation** Filename: Swan_Coastal_Plain_Remnant_Vegetation_ 2020_DPIRD_093.shp Format: shapefile Geometry: polygon	Polygons of remnant vegetation by original veg type. Source: DPIRD through SLIP	No. Same data as Native vegetation extent (DPIRD 005)	SCP only	2019 - 2020	No
5	**IBRA remnant vegetation** Filename: Beard_IBRA_remveg.shp Format: shapefile Geometry: polygon	Location of remnant vegetation and the IBRA bioregion. Source: WALGA through SLIP	No. Similar data to Swan coastal plain remnant vegetation (DPIRD 093).	Whole area	Unsure	No
6	**2020 Natural area prioritisation for Perth and Peel** Filename: L1_Prioritisation.shp Format: shapefile Geometry: polygon	Categorises native vegetation by a number of agreed criteria and scores of 1 = criteria met, 0 = not met. Source: WALGA through SLIP	No. Obtained by intersecting the 2020 remnant vegetation extent mapping with 26 other datasets which have a range of ecological or legislative relevance	Whole area	2020	No
7	**2020 Vegetation retention status for Beard Associations by IBRA regions** Filename: Beard_IBRA_postclearing_stats.shp Format: shapefile Geometry: polygon	Categorises the 2020 native veg extent mapping by % remaining of Beard Veg Association across IBRAs. Source: WALGA through SLIP	No. Uses Pre-European veg (DPIRD-006), Native Veg Extent (DPIRD-005) and IBRA maps	Whole area	2020	No
8	**Native vegetation extent by vegetation complexes** Filename: vegcomp_2020.shp Format: shapefile Geometry: polygon	Categorises the 2020 native veg extent mapping by veg complexes. Source: WALGA through SLIP	No. Derived from Native veg extent (DPIRD-005) & Veg complexes (DBCA-046 & DBCA-047)	Whole area	2012 - 2020	No
9	**Vegetation complex prioritisation for the Perth and Peel regions scheme areas** Filename: L3_Conservation_priority_RFLBC.shp Format: shapefile Geometry: polygon	Prioritises veg complexes restricted to study area & by degree of range depletion. Source: WALGA through SLIP.	No. Derived from Native veg extent (DPIRD-005) & Veg complexes (DBCA-046 & DBCA-047)	Whole area	2012 - 2020	No
10	**DBCA-046 Vegetation complexes – Swan Coastal Plain** Filename: Veg_Complexes_Swan_Coastal_ Plain_DBCA_046.shp Format: shapefile Geometry: polygon	Original (pre 1750) distribution of vegetation complexes on the Swan Coastal Plain. Source: DBCA through SLIP	Yes. Based on classifications from Heddle et al. (1980) at 1:250,000 scale	Whole area	1980	Only as an historic record of veg type.
11	**DPIRD-005 Native vegetation extent Perth NRM** Filename: Veg_Extent_DPIRD_005_PNRM_10km_z50.shp Format: shapefile Geometry: polygon	Veg extent and patch size, elongation and complexity. Source: Perth NRM	No. Derived from Native Veg Extent (DPIRD-005).	Whole area	2019 & 2020	No
12	**Vegetation complexes Perth NRM** Filename: Veg_Complexes_PNRM_DBCA_046_2022_z50.shp Format: shapefile	Veg structure, patch complexity and landform (geology). Source: Perth NRM	No. Derived from Veg complexes SW forest Region (DBCA-046) and Veg extent (DPIRD_005). .	Forest area only		No.

Riparian values						
#	**Dataset**	**Description**	**Original data?**	**Spatial extent**	**Date / age**	**Include?**
	Geometry: polygon					
13	**Vegetation complexes combined Perth NRM** Filename: Veg_Complexes_PNRM_Forest_DBCA_046_047_2022_z50.shp Format: shapefile Geometry: polygon	Veg complexes & patch size & complexity. Source: Perth NRM	No. Derived from Vegetation complexes (DBCA-046 & DBCA-047).	Whole area		No
14	**Native vegetation patch greater than 1000 ha** Filename: NVE_Patch_over_1000ha.shp Format: shapefile Geometry: polygon	Patches of native veg greater than 1000 ha. Source: Perth NRM	No. Same data as Native_Veg_Extent_DPIRD_005_PNRM_10km_z50 but limited to veg patches greater than 1000 ha	Whole area		No
15	**Native vegetation patch greater than 2000 ha** Filename: NVE_Patch_over_2000ha.shp Format: shapefile Geometry: polygon	Patches of native veg greater than 2000 ha. Source: Perth NRM	No. Same data as Native_Veg_Extent_DPIRD_005_PNRM_10km_z50 but limited to veg patches greater than 2000 ha	Whole area		No
16	**Perth regional ecological linkages** Filename: PMR_RegLinks_2004.shp Format: shapefile Geometry: polygon	Regional ecological linkages showing links between patches of regionally significant remnant veg. Source: WALGA through SLIP	Yes.	Whole area	2004	Yes.
17	**Naturelink connectivity** Filename: all_PA_LCP_linkages.shp Format: shapefile Geometry: polygon	Ecological linkages across Perth. Source: Murdoch Uni through Perth NRM	Yes. Data generated from least cost path modelling in ArcGIS.	Whole area	2020	Yes
18	**Swan and Canning Rivers Foreshore Assessment (FAMS)** Filename: Vegetation_unit_ll.shp Format: shapefile Geometry: polygon	Detailed quantification of riparian vegetation condition. Source: DBCA Riverbank	Yes. Field surveys of vegetation including dominant species, height, DBH, density, etc.	Canning only	2005/06	Yes
19	**DBCA-066 Swan Canning riparian ecology foreshores 2019** Filename: Swan_Canning_Riparian_Eco_Foreshores_2019_DBCA_066.shp Format: shapefile Geometry: polygon	Description of veg condition, foreshore type (e.g. engineered, vegetated), proportion weeds, overall condition index. Source: DBCA Riverbank	No. Derived from other sources including Swan & Canning Rivers Foreshore Assessment & Gov other datasets (e.g. conservation estate, distance to priority flora & fauna).	Canning only		No
20	**DBCA-067 Swan Canning riverbank natural foreshores 2019** Filename: Swan_Canning_Riverpark_Nat_Foreshores_2019_DBCA_067.shp Format: shapefile Geometry: polygon	Description of vegetated foreshores. Source:	No. Original data comes from FAMS vegetation assessment, 2012 hovercraft video footage, other GIS layers (age unclear) and site visits in 2015 & 2019	Canning only		No
21	**DBCA-065 Swan Canning riverpark built foreshores 2022** Filename: Swan_Canning_Riverpark_Built_Foreshores_2022_DBCA_065.shp Format: shapefile Geometry: polygon	Description of built foreshores including walls, revetments, bioengineering, etc. Source: DBCA Riverbank	Yes. Video surveys of the foreshore reviewed and classified by engineers.	Canning only	2021	Not ecological values
22	**Wungong riparian vegetation** Filename: WSE_Trib_Assx_Start_Points_hosted.shp Format: shapefile Geometry: point	Vegetation description & condition, and threats (e.g. erosion, weeds, vegetation loss). Source: DBCA Healthy Catchments	Yes. Derived from field surveys.	Southern-Wungong only	2021	Yes
23	**DWER-020 FPM Floodplain area** Filename: Format: shapefile Geometry: polygon	Shows area flooded in a 1 in 100 AEP flood. Source: DWER through SLIP	Yes. Digitised version of hardcopy floodplain mapping.	Whole area	Unknown original data, updated 2022	Yes
24	**Canning pools** Filename: Canning_Pools.shp Format: shapefile Geometry: polygon	Pool depth, sedimentation and description from visual estimates at 134 pools. Source: DBCA Healthy Catchments	Yes. Derived from field surveys.	Canning only	2013-16	Yes

Table A 5 Summary of the threats identified for MNES; threatened ecological communities (TECs); threatened flora; and, threatened fauna, as well as broad instream and riparian condition. Corresponding threats were determined from reviewing Conservation Advices, Threatened species action plans and listing documents.

Threats		TECs			Threatened flora				Threatened fauna								Broad condition	
		Banksia WL SCP	Clay pans SCP	Corymbia-Kingia TEC	*Banksia mimica*	*Eleocharis keigheryi*	*Morelotia australiensis*	*Thelymitra stellata*	Baudin's cockatoo	Carnaby's cockatoo	Carter's freshwater mussel	Chuditch	Common greenshank	Forest red-tailed	Numbat	Quokka	Riparian condition	In-stream Condition
Commonwealth-listed threatening processes	Rabbits		■					■									■	
	Dieback	■	■	■	■		■		■	■						■	■	
	Changed fire regime	■	■		■		■	■	■	■					■	■	■	
	Land clearance	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	
	Escaped garden/ aquatic plants																■	■
	Loss of climatic habitat	■	■						■	■	■		■			■	■	■
	Novel biota	■	■						■			■		■			■	
	Foxes											■			■	■		
	Feral cats														■	■		
	Feral pigs		■								■					■	■	
Threats identified in conservation / listing advice documents	Hydrological change	■	■	■		■				■	■		■			■		■
	Salinisation			■		■				■	■					■		■
	Anthropogenic degradation	■				■	■	■				■	■		■	■	■	■
	Grazing / trampling	■	■	■		■				■	■						■	
	Decline in pollinisers	■															■	
	Loss of keystone / host spp	■									■						■	■
	Weed invasion	■	■	■	■	■	■	■		■			■				■	■
	Competition								■					■				
	Illegal killing								■	■		■	■	■				
	Pathogens								■							■		
	Borer								■								■	
	Pollution										■		■					■
	Aquatic habitat loss										■							■

Table A 6 List of identified threats to MNES and broad instream and riparian condition. Threats are ranked by the number of MNES they correspond to (as per Table A5). Threats with available spatial datasets within the study area are in grey.

Threat	No./15	Dataset
Land clearance	14	2020 Vegetation retention status for Beard Associations by IBRA regions DPLH084 Development outlook – residential DPLH085 Development outlook - industrial
Changed fire regime	9	DBCA-060 fire history Juvenile Period in Slow-Maturing Plants (Recent) - SW of WA (DBCA-073) Juvenile Period in Slow-Maturing Plants (2050 RCP 4.5) - SW of WA (DBCA-074) Juvenile Period in Slow-Maturing Plants (2090 RCP 4.5) - SW of WA (DBCA-075) Juvenile Period in Slow-Maturing Plants (2090 RCP 8.5) - SW of WA (DBCA-076)
Weed invasion	9	Wungong riparian vegetation FAMs
Dieback	8	NA. There may be data held by LGAs.
Hydrological change	8	NA
Anthropogenic degradation	8	Wungong riparian vegetation FAMs
Loss of climatic habitat	7	NA
Grazing / trampling	6	NA
Novel biota	5	NA
Illegal killing	5	NA
Salinisation	4	NA
Foxes	3	NA
Feral pigs	3	NA
Loss of keystone / host spp	3	NA
Feral cats	2	NA
Competition	2	NA
Pathogens	2	NA
Pollution	2	Drains Wungong riparian vegetation (sedimentation) WIR water quality compilation DWER-049 Acid Sulfate Soil Risk Map 50K
Rabbits	2	NA
Borer	1	NA
Aquatic habitat loss	1	Canning barriers Canning pools Swan-Canning natural foreshores 2019
Escaped garden / aquatic plants	0	NA

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