Lake Kununurra and Lily Creek Lagoon

Vegetation Management Plan

PREPARED BY

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FOR

The Shire of Wyndham East Kimberley

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1. EXECUTIVE SUMMARY

The purpose of this Vegetation Management Plan (VMP) is to identify management actions for aquatic and foreshore vegetation within the Lake Kununurra and Lily Creek Lagoon Study Area.

This 2026 VMP supersedes the previous 2008 version and has been updated to reflect current management priorities, contemporary practices, and alignment with the 2024 Lake Kununurra Foreshore Plan. The review has been informed by stakeholder consultation and recognises that, while previous plans have identified key issues, implementation has historically been inconsistent and many challenges remain.

The Study Area comprises a highly valued tropical freshwater system that supports ecological, recreational, cultural, and aesthetic values, including its designation as part of the Ord River Floodplain Ramsar site. Vegetation within the area includes riparian, aquatic and parkland communities, which play an important role in maintaining water quality, providing habitat, and supporting biodiversity.

The key issues addressed by this VMP include:

- Proliferation of aquatic and riparian weeds, including cumbungi and other aquatic plant species; and
- Degradation of native riparian and foreshore vegetation requiring protection and rehabilitation.

A central focus of this Plan is the management of cumbungi (*Typha orientalis*), which has expanded significantly in parts of Lily Creek Lagoon and Lake Kununurra. While cumbungi provides important ecological functions, including habitat provision and sediment stabilisation, its excessive growth can restrict water flow, reduce recreational access, and alter habitat diversity. As such, management will focus on targeted control rather than eradication, with removal prioritised in areas of high recreational, aesthetic, or operational value while retaining sufficient vegetation to support ecological functions.

Vegetation management across the Study Area is undertaken by multiple land managers depending on land tenure and lease arrangements. Activities are generally focused on maintaining recreational areas, controlling invasive species, and preserving foreshore amenity and access.

This VMP establishes a series of guiding principles to inform vegetation management, including:

- Avoiding large-scale clearing of vegetation that provides ecological function unless supported by a long-term rehabilitation strategy;
- Ensuring that weed removal is accompanied by rehabilitation and follow-up control;
- Limiting cumbungi removal to defined priority areas and implementing staged removal to maintain habitat diversity;
- Preferring non-chemical control methods, particularly within or near waterbodies; and
- Retaining vegetation where it performs important ecological or hydraulic functions.

The VMP also recognises that current vegetation mapping and baseline data are outdated, having been derived from surveys undertaken in 2008 (and earlier). Updated flora and vegetation surveys are scheduled for 2026 to improve understanding of vegetation condition, species composition, and

spatial extent. The outcomes of these surveys will inform future revisions of the VMP and enable more targeted and evidence-based management actions.

Monitoring and adaptive management are key components of this VMP. Proposed monitoring includes:

- Assessment of vegetation condition and community composition;
- Monitoring of cumbungi extent, including comparison with historical mapping using aerial imagery (if available); and
- Ongoing evaluation of management effectiveness to inform future updates to the VMP.

Implementation of this VMP will require coordination between key stakeholders, including the Shire of Wyndham East Kimberley, Department of Water and Environmental Regulation, Department of Biodiversity, Conservation and Attractions, and other relevant land managers. Existing governance arrangements, including the Lake Kununurra Foreshore Committee, will play an important role in guiding implementation and prioritising actions.

This VMP is intended to function as a living document, with outcomes from monitoring, stakeholder input, and updated scientific data informing future revisions. Through a coordinated and adaptive approach, the Plan aims to balance ecological protection with recreational and community values, ensuring the long-term sustainability of the Lake Kununurra and Lily Creek Lagoon foreshore environment.

2. DEFINITIONS

Acronym	Definition
Aquatic vegetation	Vegetation that grows wholly or partially within water, including submerged, emergent and floating species.
Conservation area	An area set aside for conservation and preservation due to its high conservation value. In the context of the Study Area, this typically includes vegetation in good to very good condition.
Cumbungi (*Typha* spp.)	A native emergent aquatic plant commonly found in freshwater wetlands and waterways. While it provides important ecological functions, excessive growth can restrict water flow, reduce habitat diversity, and impact recreational and aesthetic values.
Foreshore	Land adjacent to a waterbody extending from the water's edge to the limit of terrestrial vegetation or development.
Land Management Unit (**LMU**)	A spatial area defined within the Study Area to group locations with similar land use, management objectives or environmental characteristics.
P1	Kununurra's public drinking water source area has been classified as a Priority One (P1) area. Land use activities within the PDWSA must be compatible with the WA *Planning Commission's Statement of Planning Policy 2.7 - Public Drinking Water Source Policy 2003* prepared under the *Town Planning and Development Act 1928.*
Parkland	An area used as a park and for recreation. These areas have high amenity value and usually require the highest amount of maintenance.
Riparian Zone	The interface between land and a waterbody, including the vegetation and soils directly influenced by the presence of water.
Study Area	The Lake Kununurra and Lily Creek Lagoon system, including associated riparian, aquatic, and foreshore environments as defined in the Shire of Wyndham East Kimberley's 2024 *Lake Kununurra Foreshore Plan* (**Figure 1**).
Weeds	Any plant species—native or non-native—that grows excessively in aquatic or riparian environments and causes ecological, economic, or social harm. These weeds can: • Obstruct water flow in rivers, creeks, and drainage systems • Effect water quality by altering nutrient cycles or oxygen levels • Outcompete native aquatic or riparian vegetation • Impact biodiversity by changing habitat structure • Interfere with recreational, agricultural, or cultural uses of waterways.

3. ACRONYMS AND ABBREVIATIONS

Acronym	Definition
APVMA	Australian Pesticides and Veterinary Medicines Authority
BRMP	Bushfire Risk Management Plan
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Department of Environment and Conservation (now DWER and DBCA)
DFES	Department of Fire and Emergency Services
DoFA	Department of Food and Agriculture (now DPIRD)
DoW	Department of Water (now DWER)
DoT	Department of Transport
DPI	Department for Planning and Infrastructure (now DPLH)
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
KAI	Kimberley Agricultural Investment
LMU	Land Management Unit
M1	Main Irrigation Channel
MG	Miriuwung Gajerrong Corporation
MNES	Matters of National Environmental Significance
NAP	National Action Plan for Salinity and Water Quality
NT	Northern Territory
NVCP	Native Vegetation Clearing Permit
OIC	Ord Irrigation Cooperative
OLW	Ord Land and Water
PDWSA	Public Drinking Water Source Area
PEC	Priority Ecological Community
SEEKS	Save Endangered East Kimberley Species
the Shire	Shire of Wyndham East Kimberley
TAFE	Technical and Further Education
TDS	Total Dissolved Solids
UCL	Unallocated Crown Land
VMP	Vegetation Management Plan
VMU	Vegetation Management Unit

4. INTRODUCTION

4.1 Background

This Vegetation Management Plan (**VMP**) was originally prepared for the Shire of Wyndham East Kimberley (**the Shire**) in January 2008 as part of the Shire's commitment to the National Action Plan for Salinity and Water Quality (**NAP**) funded project.

Community consultation was based on the 2006 version of the Shire's *Lake Kununurra Foreshore Plan* and the following organisations were consulted throughout the development of the VMP:

- Department of Water (now part of **DWER** (Department of Water and Environmental Regulation));
- Department of Environment and Conservation (now part of DWER and **DBCA** (Department of Biodiversity Conservation and Attractions));
- Water Corporation;
- Department for Planning and Infrastructure (now DPLH (Department of Planning, Lands and Heritage)); and
- Ord Land and Water (**OLW**).

Following extensive stakeholder consultation, the Foreshore Plan was updated in 2024 (**the Foreshore Plan**) (Shire of Wyndham East Kimberley, 2024a).

The need to review this VMP was identified during the Foreshore Plan consultation. This revised 2026 version supersedes the previous (2008) version and addresses administrative amendments and current best practice options and techniques for vegetation management, as well as changes to foreshore development and future development aspirations.

Assessment of floristic structure changes will occur during surveys planned for 2026 and will inform future revisions. It is expected this revised VMP will better support clearing permit applications within the Study Area.

While this update reflects current knowledge and management practices, it is acknowledged that available vegetation mapping and historical records are limited. The outcomes of the 2026 surveys will be used to refine vegetation mapping, management priorities, and control measures in subsequent revisions of this VMP.

4.2 Purpose

Weeds, ad hoc development, and increased visitor use and access place pressure on the Study Area (as defined in Section 4.3 below) which requires ongoing management. The development of this VMP arose in response to conflict between the management of these pressures, and community and agency concern over slashing boundaries, weed removal without rehabilitation, and unauthorised cumbungi (*Typha domingensis*) removal.

The purpose of this VMP is to identify management actions for aquatic and foreshore vegetation that meets community expectations for the Study Area, as identified in the Foreshore Plan, and retains the ecosystem values associated with the water body. This includes clearly identifying the responsibilities,

policies, actions, and regulations that are in place to ensure effective vegetation management within the Study Area. The VMP is therefore to provide for the management of vegetation in and around the Lake Kununurra town foreshore and Lily Creek Lagoon in a manner that is compliant with all relevant regulatory and planning bodies.

This VMP is intended to be updated as future developments occur and new strategies and techniques arise, or as the floristic structure of an area changes. This revised 2026 version of the VMP supersedes the previous (2008) version.

4.3 Overview of Study Area

Lily Creek Lagoon and Lake Kununurra are permanent water bodies formed by the damming of the Ord River. Built in 1963 to supply water to the Ord River Irrigation Area, water levels of Lake Kununurra are regulated and managed primarily for this purpose by the Water Corporation.

Biophysical conditions within the water bodies include high water temperatures, an intense sunlight regime, high water clarity, relatively high concentrations of total nitrogen and phosphorus, and fertile sediments. These conditions are ideal for growth of aquatic plants and the lake, including Lily Creek Lagoon, becomes eutrophic at various times in the year (Watkins *et al,* 1997).

This VMP focuses on the vegetation surrounding and within these water bodies. The Study Area aligns with the area defined in the Foreshore Plan and covers the area between the Diversion Dam and Kununurra Racecourse, as well as land outside of the immediate town area (**Figure 1**).

To ensure a comprehensive approach to the development of this important area, the main planning area under consideration has been separated into five Precincts, each with its own unique character and special qualities. These Precincts are described in detail in Section 9 below.

4.4 Significance of the wetland

Lake Kununurra and Lily Creek Lagoon are listed under the Convention on Wetlands of International Importance (Ramsar Convention) as components of the listing 'Lakes Argyle and Kununurra', Western Australia site no. 32 and are therefore afforded protection under both State and Commonwealth legislation. The Lake supports habitat for waterbirds, freshwater fish, and the freshwater crocodile and is an important dry season refuge. Twenty-one species of fish are known to occur in Lake Kununurra (Hall, 2000).

Lake Kununurra and Lily Creek Lagoon are used extensively for a variety of industry purposes and recreational activities and the area considered by this VMP is central to the character of Kununurra. The water body and its environs are highly valued by the community (both residents and visitors alike).

Prior to the development of the Foreshore Plan, some development occurred within the Study Area in the absence of an overarching strategy to guide decision making. These include several caravan parks, a golf course, boating and yachting facilities, areas for swimming and water-skiing, and an amphitheatre (Lake Kununurra Foreshore Committee, 2006). However, since its development the Foreshore Plan has served as a set of guiding principles to be used during planning process to shape and direct development and management of the Foreshore.

Water from Lake Kununurra is used to irrigate farms in Stage 1 and Stage 2 of the Ord Irrigation Scheme via the M1 and M2 irrigation channels and the M2 Supply Channel Project expanded irrigation

infrastructure to support agriculture on approximately 50,000 hectares of black soil plains, including the Weaber, Keep River, and Knox Creek Plains (Kimberley Development Commission [KDC], 2025). This expansion was facilitated by the construction of the M2 supply channel, with development commencing around 2010. Farming activities, particularly on the Goomig farmlands, began in 2015 (Department of Primary Industries and Regional Development [DPIRD], 2018).

The Stage 2 project is being developed by Kimberley Agricultural Investment (**KAI**), which entered into lease agreements with the Western Australian Government in 2017. Further expansion, referred to as Stage 3, is underway, focusing on an additional 6,000 hectares of red loamy soils at the Cockatoo Sands near Kununurra (KDC, 2025).

Water for these developments continues to be sourced from Lake Kununurra and is distributed through the newly established M2 channel infrastructure. This expansion significantly increased the irrigated agricultural area in the region, supporting a variety of crops and contributing to the local economy.

The water from Lake Kununurra and Lily Creek Lagoon also recharges the bores from which Kununurra's potable water is supplied. The Study Area includes the well-head protection zone around the bores and a larger P1 classification area designed to ensure the town's water supply is not compromised (Department of Water [DoW], 2012).

The water body and its environs are important to the local Aboriginal (Miriuwung Gajerrong) people and a number of significant Aboriginal Heritage Sites are located within the Study Area.

The foreshore and waterway directly support a thriving tourism industry. People who visit Kununurra often utilise commercial tourism opportunities during their stay. These tourism enterprises, such as caravan parks, tour boat operators and the annual Ord Valley Muster's Kimberley Moon Experience, directly contribute to the local economy and provide local employment.

The foreshore and waterbodies are used extensively by residents and visitors for both passive and active recreational pursuits. These include:

- Walking;
- Cycling
- Bird watching;
- Dog exercising;
- Picnicking;
- Swimming;
- Sightseeing;
- Boating;
- Water-skiing;
- Local events;
- Sailing;
- Fishing; and

- Canoeing/ kayaking.

Balancing these activities and values while maintaining the ecological and amenity values upon which these activities rely is a challenge.

4.5 Legislation and policies

The Study Area covers a wide range of land tenures, and many agencies have Acts, Regulations and policies that will guide land use and vegetation management. These include:

- *Land Administration Act 1997;*
- *Country Area Water Supply Act 1947;*
- *Rights in Water and Irrigation Act 1914* (RIWI Act)*;*
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Aboriginal Heritage Act 1972;*
- *Environmental Protection Act 1986* (EP Act)*;*
- *Environmental Protection (Clearing of Native Vegetation Regulations 2004);*
- *Biodiversity Conservation Act 2016;*
- *Biosecurity and Agriculture Management Act 2007*;
- *Conservation and Land Management Act 1984* (CALM Act);
- *Planning and Development Act 2005;* and
- Statement of Planning Policies.

These instruments relate to actions such as clearing of native vegetation, taking of water, flora and/or fauna, disturbance to bed and banks, protection of heritage and aboriginal sites and developments. Consultation with relevant agencies and departments should occur before any new actions or activities take place within the Study Area.

4.6 Related documents

In addition to statutory obligations, this VMP is guided by the following documents. These documents were prepared with a high level of community consultation, and each should be considered in future management of the Study Area:

- Lake Kununurra Foreshore Plan (2024);
- Rangelands Natural Resource Management Strategy (2015 - 2025); and
- Ord Surface Water Allocation Plan (2013).

Consideration of and consistency with these above documents contributes to ensuring that this VMP fulfils community expectations.

5. VISION AND OBJECTIVES

Vision

To manage Lily Creek Lagoon and Lake Kununurra in a manner that satisfies conservation requirements whilst maintaining aesthetic and recreational values.

Objectives

- To maintain the ecological values of Lily Creek Lagoon and Lake Kununurra whilst still enabling the management and maintenance of public open space for recreation purposes.
- To integrate the town development with that of the Lake foreshore and provide appropriate recreational and tourism facilities while avoiding degradation of the Lake's and Lagoon's ecological values.
- To outline a cooperative and coordinated approach to the management of vegetation in and around Lake Kununurra and Lily Creek Lagoon that meets legislative requirements as well as community expectations.
- To conserve the natural, scenic, and wildlife resources.
- To protect the foreshore from fire, erosion, and general misuse.

6. MANAGEMENT RESPONSIBILTIES

The foreshore reserves and associated areas included in the VMP are owned or managed by a variety of agencies including the Shire, the DWER, Water Corporation, DPLH, the Miriuwung Gajerrong Corporation (**MG**) and the Department of Biodiversity, Conservation and Attractions (**DBCA**). Additionally, a number of private landholdings exist within the Study Area, including three caravan parks with access leases to the foreshore, and the land containing the Pump House Restaurant, which is held in freehold title by the Water Corporation.

6.1 DBCA

DBCA's overarching role is to achieve improved environmental outcomes. Key responsibilities include roles in conserving biodiversity and protecting, managing, regulating, and assessing many aspects of the use of the State's natural resources.

Key responsibilities in regard to Lake Kununurra and its foreshore are:

- Contributing to the environmental impact assessment process for proposed developments;
- DBCA is responsible for reporting on listed Ramsar wetlands, mapping wetland areas and management of wetlands on conservation estate under the CALM Act. DBCA provides advice to decision makers and is involved in wetlands research and monitoring; and
- Protecting native flora and fauna.

6.2 Kununurra Visitor Centre

The Kununurra Visitor Centre is involved in decision making ideas to bolster the tourism opportunities on the Foreshore. The Visitor Centre also play a vital role in promotion of the Foreshore to visitors and locals around tourism opportunities.

6.3 Water Corporation

The Water Corporation is responsible for the management of water levels in the lake for irrigation water supply and environmental flows. The Water Corporation maintains the infrastructure associated with the lake which are the Lake Argyle Dam, Diversion Dam, Spillway, and the M1 irrigation channel intake.

In addition to management of the water supply and infrastructure for irrigation, the Water Corporation manages the Kununurra Public Drinking Water Source Area (**PDWSA**) and the bore fields that supply the town with good quality drinking water.

6.4 The Shire

The Shire is responsible for the management of Foreshore Reserve 41812, Reserve 29167 (Kununurra Golf Club) and Reserve 30290 (racecourse). Reserve 41812 includes the areas known as Swim Beach and Ski Beach, Celebrity Tree Park (Reserve 42371) and Lakeside Caravan Park. The Shire manages these public parks for recreation and leases other areas to sporting groups such as the ski, race, rodeo, and golf clubs.

The Shire plays a pivotal role in the management of the foreshore due to its administrative jurisdiction over the area. Their involvement encompasses various responsibilities such as:

- Policy Development;
- Management of leases and reserves (including properties leased to commercial boat operators);
- Community Engagement;
- Environmental Conservation;
- Development Approval and Regulation; and
- Implementation of the Lake Kununurra Foreshore Plan.

6.5 DWER

The DWER is responsible for the sustainable management of the State's water resources and environment through investigation, planning, regulation, and management of these resources. Broadly, DWER is the lead agency responsible for waterways, floodplains, and estuaries, while the DBCA is responsible for wetlands. In the context of the Foreshore Plan, DWER is a management authority responsible for:

- Providing water-related advice and conditions for planning decisions;
- Implementing the Ord Surface Water Allocation Plan (2013), which specifies how water will be allocated to meet competing environmental, social and commercial water requirements;
- Protecting Kununurra's public drinking water source through the implementation of the Kununurra Drinking Water Source Protection Plan (2003) and Kununurra Drinking Water Source Protection Review (2012);
- Licensing surface and groundwater use, including water service providers such as the Ord Irrigation Cooperative (**OIC**) and Water Corporation and self-supply users in accordance with the RIWI Act;
- Issuing native vegetation clearing permits for the purpose of managing cumbungi and other aquatic and riparian vegetation;
- Measuring and monitoring the quality and quantity of groundwater and surface water in the Ord River catchment;
- Issuing permits to disturb the bed or banks of a water course for the purpose of vegetation clearing, water pump infrastructure installation, boat ramp/jetty construction or bank modification.
- Management of contaminated sites and coordination of pollution incident responses.

6.6 Department of Transport (DoT)

The purpose of DoT within the Foreshore and waterway is Marine Safety. DoT provide safe navigation and safe use of State waters, protect the marine environment and provide for an effective response to marine emergencies. Marine Safety fulfils this role through:

- Ensuring compliance by commercial and recreational boat owners with marine regulations and standards;

- Minimising the impact of marine pollution;
- Providing expert marine safety advice and infrastructure to aid safe navigation of State waters;
- Educating and training the community in safe, sustainable use of State waters;
- Gazetting and enforcement of speed restrictions, ski area and other gazettes; and
- Approving and administering moorings.

6.7 DPLH

The Land Use Management division of the DPLH administers Crown land under the *Land Administration Act 1997* and other legislation, providing functions such as:

- Creation and administration of easements, leases, licences, reserves and roads;
- Transfer of Crown land in freehold;
- Management of the Aboriginal Lands Trust and Crown land estates in association with other agencies;
- Negotiation and consultation with native title holders and claimants where the *Native Title Act 1993* provides rights to those parties in relation to Crown land; and
- Acquisition of land for government public works.

The Heritage and Property Services division provides support and advice in relation to Aboriginal cultural heritage in line with the *Aboriginal Heritage Act 1972* (**AHA**), including:

- Assistance in identifying known cultural heritage values prior to commencement of ground disturbing works;
- Guidance in relation to stakeholder engagement on matters of possible ground disturbing activities, cultural heritage obligations, and the requirement to consult under s18(1AA) AHA;
- Assistance with engagement with stakeholders, where required, to minimise the impact to the natural environment and maintain cultural heritage; and
- Assistance with consultation with stakeholders, where required, in the development of cultural heritage management plans to maximise the protection, preservation, and promotion of Aboriginal cultural heritage.

6.8 Miriuwung Gajerrong Corporation (MG)

The MG Corporation is a key stakeholder in all lands and waters surrounding Kununurra, representing the traditional owners of the land. MG Corporation is consulted before development and land use planning occurs.

This Corporation and its people are important in identifying sites of cultural significance and speaking the history of the area, and their involvement is required for any land development activities on which native title has not yet been resolved.

Including an MG representative in all decision making is critical to ensure the development continues to align with Miriuwung Gajerrong Corporation's vision for their country.

7. POTENTIAL THREATS

Threats to the maintenance of the ecological, social, economic, and cultural values of the lake include:

- Fire;
- Ad hoc development;
- Weeds; In particular *Salvinia molesta* (salvinia) and *Leucaena leucocephala* (leucaena);
- Increased visitor use and access including increases in power boat activities;
- Unmanaged visitor use and access;
- Stormwater runoff;
- Feral animals;
- Use of pesticides and herbicides near the waterbody;
- Unauthorised clearing;
- Cumbungi and other aquatic vegetation that has become weedy, resulting in the loss of wading habitat, reduced biodiversity, or reduced access;
- Absence of a statutory Ramsar Management Plan; and
- Lack of resource allocation from land managers.

8. THE PLANNING FRAMEWORK

8.1 Land Management Units (Precincts)

In order to link this VMP with the Foreshore Plan, the five Precincts used in the Foreshore Plan are replicated here as Land Management Units (**LMUs**) (see Figure 1). These Precincts are described in detail in Section 9 below.

8.2 Vegetation Management Units

To gain an understanding of the floristic components of the Study Area, each LMU was historically broken into Parkland, Conservation, and Riparian Vegetation Management Units (**VMUs**) however, due to inconsistencies in the data presented in previous versions of the VMP, these have not been replicated in this VMP. As described below, surveys will be conducted in 2026 to inform vegetation mapping that will be utilised in the development of future iterations of this VMP.

8.3 Historical vegetation condition mapping

The extent and floristic structure of the vegetation within the Study Area was mapped in 2008 using data collected by Kimberley TAFE students from transects and quadrats. Data was interpreted using a modified Vegetation Condition Scale as presented below. This scale used both quantitative and qualitative assessment procedures to describe the state of the vegetation in a particular area.

Table 1 – Vegetation Condition Scale (Adapted from Trudgen, 1991)

Good – Very Good	• 80-100% native flora composition • Vegetation structure intact or nearly so • Cover/abundance of weeds less than 5% • No or minimal signs of disturbance
Fair - Good	• 50-80% native flora composition • Vegetation structure modified • Cover/abundance of weeds 5-20% • Minor signs of disturbance
Poor	• 20 – 50% native flora composition • Vegetation structure completely modified • Cover/abundance of weeds 20-60% • High level of disturbance
Very Poor	• 0-20% native flora composition • Vegetation structure disappeared • Cover/abundance of weeds 60-100% • Very high level of disturbance

The 2008 vegetation surveys involved transects carried out on foot or by boat in each of the original six precincts to determine placement of vegetation sampling quadrats. Areas with differing forms of vegetation or areas that appeared to represent the dominant vegetation within the precinct were chosen as quadrat sites. The location of these sites was recorded with GPS. These 100m^2 quadrat sites were used to determine:

- composition and percentage of native flora;
- composition and percentage cover of weeds;
- vegetation structure; and
- signs of disturbance such as clearing, rubbish disposal, fire and tracks.

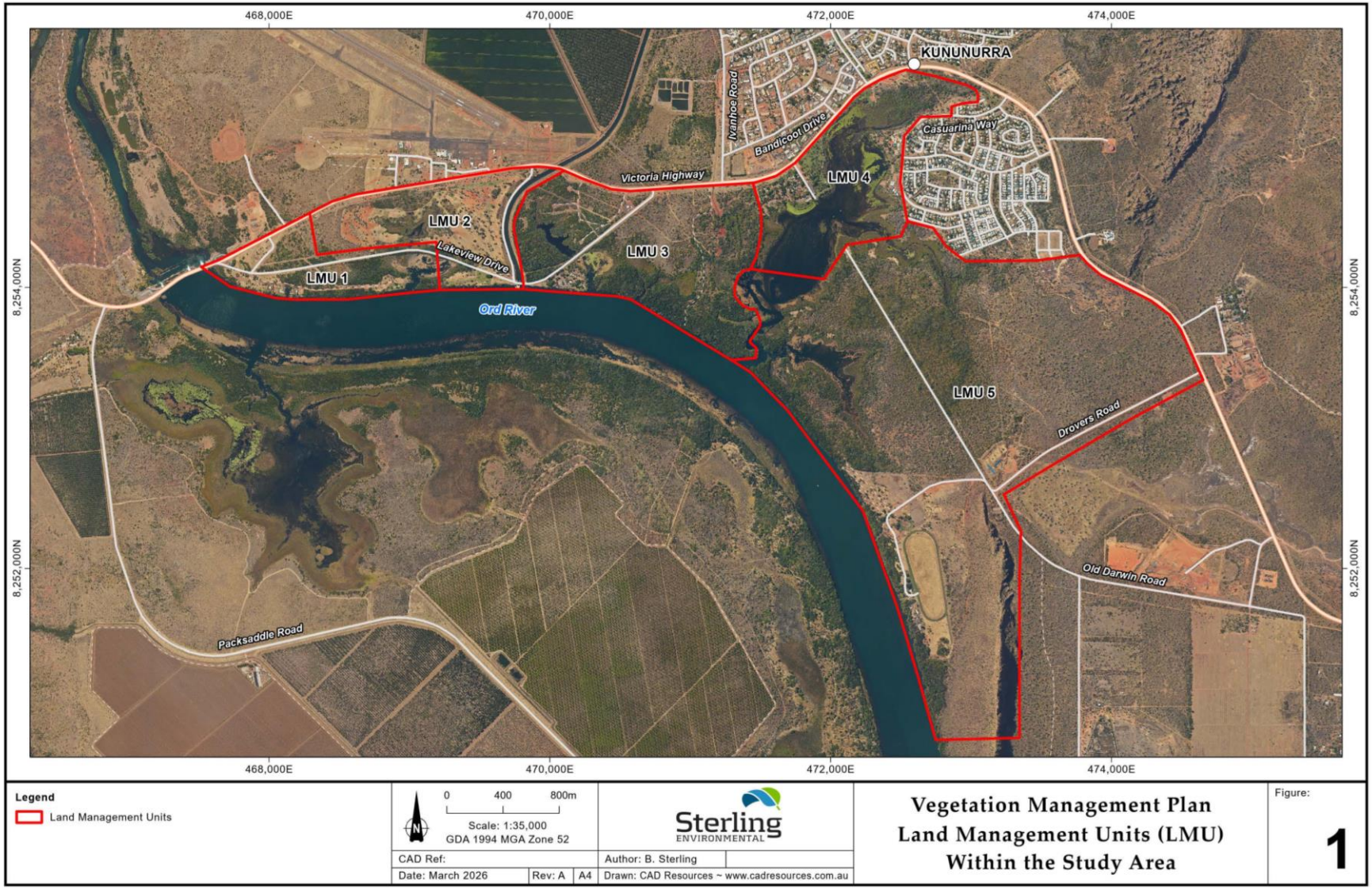

Figure 1: Land Management Units (Precincts) of Lily Creek Lagoon and Lake Kununurra

For each quadrat, the plant species and their numbers were used to give an indication of dominant species within each precinct.

This information formed the Vegetation Condition Tables for each LMU which in turn was used to help guide the recommended management actions. Improvement in the management of the LMUs should result in an improvement in vegetation condition and hence these condition ratings and species information can be used in the future to help assess whether vegetation condition has improved or degraded.

Aerial Mapping

Past and present (in 2008) photographs were used to map the extent of cumbungi in the 2008 version of the VMP (**Figure 9**). This process was limited by the quality and different scales of the aerial photographs. However, when combined with ground-truthing, the photographs provided a useful starting point for the on-ground analysis as well as portraying some patternistic changes. See Section 10 for further information and discussion on cumbungi.

A review of publicly available aerial imagery is proposed as part of 2026 monitoring, subject to imagery of sufficient resolution being available. No drone or aircraft surveys are proposed. These images will be used to undertake a visual comparison with the 2008 mapping to assess any broad changes in the extent of Cumbungi within Lily Creek Lagoon. The results of this monitoring will be reflected in the 2027 iteration of this VMP.

Future (2026) Flora and Vegetation Surveys

As part of a Master Planning initiative underway at the time of writing this VMP, the Shire is planning to undertake further biological surveys within the five Precincts described in the Foreshore Plan (and this VMP) in March 2026. Due to a loss of continuity in data, the quadrat and photo reference points used in 2008 are not proposed to be replicated. The 2026 surveys will involve significantly more monitoring points, and data obtained will form the basis for future updates to this VMP.

The 2026 vegetation surveys will involve a reconnaissance flora and vegetation survey undertaken in accordance with EPA guidance. Survey areas will be traversed on foot to identify representative vegetation types and suitable locations for vegetation sampling. Sampling points will be selected to capture the range of vegetation communities present across the Study Area, including areas representing dominant vegetation types or distinct habitat features.

At each sampling location, non-permanent vegetation sampling points (relevés) will be established and recorded using GPS. Data collected at each relevé will include vegetation structure, dominant flora species and their estimated cover, soil and landform characteristics, and evidence of disturbance (e.g. grazing, fire or weed invasion). Representative photographs will also be taken at each sampling location.

Additional observations and opportunistic data collection will occur while traversing the survey areas to assist with vegetation mapping and condition assessment. Targeted searches will also be undertaken for conservation-significant flora, including Threatened and Priority species where suitable habitat occurs. The data collected from relevés, targeted searches and opportunistic observations will be used to characterise vegetation communities, assess vegetation condition, and support preparation of vegetation mapping for the Study Area.

Data obtained through these surveys will be used to validate the biological data collected to inform the development of future iterations of this VMP and to understand how the vegetation has changed over time. The in-field component of these surveys will be conducted in March 2026 and data collected will be used to inform the 2027 revision of this VMP.

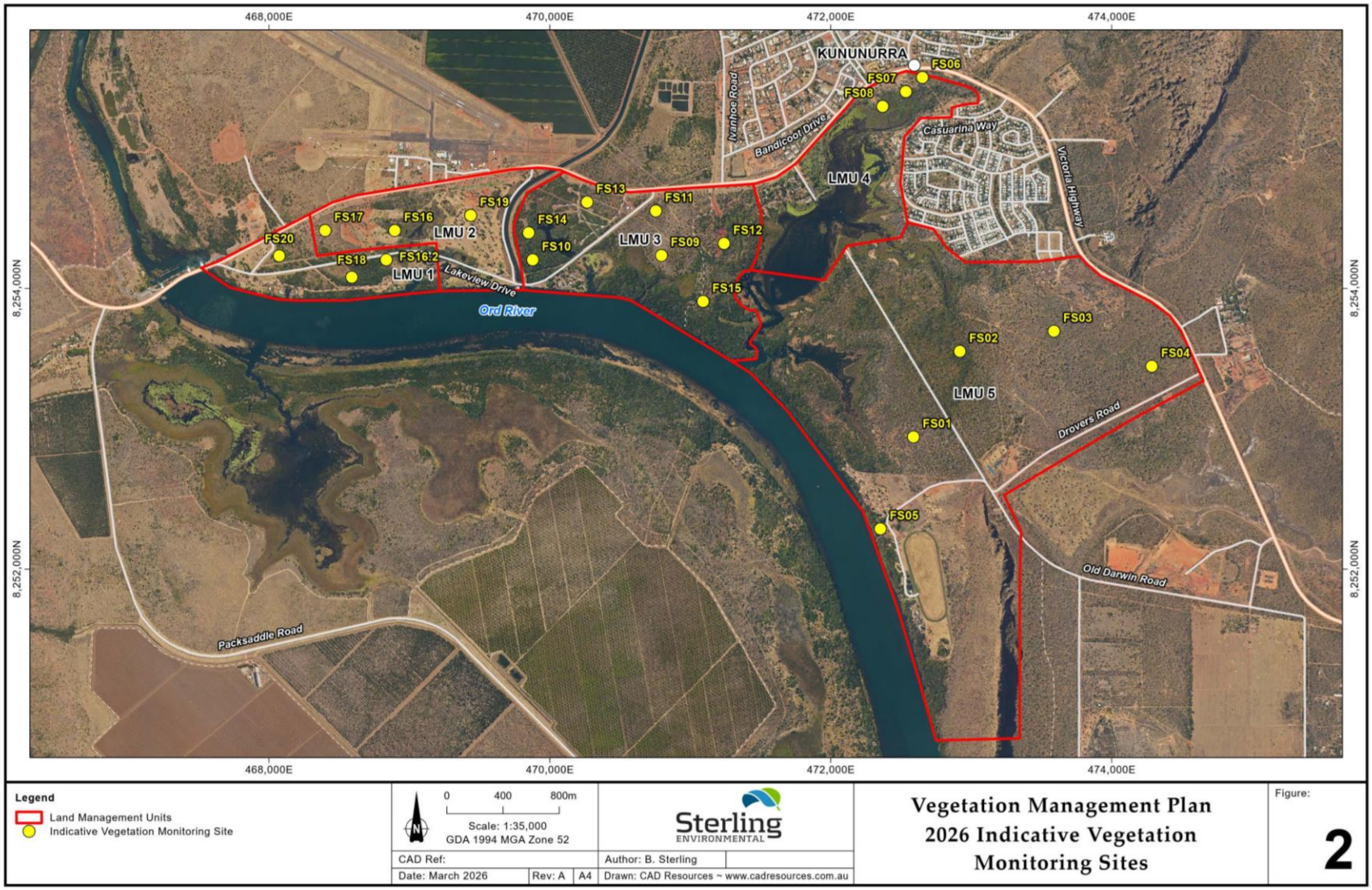

Figure 2: Proposed Relevé Sites for 2026 Vegetation Monitoring

8.4 Plants of ethnobotanical importance

Lily Creek Lagoon and Lake Kununurra contain many plants of indigenous cultural importance. The majority of these species are endemic to the region however some weed species are now also part of Aboriginal culture.

Elders have expressed their desire to conserve endemic species in the Study Area. There is recognition that not all species have an ethnobotanical use, but Aboriginal belief is that all the endemic species are of importance in maintaining a healthy landscape.

Whilst weed control within the Study Area is seen as important, some weed species, like the wild passionfruit (*Passiflora foetida*), have contemporary value to local aboriginal people.

8.5 Rare flora, fauna and ecological communities

Desktop biodiversity (flora, vegetation and fauna surveys) were conducted by Sterling Environmental (on behalf of Hassell Studios) in May 2025 as part of a Lake Kununurra Foreshore Master Planning initiative initiated by the Shire.

As part of this desktop assessment, all five Precincts in the Foreshore Plan were assessed against publicly available databases for threatened and priority flora and vegetation communities. This search identified:

- Potential presence of two Priority Flora species within the development footprint.
- The majority of the development footprint overlapping with a Priority Ecological Community (**PEC**).

Furthermore, under the EPBC Act an action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on Matters of National Environmental Significance (**MNES**).

A Protected Matters Search for MNES using the Protected Matters Search Tool identified that:

- 21 listed threatened species,
- 17 listed migratory species, and
- 3 listed marine species may occur in and around the foreshore development footprint.

As described above, as part of the Master Planning initiative, the Shire is planning to undertake further biological surveys within the five Precincts of the Study Area defined in March 2026. These surveys will include the identification and mapping of PECs, threatened and priority flora listed by DBCA, assessments of vegetation condition, and additional weed surveys.

In addition, targeted ecological surveys will be undertaken to confirm the presence or absence of listed or significant species, and to identify suitable habitat for listed or significant fauna species within the Study Area.

Data obtained through these surveys will be used to validate the biological data collected to inform the development of future iterations of this VMP.

8.6 Fire

Initial fire scar mapping for the 2008 version of the VMP was undertaken in 2005. To support this (2026) version of the VMP, fire scar mapping was undertaken in July 2025, with two fire events noted to have infringed along the eastern edges of LMU5 in 2015 and 2012 (**Figure 3**).

Fire scarring was, however, identified within the broader region at the scale that the map was produced at, predominantly in the southwest corner of the map including in areas that were within the Study Area of the previous (2008) version of this VMP, including as recently as September 2024.

Impacts of hot, late dry season fires can include the removal of understory and sensitive riparian species and ultimately a change in the vegetation composition including an increase in weeds and cane grass (*Sorghum stipoideum*). Cool burns maintain these more sensitive species and therefore result in less loss of biodiversity.

The Shire has developed a Bushfire Risk Management Plan (**BRMP**) that encompasses all land within the Shire's boundaries and has been written on behalf of all stakeholders within that area (Shire of Wyndham East Kimberley, 2024b). The BRMP is informed by consultation and communication with land and asset managers that has occurred throughout its development to ensure an informed and collaborative approach to managing bushfire risk.

The BRMP has been prepared with due consideration of the requirements stated in the *Guidelines for Preparing a Bushfire Risk Management Plan* (the Guidelines) published by the Office of Bushfire Risk Management (**OBRM**) including the principles described in ISO 31000:2018 Risk Management.

The BRMP planning program supports local governments to reduce the threat posed by bushfire. The Shire will contribute to achieving the BRMP's objectives by:

- Guiding and coordinating a cross-tenure, multi-stakeholder approach to BRMP planning.
- Facilitating the effective use of the financial and physical resources available for BRMP activities.
- Supporting integration between risk owners, strategic objectives, and tactical outcomes.
- Documenting processes used to monitor and review the implementation of treatments to ensure risk is managed to an acceptable level.

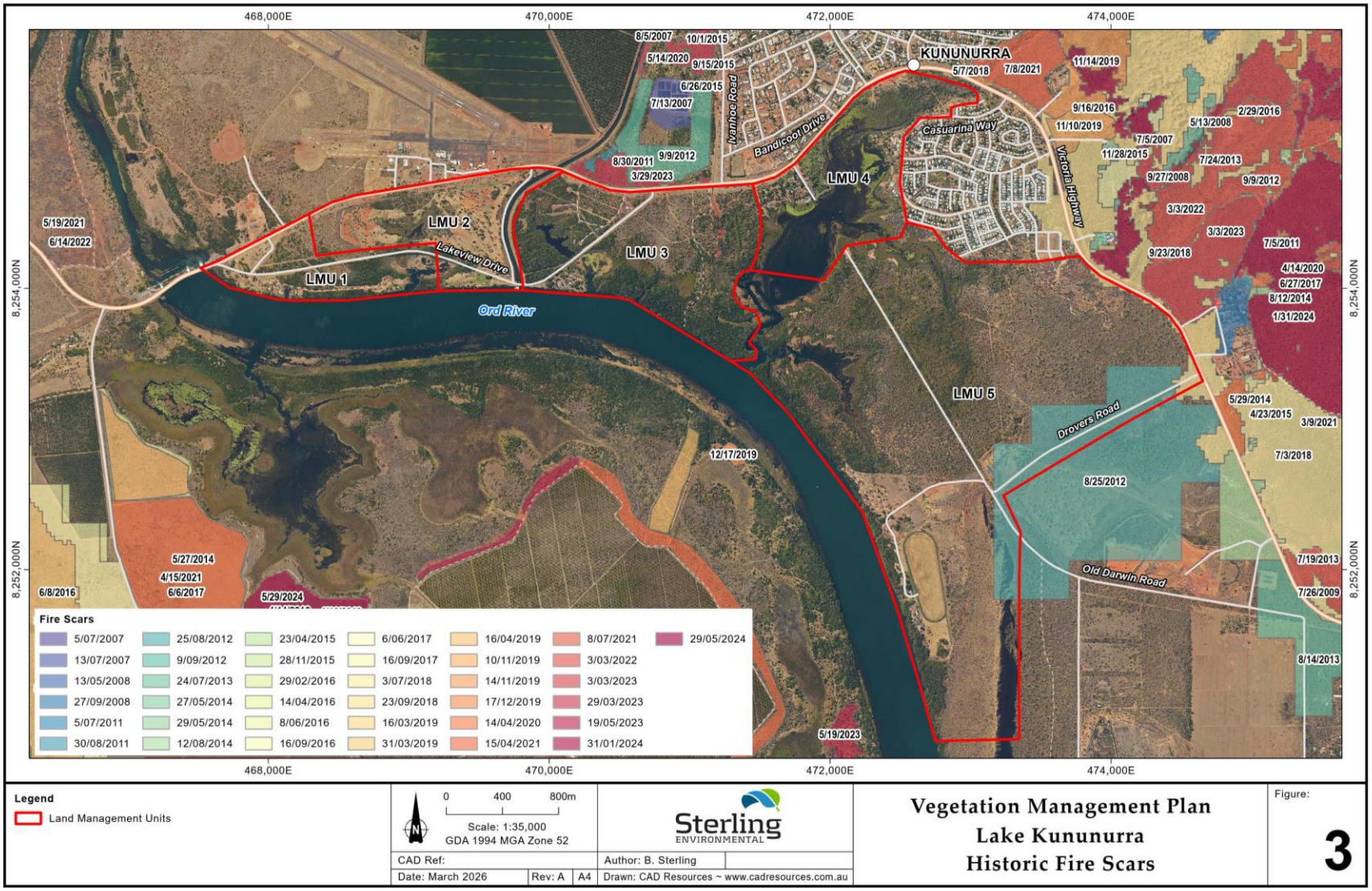

Figure 3: Lake Kununurra Historic Fire Scar Mapping

8.7 Current vegetation management

Vegetation management across the Lake Kununurra foreshore is undertaken by a range of land managers depending on land tenure and lease arrangements as outlined in Section 6. Management activities are generally focused on maintaining recreational areas, controlling invasive species (particularly neem), and maintaining access to the lake foreshore.

Routine activities typically include mowing and slashing within maintained parklands, weed control, removal of invasive tree species, and occasional revegetation using locally native species. In some areas, aquatic vegetation management such as the removal of cumbungi has historically been undertaken to maintain recreational access and waterway function.

Vegetation management within leased areas (e.g. caravan parks, sporting clubs, and other private operators) is typically undertaken by the leaseholder in accordance with lease conditions and relevant environmental legislation.

A summary of the high-level interim management actions for each Precinct is provided below. These actions may be further refined based on the outcome of flora and vegetation surveys planned to be undertaken in March 2026.

9. LAND MANAGEMENT UNITS

9.1 Land Management Unit 1 (Precinct 1 – Swim Beach)

LMU1 aligns with Precinct 1 (Swim Beach) as defined in the Foreshore Plan (**Figure 4**). This Precinct is located on the northern foreshore of Lake Kununurra near the Diversion Dam and includes areas adjacent to Victoria Highway.

Land uses within this Precinct include recreational foreshore areas associated with Swim Beach, the Kununurra Water Ski Club, Boab Park and the Commercial Boating Facility. The Precinct provides important public access to Lake Kununurra and supports a range of recreational activities associated with the lake.

Vegetation within this LMU occurs primarily along the lake foreshore and associated low-lying areas and consists predominantly of riparian and foreshore vegetation communities typical of the Lake Kununurra environment. Vegetation patterns are influenced by proximity to the lake, recreational land use, and historic vegetation management associated with parkland areas.

Vegetation values within LMU1 will be further informed by the flora and vegetation surveys scheduled for 2026, the results of which will be incorporated into the next revision of this VMP.

Table 2 – Recommended Actions (LMU 1)

Management Action	Responsible Agency
Maintain riparian vegetation along the M1 inlet to support bank stability and habitat values.	The Shire
Monitor expansion of aquatic vegetation including cumbungi within inlet areas.	The Shire
Implement targeted control of invasive vegetation where it threatens native riparian vegetation	The Shire
Minimise vegetation disturbance during foreshore maintenance activities.	The Shire
Support periodic monitoring of vegetation condition to inform future management updates.	The Shire

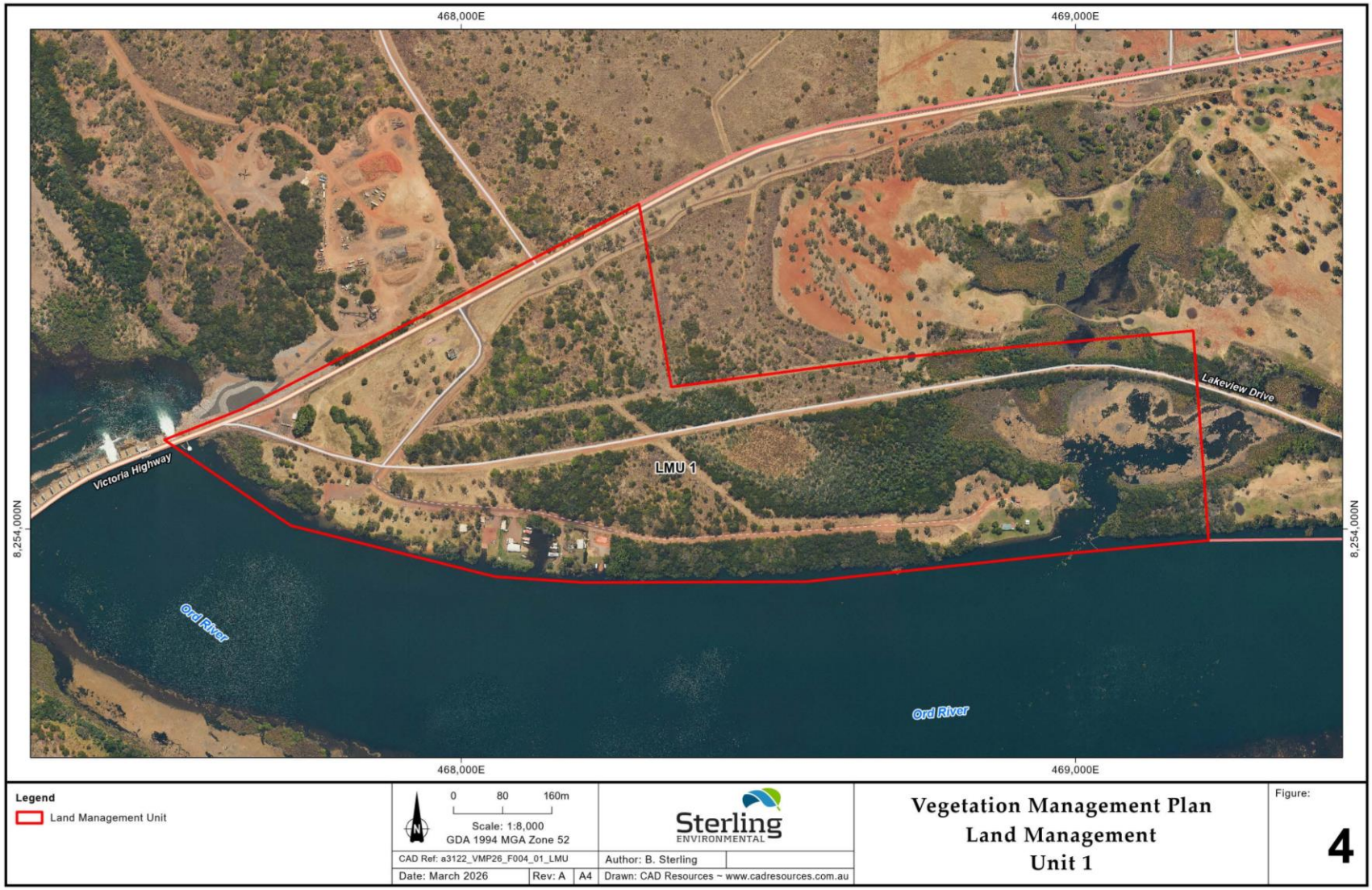

Figure 4: Land Management Unit 1

9.2 Land Management Unit 2 (Precinct 2 – M1 Channel)

The M1 Precinct is located in the central part of the area north of Lake Kununurra and is bounded by the Victoria Highway and Lakeview Drive (**Figure 5**). It is a diverse Precinct that contains recreational leases, freehold land, and commercial leases.

The Precinct currently contains several key features, including the Jim Hughes Amphitheatre, the Pump House Restaurant, the M1 Channel, a tourist development and the golf club.

The Jim Hughes Amphitheatre is a stage that was formalised for the Kimberley Moon festival, however this festival has been transitioned to Celebrity Tree Park and now the amphitheatre has limited utilisation.

The Precinct also includes the Pump House Restaurant, a popular dining destination that offers stunning views of the lake and surrounding landscape.

Vegetation within this LMU reflects a combination of landscaped parkland vegetation and remnant riparian vegetation associated with the lake margin. Vegetation patterns are influenced by recreational land use, irrigation infrastructure, and foreshore access areas.

Vegetation values within LMU2 will be further informed by the flora and vegetation surveys scheduled for 2026, the results of which will inform the 2027 update of this VMP.

Table 3 – Recommended Actions (LMU 2)

Management Action	Responsible Agency
Support periodic monitoring of vegetation condition to inform future management updates.	The Shire
Maintain riparian vegetation along the M1 inlet to support bank stability and habitat values.	The Shire
Monitor expansion of aquatic vegetation including cumbungi within inlet areas.	The Shire
Implement targeted control of invasive vegetation where it threatens native riparian vegetation.	The Shire
Minimise vegetation disturbance during foreshore maintenance activities.	The Shire
Support periodic monitoring of vegetation condition to inform future management updates.	The Shire

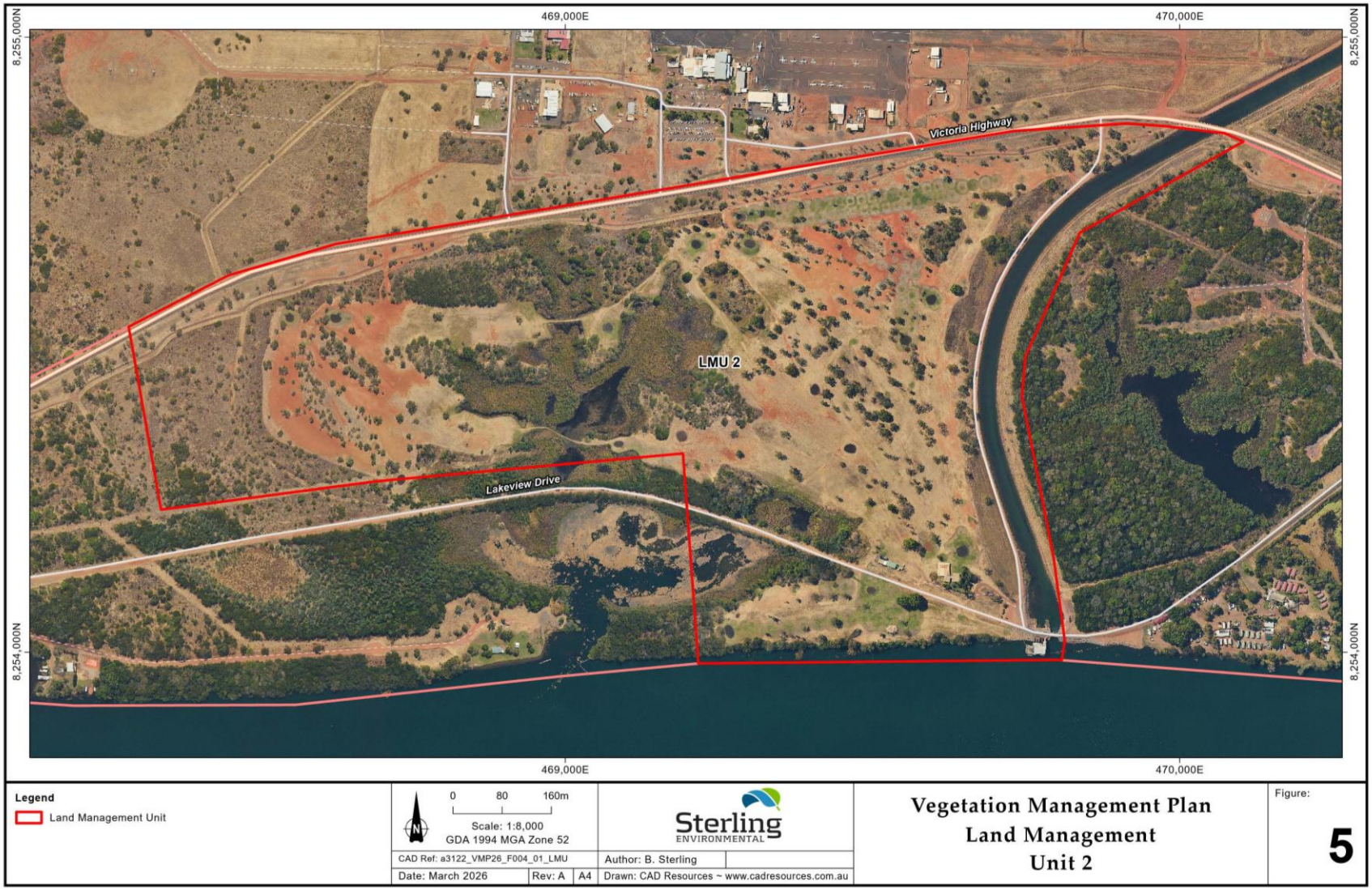

Figure 5: Land Management Unit 2

9.3 Land Management Unit 3 (Precinct 3 – Discovery Inlet)

LMU3 aligns with Precinct 3 (Discovery Inlet) as identified in the Foreshore Plan and occupies the eastern section of the northern Lake Kununurra foreshore between Victoria Highway, Lily Creek Lagoon and Old Darwin Road (**Figure 6**).

Land uses within this Precinct include areas associated with the Kununurra PDWSA, groundwater borefields, tourism-related development and conservation areas. The Precinct contains a mixture of developed and undeveloped land that forms an important interface between the town centre and the broader Lake Kununurra foreshore.

Vegetation within this LMU occurs across a range of landscape settings including foreshore environments, lagoon margins and areas influenced by surrounding development. Vegetation communities in this Precinct are therefore influenced by both natural riparian processes and land use associated with the PDWSA and surrounding development.

Vegetation values within LMU3 will be further informed by the flora and vegetation surveys scheduled for 2026, with results to be incorporated into the next revision of this VMP.

Table 4 – Recommended Actions (LMU 3)

Management Action	Responsible Agency
Protect riparian vegetation along the inlet shoreline where practicable.	The Shire
Manage invasive vegetation species within foreshore reserves.	The Shire
Minimise disturbance to vegetation during recreational infrastructure upgrades.	The Shire
Monitor vegetation condition in areas of increased public access.	The Shire
Incorporate native vegetation into foreshore rehabilitation works where required.	The Shire

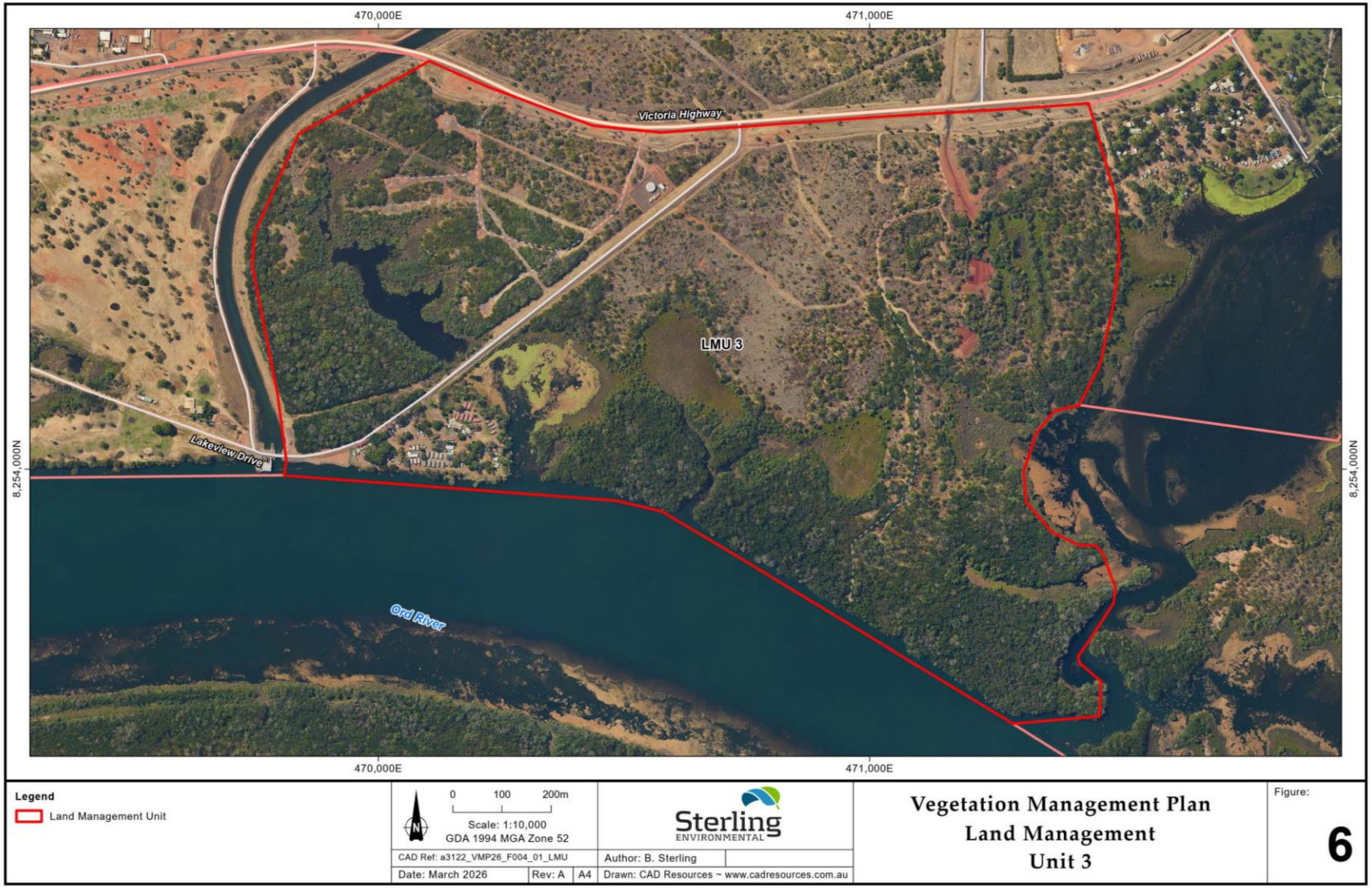

Figure 6: Land Management Unit 3

9.4 Land Management Unit 4 (Precinct 4 – Lily Creek Lagoon)

LMU4 corresponds with Precinct 4 (Lily Creek Lagoon) of the Foreshore Plan and includes the areas surrounding Lily Creek Lagoon and adjacent foreshore environments (**Figure 7**).

Key features within this Precinct include Celebrity Tree Park, a public boat ramp, tourist accommodation developments and foreshore areas associated with the Lakeside residential subdivision. The Precinct represents an important recreational and tourism destination within the broader foreshore area.

Vegetation within this LMU is strongly influenced by the presence of Lily Creek Lagoon and associated riparian environments. Vegetation occurs along lagoon margins, foreshore areas, and within landscaped public open spaces associated with recreational and tourism infrastructure.

Vegetation values within LMU4 will be further informed by the flora and vegetation surveys scheduled for 2026, which will inform the 2027 update of this VMP.

Table 5 – Recommended Actions (LMU 4)

Management Action	Responsible Agency
Monitor the extent and density of cumbungi and other aquatic vegetation within Lily Creek Lagoon.	The Shire / DWER
Undertake targeted cumbungi management where expansion threatens open water habitat or riparian vegetation.	The Shire
Protect wetland margin vegetation from unnecessary disturbance.	The Shire
Coordinate with relevant agencies regarding wetland ecological values and management priorities.	The Shire / DBCA / DWER
Support ecological monitoring to inform future updates to the Vegetation Management Plan.	The Shire

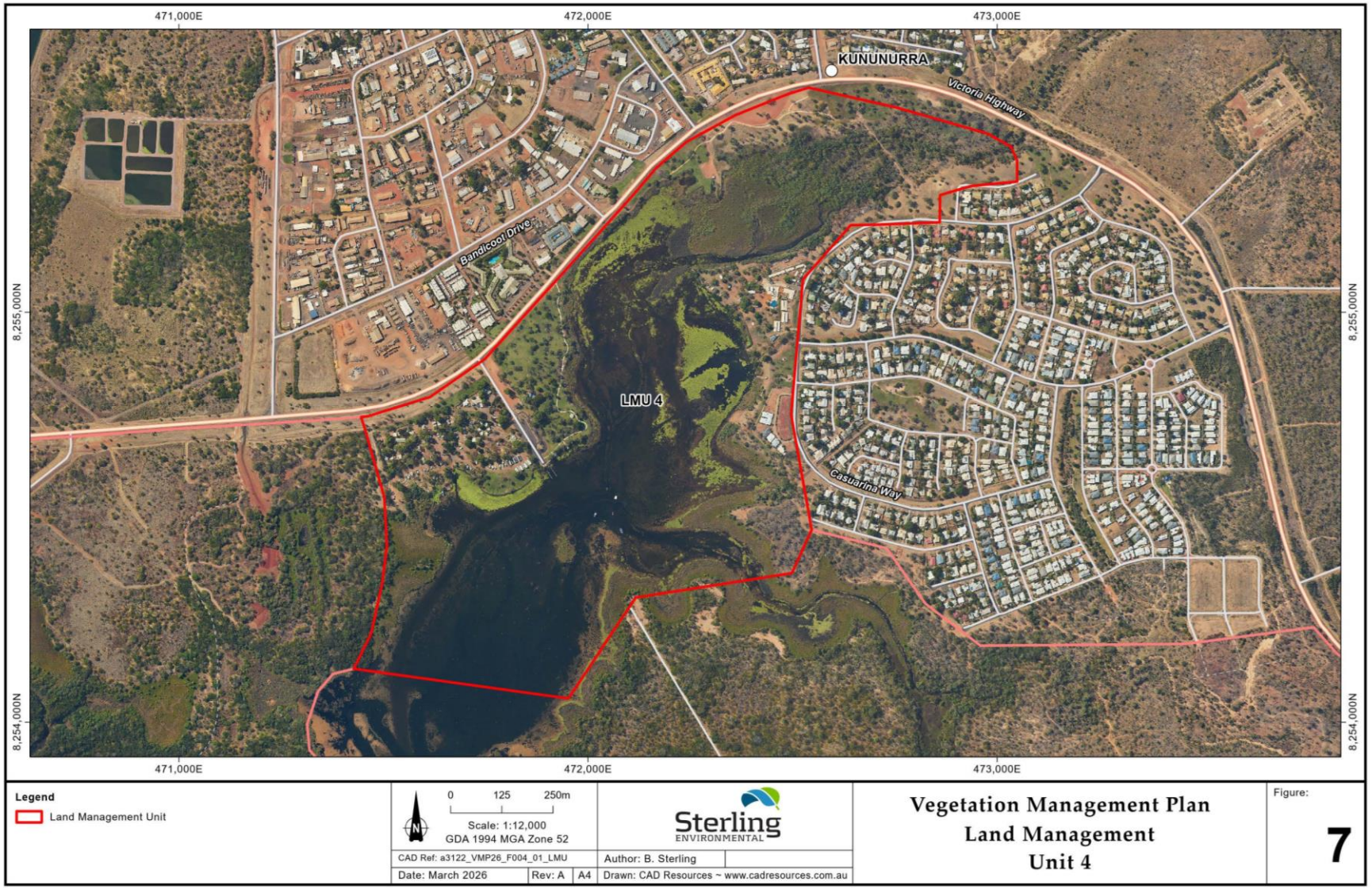

Figure 7: Land Management Unit 4

9.5 Land Management Unit 5 (Precinct 5 – Thethebeleng / Elephant Rock)

LMU5 aligns with Precinct 5 (Thethebeleng / Elephant Rock) as defined in the Foreshore Plan and includes the southern portion of the Study Area extending downstream of Lily Creek Lagoon (**Figure 8**).

This Precinct includes a range of leased and recreational land uses including areas associated with the Kununurra Racecourse, Rodeo Grounds, Ord River Paddlers, Ord Pistol Club, Kimberley Action Sports and the Gourmet Camp Oven Dinner Experience. The Precinct also includes areas of relatively undeveloped reserve land.

Vegetation within this LMU occurs across foreshore and floodplain environments associated with Lake Kununurra and the Ord River corridor. Vegetation patterns reflect the presence of riparian vegetation along the water's edge as well as vegetation associated with recreational land uses and reserve areas.

Vegetation values within LMU5 will be further informed by the flora and vegetation surveys scheduled for 2026, the results of which will be incorporated into the next revision of this VMP.

Table 6 – Recommended Actions (LMU 5)

Management Action	Responsible Agency
Maintain existing native vegetation within foreshore reserves where practicable.	The Shire
Manage invasive vegetation species where they threaten native vegetation communities.	The Shire
Minimise disturbance to shoreline vegetation during maintenance activities.	The Shire
Monitor vegetation condition in areas subject to recreational access.	The Shire
Incorporate native vegetation into future foreshore rehabilitation works where feasible.	The Shire

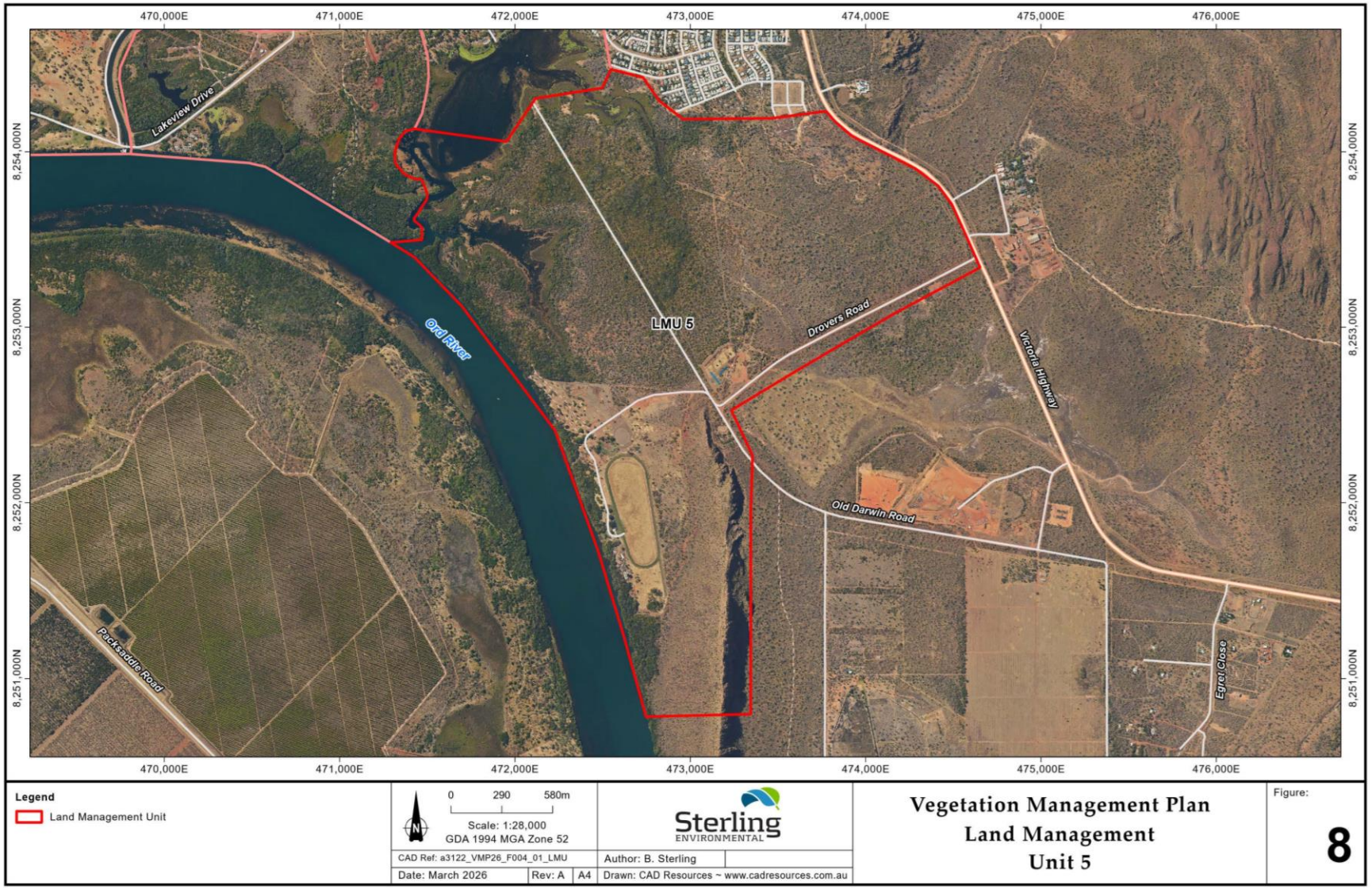

Figure 8: Land Management Unit 5

10. CUMBUNGI MANAGEMENT

10.1 Introduction

Narrow leafed cumbungi (*Typha domingensis*) is native to the Ord River. The damming of the Ord River created Lake Kununurra and Lily Creek Lagoon with the resultant permanent, slow flowing, shallow water, warm temperatures, and high nutrient levels providing optimum conditions for rapid cumbungi establishment and growth.

Within the Study Area, cumbungi has flourished and is considered by many to be a nuisance, particularly in Lily Creek Lagoon. Its tendency to dominate, its rapid spread, and the need for management was noted to be of concern in the Foreshore Plan.

As cumbungi is native to the Ord River and its associated wetlands, a permit to clear native vegetation is required. These permits can be applied for through the DWER. A permit to disturb the bed and banks may also be required and can also be obtained through DWER.

The following section of the report focuses on cumbungi; its biology, the historic change in the Study Area covered by cumbungi, the advantages and disadvantages it can provide, as well as recommendations for its control.

10.2 Biology

Cumbungi is a tough, rapid growing perennial sedge that can eventually become the dominant or climax species within shallow wetlands. Typha species are recognised as early colonisers of wetland environments, with rapid growth and rhizomatous spread enabling them to compete strongly with other wetland vegetation (Pandey & Verma, 2018).

It is a prolific seed producer that can produce 300,000 to 400,000 seeds per plant. Seeds can live for four years before germination, are very light and are easily spread by wind or water movement (Shire of Wyndham East Kimberley, 1987). The seed is also carried to new places by animals and birds, and on earth moving or agricultural equipment.

Cumbungi colonises new areas from both seed and rhizome growth. Seeds germinate in 5 to 20cm of water and a single seed can produce a rhizome (running root) system up to 3m in length (Shire of Wyndham East Kimberley, 1987). These rhizomes can move from relatively shallow water to water depths in excess of 2m as they grow. These rhizomes can increase the size of existing colonies each year. Rhizomes survive from harvest most of the year, however less growth and recovery occur if the plant is harvested during the cool dormant period.

Cumbungi thrives in fresh or lightly brackish water of less than 2 metres in depth. Nutrient rich sediment provides the ideal substrate for flourishing cumbungi plants. Their thick, fast-growing rhizomes trap and stabilise sediments, while dense emergent stems slow water movement and promote further sediment deposition. Typha species also thrive in slow-flowing, nutrient-rich waters, allowing them to form dense monotypic stands that can dominate wetland habitats (Arthur Rylah Institute, 2017; Li *et al.*, 2024).

10.3 Disadvantages of cumbungi

Cumbungi is a troublesome weed in most states of Australia, as well as countries such as Papua New Guinea, New Zealand, Indonesia, Malaysia, and the Philippines (Department of Primary Industries and Water, 2007).

Disadvantages or adverse effects associated with the spread of cumbungi include:

- Formation of dense monocultures that may reduce habitat heterogeneity and eliminate other plants (Apfelbaum, 1985);
- Reduction in the holding capacity and access to dams and waterways (Department of Primary Industries and Water, 2007);
- Restriction and, in extreme cases, almost total blockage of water flow in rivers, creeks, and irrigation and drainage channels (Department of Primary Industries and Water, 2007);
- Destruction of the weed can result in a large amount of decaying vegetation which may pollute the water, increase nutrients, or block pump intakes, channels, and ditches;
- The dark, thick environment of cumbungi stands create suitable environments for mosquito larvae and other pests;
- Reduced waterbird habitat and adversely affect fringing vegetation (Bartle, J *et al.*, 1986)
- Creation of a fire hazard; and
- Restricted views over the water and access to the water's edge.

10.4 Advantages of cumbungi

Cumbungi is a natural part of many Australian wetland systems and has a number of important attributes. Cumbungi:

- Stabilises banks to prevent erosion;
- Uses nutrients and acts to strip nutrients from runoff;
- Provides a natural looking wetland fringe;
- Acts as a litter trap; and
- Provides cover, food, nesting places, and habitat for water birds, aquatic insects, native fishes, freshwater invertebrates (such as the Giant Freshwater Prawn or "Cherabin" (*Macrobrachium rosenbergii*)), and frogs.

10.5 Change in area of cumbungi

From relative obscurity, cumbungi now occupies broad tracts around the margins of Lake Kununurra and Lily Creek Lagoon. For example, the perimeter of Lily Creek Lagoon was over 75% cumbungi free in 1978 but by 1993 almost the entire margin was colonised (Watkins, D *et al.*, 1997).

A survey by Gowland in 1981 estimated that the total area of cumbungi in Lily Creek Lagoon had increased approximately 100% between 1978 and 1981 (Sinclair Knight Mertz, 1995). The same report produced a diagram which identified the changes in area covered by cumbungi from 1978 to

1993. Estimates in the change of cover between 1978 and 1993 indicated a 500% increase to an area of approximately 39.5ha (Sinclair Knight Mertz, 1995).

In an attempt to understand the changes that have occurred to the growth of cumbungi in Lily Creek Lagoon, the Sinclair Knight Mertz diagram was compared to a set of aerial photographs from 1999, 2002, and 2006. Followed by ground-truthing, this enabled the production of a new map that included the changes from 1993 to 2006 (see **Figure 9** below).

In the period from 1978 to 1993, cumbungi growth spread rapidly along the water's edge. Much of this growth mirrored the Lagoon edge contour.

As described in Section 8.3 above, a review of publicly available aerial imagery is proposed as part of 2026 monitoring, subject to imagery of sufficient resolution being available. These images will be used to undertake a visual comparison with the 2008 mapping to assess any broad changes in the extent of Cumbungi within Lily Creek Lagoon. The results of this monitoring will be reflected in the 2027 iteration of this VMP.

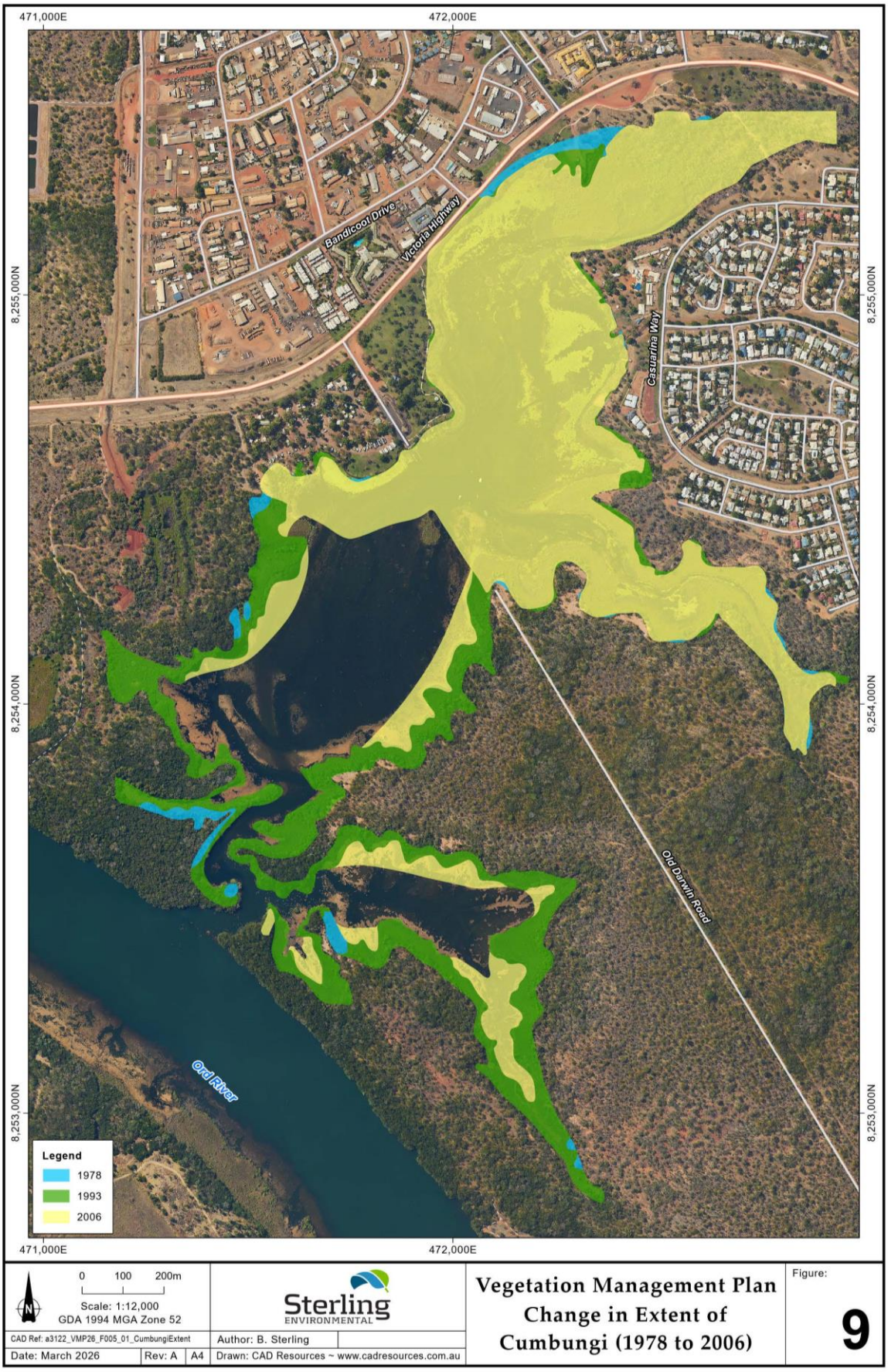

Figure 9: Change in Area of Lily Creek Lagoon Covered by Cumbungi from 1978 to 2006

10.6 Predicted area available for colonisation by cumbungi

It was predicted in the Sinclair Knight Mertz report that, if left unchecked, cumbungi would continue to spread until all areas of Lily Creek Lagoon less than 2 meters in depth were colonised. Its ability to trap sediment will increase the area of the Lagoon suitable for colonisation whilst the floating rhizomatous rafts will allow it to encroach into deeper waters.

The total area of the lagoon is estimated to be 135ha. The area colonised by cumbungi in 2006 was estimated to be 71.43ha or 52.91%. This was estimated using aerial photography and mapping. In order to estimate the potential areas for cumbungi to spread to, depth readings of the lagoon were undertaken by boat. **Figure 10** presents the points where depth was measured and the area available for colonisation estimated.

It is interesting to note that in areas of the historical LMU 4 and 5 (in the 2008 version of this VMP) where the depth was greater than 2 meters the cumbungi growth had seemed to reach its limit of growth. This area could be assumed to be stable in that cumbungi should not continue to grow out over the lagoon. However, the other end of the lagoon, upstream of the current boat ramp at Celebrity Tree Park, was shallow with the majority being less than 2 meters in depth. It can therefore be assumed that cumbungi has the potential to cover this area completely if not controlled.

As described in Section 8.3 above, a review of publicly available aerial imagery is proposed as part of 2026 monitoring, subject to imagery of sufficient resolution being available. These images will be used to undertake a visual comparison with the 2008 mapping to assess any broad changes in the extent of Cumbungi within Lily Creek Lagoon. The results of this monitoring will be reflected in the 2027 iteration of this VMP.

10.7 Management Strategies

The Sinclair Knight Mertz report (1995) recommended the short-term management of cumbungi through the removal of 23.5ha of cumbungi or 60% of the existing cumbungi in Lily Creek Lagoon at the time. Removal was recommended in areas from which views and access are desired and for the prevention of further expanse of cumbungi dominated areas. It also recommended maintaining areas of untouched riparian vegetation.

The Foreshore Plan states that " Cumbungi, although being a native plant, is gradually attaching and growing onto the foreshore which is preventing use of the foreshore and blocking views into the river. Management of these plants are important to ensure the foreshore can be enhanced."

In response to this recognised problem, some locals take cumbungi control into their own hands through unauthorised and illegal spraying, fires, and mechanical excavation. In order to manage this, a plan that outlines a coordinated approach to cumbungi control and removal is needed.

It is recognised that some removal of cumbungi needs to be performed. Removal should occur in sections where the need has been identified (as below) whilst other areas of untouched riparian vegetation of sufficient size should be maintained to support the reliant biological community. To have only cumbungi or open water reduces habitat diversity and biodiversity. Therefore, the aim of cumbungi removal is control, not eradication. Planned cumbungi control should address community concerns as well as increase the interface between open water and cumbungi to provide a diversity of habitats, in turn, increasing biodiversity.

Figure 10: 2008 Depth Measurements / Estimated Area Available for Cumbungi Growth in Lily Creek Lagoon

10.8 Areas and amounts for control

Total exclusion of cumbungi will not be possible, nor would it be desirable as cumbungi provides a number of key roles in the waterbody.

The 2006 version of the Foreshore Plan highlighted a large portion of Lily Creek Lagoon for cumbungi control (see **Figure 11**). Specific areas of high motor traffic and high aesthetic values or commercial and recreational use were listed within the lagoon for specific cumbungi removal. The specific areas identified are:

- Lily Creek Lagoon boat ramp;
- Kimberleyland Caravan Park;
- Lakeside Resort;
- Celebrity Tree Park;
- Celestin Nominees lease area;
- Swim Beach; and
- Ski Beach.

The 2024 version of the Foreshore Plan does not identify any specific areas requiring cumbungi control. As described above, additional vegetation surveys and aerial photo analysis will be conducted in 2026 and data will be used to inform future iterations of this VMP and to understand how the vegetation has changed over time.

In past discussions with DBCA it was recommended that a precautionary approach be taken to cumbungi removal, and that some uncleared strips be left between the cleared areas, to provide alternate habitats for biodiversity. Along the banks of the wetland, it is recommended that cumbungi stands of no larger than 100m in length be removed. In between these areas cumbungi stands of no less than 20m in length should be left.

By targeting cumbungi removal in specific areas, the majority of cumbungi in Lake Kununurra and Lily Creek Lagoon will remain as uninterrupted and undisturbed. Due to its effectiveness in nutrient stripping and sediment control, cumbungi should not be removed around drains or in areas prone to erosion.

Where cumbungi is to be removed right to the foreshore then other species of rushes and sedges that will not obstruct access and view should be planted. Some recommended species are listed in **Table 7** below yet others may also be suitable as long as they are locally native. If the bank is not suitable for this type of planting, then a formalised structure such as a retaining wall may be considered yet is not preferred. Bank treatment and protection is necessary to prevent undercutting of banks from boat wash and change in water levels.

A permit to clear native vegetation as well as a permit to interfere with the bed and banks of a waterway will be needed for ongoing cumbungi control. These permits can be applied for through the DWER.

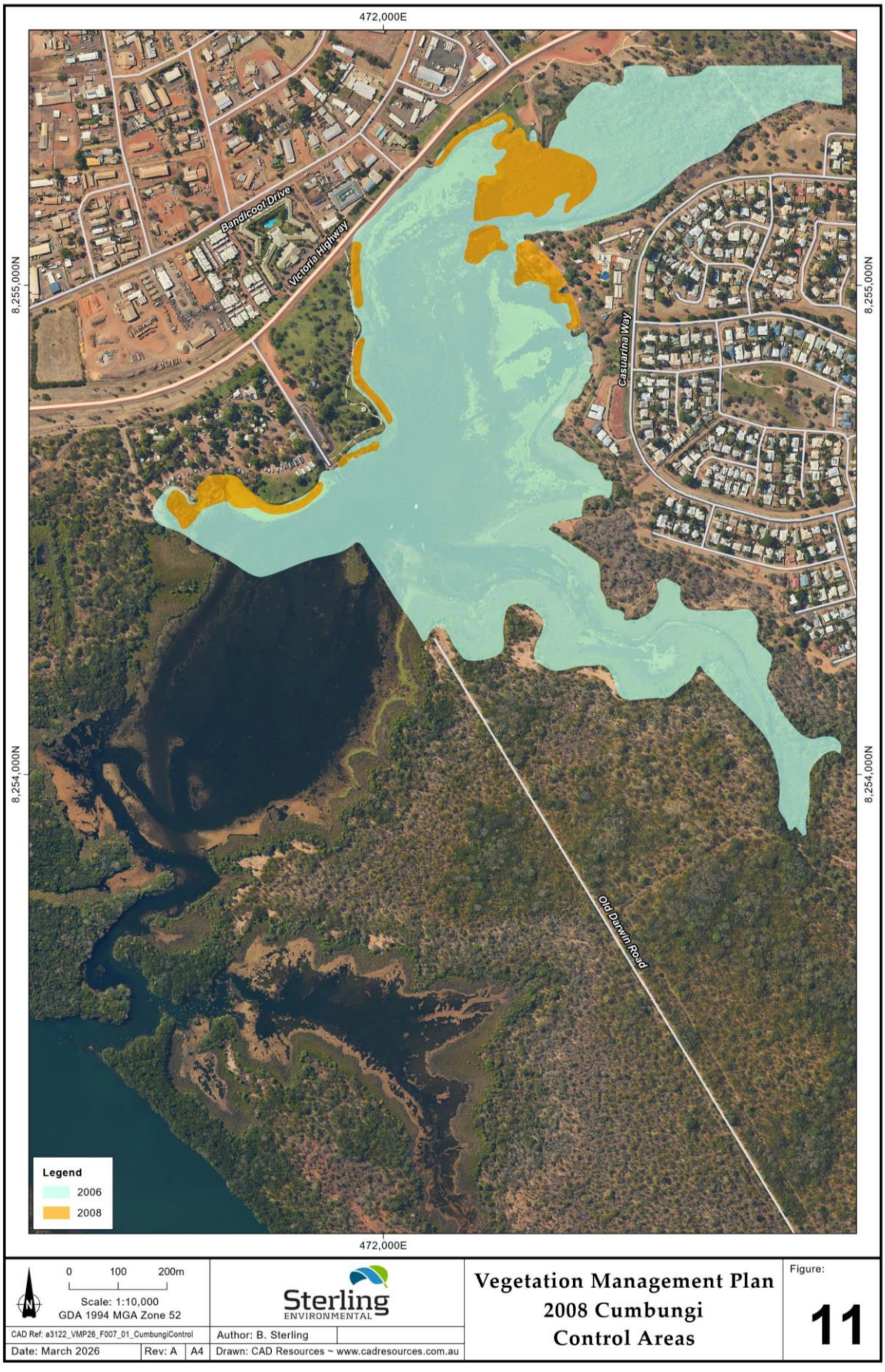

Figure 11: Cumbungi Control Areas as Identified in Lake Kununurra Foreshore Plan (2006)

10.9 Recommended control methods

Mechanical Removal

Mechanical removal of cumbungi and other aquatic vegetation may be undertaken within Lily Creek Lagoon and Lake Kununurra using specialised equipment such as aquatic weed harvesters or amphibious excavators, depending on site conditions and available resources. Mechanical removal enables vegetation to be cut or removed below water level and is suitable for application across much of the lagoon and lake margins.

Removal activities should preferentially be undertaken during the cooler months (June–July), when growth rates are lowest and disturbance to waterbirds such as the comb-crested jacana (*Irediparra gallinacea*) and purple swamp hen (*Porphyrio porphyrio*), which utilise cumbungi for breeding habitat, is minimised (Western Australian Museum, 2005).

Mechanical removal methods provide an effective means of managing aquatic vegetation without the introduction of chemical residues and, where biomass is removed from the system, reduce the risk of nutrient release associated with decomposition *in situ*. In addition to cumbungi, these methods may also assist in managing other aquatic vegetation such as ribbon weed and *Potamogeton* spp., which can impede recreational use in high-traffic areas.

At the time of writing, an amphibious excavator is available for us within the Lake Kununurra and Lily Creek Lagoon system to undertake targeted removal of aquatic vegetation. These machines provide flexibility to operate in shallow water and soft sediments and can remove both above-ground biomass and underlying rhizomes, which may assist in reducing rates of regrowth compared to cutting alone.

Where required, alternative mechanical methods may be employed to remove dense vegetation or floating rafts in areas not readily accessible by primary equipment. This may include the use of long-reach excavators, manual cutting tools, or mechanical extraction techniques. Any such activities should be undertaken with care to minimise disturbance to sediments, banks and adjacent riparian vegetation.

All mechanical works within or adjacent to waterways must be undertaken in accordance with site environmental requirements and relevant approvals, ensuring that disturbance to water quality, hydrology and ecological values is minimised.

11. OTHER AQUATIC PLANT MANAGEMENT

Submerged and floating aquatic vegetation, including ribbon weed, pondweed (*Potamogeton* spp.) and water lilies, are present within Lake Kununurra and Lily Creek Lagoon and have proliferated under the stable water levels established following construction of the Ord River Diversion Dam (Watkins *et al.*, 1997).

While these species provide ecological value, including habitat and primary productivity, excessive growth can interfere with recreational activities such as boating and swimming, resulting in increased pressure for active management.

Mechanical removal is the preferred method for managing these species, consistent with the approach outlined for cumbungi above (**Section 10.9**). Removal may be undertaken using aquatic weed harvesters or amphibious excavators, depending on site conditions and accessibility. These methods enable targeted clearing of vegetation, including the establishment and maintenance of localised access corridors (e.g. boating channels), while minimising broader disturbance to the waterbody.

Dredging of the lakebed to control aquatic vegetation is not recommended due to the high level of disturbance to sediments, potential impacts to water quality, and ecological values.

Management of submerged and floating vegetation should be undertaken in a targeted manner, focusing on areas of high recreational use, while retaining vegetation in other areas to maintain ecological function.

Further investigation into the distribution, growth dynamics and management of these species is recommended to inform future updates to this VMP.

Figure 12: Area Recommended for Removal of Aquatic Weeds (2008)

12. INTRODUCED WEEDS

Introduced plant species occur throughout the Lake Kununurra and Lily Creek Lagoon system and have the potential to adversely affect native vegetation communities and ecological function. These species may outcompete native flora for light, water and nutrients, alter habitat structure, and increase fuel loads, thereby affecting biodiversity and ecosystem resilience (Dixon and Douglas, 2007).

Common introduced and high-risk species recorded within the Study Area include neem (*Azadirachta indica*), leucaena (*Leucaena leucocephala*), date palm (*Phoenix dactylifera*), calotropis (*Calotropis procera*), passionfruit vine (*Passiflora foetida*), and *Merremia* spp. These species are considered priority weeds for management within riparian and foreshore environments, consistent with previous regional assessments (Dixon and Douglas, 2007).

Aquatic weed species represent a particular risk to the Lake Kununurra system. The floating fern *Salvinia molesta* has previously been recorded within Lily Creek Lagoon and is listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (WA). As a C1 (Exclusion) species, *Salvinia molesta* must be eradicated where detected, and its movement, sale and possession are prohibited.

Historical infestations of *Salvinia molesta* within the Lake Kununurra system have been subject to control. Advice from DBCA indicates that these infestations are understood to have been successfully eradicated; however, given the high risk of reintroduction, ongoing vigilance and monitoring are required.

Uncontrolled infestations of salvinia have the potential to form dense surface mats, which can significantly impact water quality, aquatic biodiversity, irrigation infrastructure, and recreational use. Given that Lake Kununurra forms part of the Ord River Floodplain Ramsar site, there is potential for infestations to impact wetland values locally and spread downstream within the broader Ramsar system if not effectively managed.

Management of declared and priority weed species is undertaken in accordance with relevant legislation and site environmental management requirements, with a focus on early detection, rapid response and coordinated control. Mechanical removal methods (as described in **Section 10.9**) may be used where appropriate for aquatic species, while other control measures may include targeted herbicide application and ongoing monitoring.

The introduction of aquatic weeds into the system remains a key risk. Species such as water hyacinth (*Eichhornia crassipes*) have the potential to establish and cause similar impacts if introduced. Pathways for introduction include contaminated equipment, boats and trailers, and the release of aquarium plants. Ongoing awareness, hygiene practices, and surveillance are therefore critical to minimising the risk of new infestations.

Figure 13 below indicates areas that were identified for weed removal in the 2008 VMP. These will be reassessed following 2026 vegetation surveys.

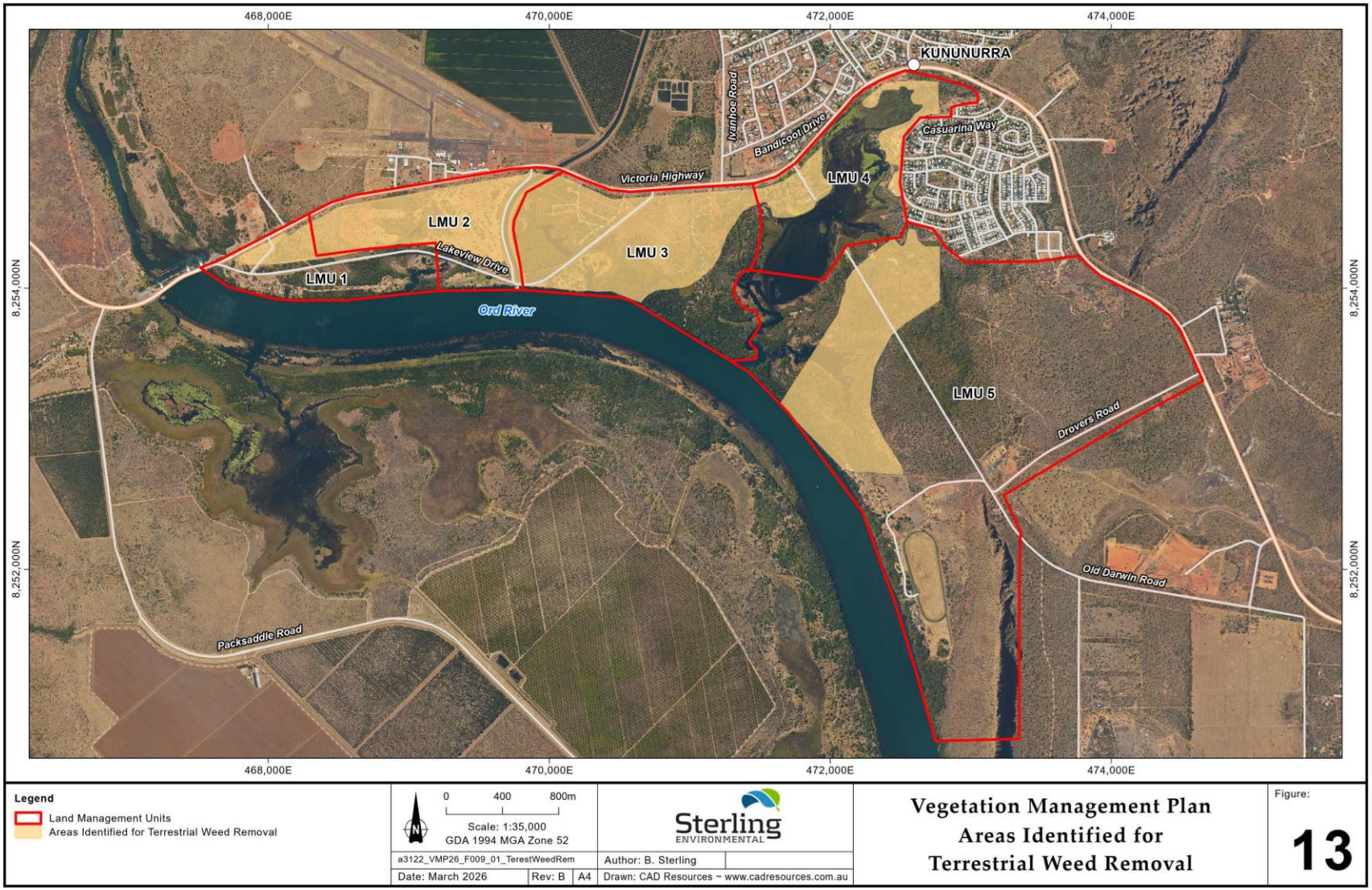

Figure 13: Area Recommended for Removal of Terrestrial Weeds (2008)

13. REGENERATION PRINCIPLES

The Bradley Method of bush regeneration (Weeds Cooperative Research Centre, 2004) appears to be the most cost effective, low impact, and sustainable form of weed removal and rehabilitation for the Study Area. This method has, as its basis, three principles:

1. Work from areas of least disturbance and prioritise areas where significant species occur (i.e., from areas where indigenous or desired vegetation is at its healthiest with few unwanted species). Native plant seed will more likely be in the ground in areas where native plants are growing and weed propagules are more likely to be in the ground in areas where weeds are growing.
2. Make minimal disturbance using careful hand removal techniques or herbicides. Even careful weeding will disturb the soil, increase available nutrients, and activate weed seed, increasing the opportunity for weed species to propagate.
3. Let native plant regeneration dictate the rate of weed removal. Regeneration slows down as the weed numbers increase so ensure that the weeding rate matches the regeneration rate. Do not over clear. Ensure that the area weeded is not so large that other weeds now have the chance to out-compete the desired indigenous species.

The three principles above are guided by the following set of rules:

1. Watch where you tread. Minimise the impact from foot and vehicle traffic as all disturbance has an impact on vegetation.
2. Disturb the soil as little possible. Simple hand tools have the least impact on soil.
3. Preserve and replace mulch. Mulch acts as a weed suppressant, conserves soil moisture and provides habitat for soil fauna.
4. Mulch with weeds provided they are free of seed, bulbs, or rhizomes.
5. Do not pile weeds in heaps. Disperse them as mulch.
6. Never pile or hang weeds on other weeds. The surviving weeds grow through the dead weeds creating a difficult tangle to remove as well as necessitating double handling. Hang weeds on native plants or remove them as piles and dispose/burn when they have dried out.
7. Remove all weeds when weeding an area. Do not just remove a single species but remove all weed species simultaneously.
8. Work with the weather. Avoid weeding during the wet season in areas that may be prone to erosion following a heavy rain event. Weeding in very dry soil conditions can disturb soil until the next rain event.
9. Do not remove a plant that cannot be identified.

The above process, whilst the most cost effective, does require a considerable timeframe and is not always fully achievable, particularly on sites containing a high density of large woody weeds. These principles are recommended as a guide to weed removal within Australia yet will not always be applicable. See below for more specific weed removal techniques.

13.1 Weed removal methods

(As taken from Weeds Cooperative Research Centre, 2004)

A key consideration to weed removal is possible adverse environmental impacts. Examples of adverse impacts include

- Loss of fauna habitat, e.g., Leucaena provides habitat for flying foxes, while parkinsonia (*Parkinsonia aculeata*) can provide protection for small mammals from predation.
- Weed substitution: a weed is removed only to be replaced by a weed which is more difficult to remove, e.g. neem substituted by luecaena.
- Chemical effects on fauna, e.g., impact on frogs by chemical sprays used for weed control.
- Increased erosion e.g., when leucaena is the most dominant or only vegetation growing on foreshore areas and is acting to control soil erosion.

Many potential adverse impacts of weed management can be prevented by trying to implant the principles and rules listed above and through revegetation with appropriate local species at the same time as weeds are removed. This approach maintains habitat values and reduces the risk of weed substitution.

The following methods are the most widely used and easiest to apply.

Herbicides

The use of herbicides near waterways or where herbicides may eventually enter waterways requires careful consideration and care. It is best, if possible, to avoid or at least minimise herbicide use in these situations. If used, the chosen herbicide would need to be registered for use near waterways by the Australian Pesticides and Veterinary Medicines Authority (**APVMA**) and label instructions strictly adhered to.

In PDWSAs, their use should also comply with the DWER's water quality protection guidance, including *WQPN 65 – Toxic and hazardous substances*.

There should be no use of 'weed n feed' products as these contain the chemical dicamba which is harmful to human health.

- Foliar spraying: Application of herbicide diluted with water or sometimes diesel, applied at a specific rate using spray equipment onto the foliage of plants until every leaf is wet (not dripping). High potential for offsite damage. Important to check the mode of action of the herbicide; herbicides with surfactants spread across the leaf surface and so a fine spray with less volume can be sufficient.
- Basel bark spraying: This method involves mixing an oil-soluble herbicide in diesel and spraying the full circumference of the base of the trunk or stem right down to the ground. Often used to treat woody weeds. The primary limitation of this method is that dead wood is left in the area which can reduce access, promote weed growth, and increase fuel loads.
- Cut and paint: Particularly useful for woody weeds. Cut the stem horizontally as close to the ground as possible then apply herbicide as soon as possible using a paint brush, sprayer, or similar. This method does not always provide a 100% kill rate and follow up and monitoring of treated plants will be required. Removing the cut wood and disposing

or burning in piles will reduce the fire risk. Remove woody debris that may become covered in weeds and restrict access and dispose or incinerate attached weed seed (or weed seed accumulated on or near to the soil surface surrounding the weed). A cut and painted plant that needs to be re-sprayed at a later date has an advantage in that less herbicide is used than an initial aerial or foliar spray and there is less chance of an off target kill.

- Stem injection: This method targets individual plants. A cordless drill, injection gun or similar is used to drill angled holes into the base of the plant. Herbicide is then injected into the holes within 10 seconds. The primary limitation of this method is that dead wood is left in the area which can reduce access, promote weed growth, and increase fuel loads.

Hand

- Hand pulling: Useful for isolated occurrences of seedlings or other small, soft, non-bulbous weeds.
- Digging, hoeing, or grubbing: Can be effective for isolated weed occurrences and are useful follow up techniques. Larger woody weeds are more effectively treated with herbicides.

Mechanical

- Grooming: earthmoving equipment fitted with specialised grooming arms may be effective for treating large infestations of woody weeds in hard-to-reach places. The grooming device shreds plant material down to ground level, reducing biomass. Follow up treatments of any regrowth, using herbicides or manual methods, requires considerably less chemical input and effort than would have been required to treat the original infestation. This form of weed removal should only be used where resources exist to carry out necessary follow up work and rehabilitation/restoration of the site with suitable vegetation.

13.2 Weed removal and self-regeneration

Weed removal and self-regeneration of existing native plant species is recommended in stable areas where large stands of native vegetation still exist and/or where weed species tend to be scattered individual plants or vines. Regeneration of these species is likely to occur from existing seed banks and/or adjacent vegetation. These species are generally resilient, require minimal maintenance, and exhibit high survival rates .

1. Remove weeds using the lowest impact, effective method (**Section 13.1**).
2. If in a slashed area, stake seedlings so that the slasher driver can avoid them.
3. Ongoing weed removal and management of the site through follow up spraying and/or hand pulling.

13.3 Weed removal and rehabilitation

Weed removal and planting of the site with either seedlings or seed of local native species is recommended in areas where a weed species has outcompeted the native vegetation to become the

most dominant species resulting in a low diversity of native vegetation. Physical rehabilitation techniques such as bank stabilisation, mulching, or gabion construction may need to be undertaken prior to replanting.

In some instances, due to the high density and physical stature of some weeds (i.e., leucaena) then a mechanical mulching machine may be needed. In this circumstance, a precautionary approach to weed removal should be used with the maximum area of weeds to be cleared at any one time being that which is able to be followed up regularly and be easily replanted with native species (refer to Bradley Regeneration Principles in **Section 13** above). If accessible then another option would be to remove all seeder (mature) and semi mature trees from an area, plant, and then return the following year to remove the remaining immature weeds.

Direct seeding using pioneer species is an option in areas where immediate cover is needed. In a less intact site this would need to be followed up with planting of native seedlings at some stage to increase biodiversity at the site.

It is important for slasher and other machine operators to follow appropriate hygiene practices so that weeds are not spread from one area to another via the slasher.

Rehabilitation should be implemented as outlined below:

1. Remove weeds using the lowest impact yet effective method (**Section 13.1**).
2. Unless plants will be hand watered, plan weed removal and planting for the wet season (December - February) as this will give plants the best chance of establishment.
3. Inform and involve the community in planting days as this gives a sense of ownership over the project which helps to reduce vandalism and encourage maintenance of the seedlings.
4. Select species that are most suitable for the location. Seedlings selected for shade, shape, longevity, safety, and other parkland/recreational values are best.
5. Select small plants 300-400mm high. These require less work in digging and site preparation and the younger, smaller plants suffer less in transplant shock.
6. Using either a stake or paint, mark out where you want the plants to go.
7. Make sure seedlings are at least 15 meters apart to allow a slasher to manoeuvrer between them. Seedlings should be a minimum of 2 meters from a footpath or road.
8. If using more than one species and a particular planting pattern is needed, then mark this pattern on a site map and give to the planters.
9. Make sure you dig a large hole. The Shire auger may be available. A large hole gives the seedling's roots room to grow.
10. Fill the hole with good dirt. If the dirt removed is too rocky or clayey then bring in better dirt from elsewhere (ensuring any imported material has been certified as “weed free” by the supplier).
11. Create a shallow bowl or depression around the planted seedling so that any rain fall is captured and contained.
12. Push down hard around the base of the seedling to compact the dirt and remove any air that is trapped.

13. Plant the seedlings with a stake for support and so that they are easily identified by the slasher driver.
14. Water seedlings immediately after planting, this will also help with compaction around the roots.
15. Stake any local native trees that have self-generated so that they are not slashed.
16. Inform slasher driver of the new trees that have been planted and staked.
17. Follow up weeding will be needed. Remove stakes once the trees are big enough to be seen by the slasher driver.

13.4 Suitable species for rehabilitation

Plant species to be used for regeneration of conservation areas should be predominantly endemic to the area. Previous documents have included species lists representing vegetation historically present within the Lake Kununurra system (DBCA, 2018).

Table 7 below represents vegetation historically recorded within the Lake Kununurra area and is indicative of species suitable for revegetation in similar environments.

Due to the modified environment and therefore continual vegetation succession, species may need to be varied to suit the current conditions. Species should however be limited to those that occur within the local Kununurra area.

Parkland areas that receive regular maintenance can have a more diverse range of species planted including species widely known from the Kimberley region.

Limiting factors for selection of suitable species include unknown propagation techniques, unreliable germination rates, and difficulty in gaining supply of plant material.

Plant material for rehabilitation and revegetation works should preferentially be sourced from local provenance seed to ensure compatibility with existing vegetation communities and site conditions.

Seed collection and propagation may be undertaken by a range of providers, including local organisations with demonstrated experience in the East Kimberley region. The Shire has engaged Gelganyem Group to support the identification of suitable species for planting, and the group maintains an active seed collection and propagation program, including involvement in large-scale rehabilitation projects such as the Argyle mine site. Their knowledge and experience may be drawn upon to inform species selection and propagation methods where appropriate.

Where required, plant material may also be sourced from commercial nurseries or specialist suppliers, provided that species are appropriate to the local environment and, where practicable, derived from local or regional seed sources.

For aquatic and riparian species (e.g., sedges and rushes), it is preferable that plant material be grown from locally collected seed or sourced from regional suppliers to maintain genetic integrity and improve establishment success.

The outcomes of the 2026 vegetation surveys will further inform the selection of suitable species and propagation approaches for future rehabilitation and revegetation works within the Study Area.

Table 7 – Historically recorded local plant species for rehabilitation

Shrubs	Trees	Trees Cont.	Grasses
Acacia translucens (poverty bush)	*Adansonia gregorii* (boab)	*Ficus opposita* (sandpaper fiq)	*Cyperus a/bomarqinatus*
Cochlospermum fraseri (kapok bush)	*Atalaya hemig/auca* (whitewood)	*Grevil/ea striata* (beefwood)	*Cyperus macrostachyos*
Carissa lanceolata (conkerberry)	*Barringtonia acutangula* (freshwater manqrove)	*Gyrocarpus americanus* (helicopter tree)	*Echinochloa kimberleyensis*
Eucalyptus pruinosa (silver leaf box)	*Bauhinia cunninghamii*	*Lophostemon grandiflorus*	*Eleocharis atropurpurea*
Aquatic	*Cathormion umbellatum* (Cathormium)	*Mela/euca leucadendra* (cadieput)	*Eleocharis brassii* (spike rush)
Nymphoides indica	*Erythrina vespertilio* (yulbah)	*Melalueca viridiflora* (broad leaf paper bark	*Eleocharis philippinensis*
Nymphaea gigantean (giant waterlily)	*Erythrophleum Chlorostachys* (ironwood)	*Nauclea orientalis* (leichhardt Pine)	*Eleocharis spiralis*
Hydrilla verticillate (water thyme)	*Eucalyptus camaldulensis* (river gum)	*Owenia vernicosa* (emu apple)	*Eleocharis sphacelata* (tall spike rush)
Myriophyllum verrucosum (red Water Milfoil)	*Eucalyptus microtheca* (Coolibah/flooded box)	*Pandanus spiralis* (screwpine)	*Eriachne sulcata*
Potamogeton tricarinatus (floating pond weed)	*Eucalyptus foelscheana* (smooth barked bloodwood)	*Sesbania Formosa* (white dragon tree)	*Oryza australiensis* (Australian wild rice)
Vallisneria spiralis (ribbon weed)	*Eucalyptus grandifolia*	*Tristania grandiflora* (wild Plum)	
	Excoecaria parvifolia (quttapercha Tree)		

14. RECOMMENDATIONS

A review of the 2008 VMP identified that there remains limited contemporary data and information available for the wetland ecosystem. Improving the evidence base will support a better understanding of Lily Creek Lagoon and Lake Kununurra and enable more informed management of the waterbody and its vegetation.

Accordingly, this (2026) VMP retains and updates a number of key recommendations from the 2008 document, with a focus on improving water quality, protecting ecological values, and increasing the availability of relevant environmental information.

Recommendation 1. Continue to support and utilise the existing Lake Kununurra Foreshore Committee to coordinate management of the Study Area. The Committee includes representatives from the Shire, DWER, DBCA, DPLH, DoT and other relevant stakeholders, and provides a suitable forum for collaboration, information sharing and coordination of management actions.

Recommendation 2. Retain and protect areas of native vegetation that remain largely undisturbed for conservation purposes.

Recommendation 3. Retain mature native trees where practicable. Given the time required for establishment, replacement planting should be undertaken to ensure long-term canopy continuity where trees are removed or lost.

Recommendation 4. Implement best practice stormwater management measures to reduce sediment and nutrient inputs to the system. This includes rehabilitation of stormwater drains, appropriate regulation of developments (e.g., through Shire policies), and application of erosion and sediment control measures .

Recommendation 5. Establish sediment monitoring locations to assess sediment loads entering Lily Creek Lagoon and inform future management actions.

Recommendation 6. Undertake targeted fauna surveys (including nocturnal mammal surveys and dawn/dusk bird surveys), where appropriate, to support understanding of habitat values and inform vegetation management and rehabilitation outcomes.

Recommendation 7. Support resourcing for on-ground vegetation management, including roles with responsibility for park maintenance and bush regeneration.

Recommendation 8. Support the development of a Ramsar Wetland Management Plan for the Ord River Floodplain Ramsar site.

15. MONITORING, EVALUATION, AND REVIEW

Monitoring and Evaluation

Monitoring is a critical component of this VMP and is required to assess the effectiveness of vegetation management actions, identify emerging risks, and inform adaptive management over time.

Monitoring activities should focus on key environmental indicators relevant to the Study Area, including:

- Water quality, including parameters such as turbidity and total dissolved solids (**TDS**), and where feasible, sediment inputs to Lily Creek Lagoon.
- Vegetation condition and extent, including cumbungi distribution, aquatic vegetation, and riparian and fringing vegetation communities.
- Weed distribution and abundance, including mapping of priority introduced species.
- Rehabilitation outcomes, including survival and establishment of planted species.
- Photographic monitoring, including fixed photo points and, where available, analysis of aerial imagery to assess changes in vegetation extent over time.

Existing monitoring programs should be utilised where possible. At the time of writing, DWER undertakes routine water quality monitoring (including TDS and turbidity) within Lily Creek Lagoon and Lake Kununurra, with data publicly available via their website.

Where practicable, monitoring data should be recorded, stored and managed within a centralised system accessible to relevant stakeholders to support coordination and informed decision-making.

Implementation and Responsibilities

Implementation of monitoring activities will require coordination between land managers and relevant stakeholders, including the Shire, DWER, DBCA and other agencies as appropriate. The Lake Kununurra Foreshore Committee provides an appropriate forum to coordinate monitoring activities, assign responsibilities and identify funding opportunities.

Funding mechanisms may include existing operational budgets, project-based funding, or other sources such as foreshore reserve lease arrangements, where applicable.

Monitoring requirements associated with statutory approvals (e.g., clearing permits) should also be integrated into the overall monitoring framework where relevant.

Review

This VMP should be considered a living document and reviewed periodically to ensure it remains current and effective.

The outcomes of the 2026 vegetation surveys and any subsequent monitoring programs should be used to inform a comprehensive update of this VMP.

In the interim, the VMP should be reviewed at least annually at first, with the potential for the review period to extend if annually becomes excessive with future iterations.

16. REFERENCES

Apfelbaum, S.I. (1985). *Cattail (Typha spp.) management*. Natural Areas Journal, 5(3), 9–17.

Arthur Rylah Institute for Environmental Research (2017). *Knowledge document: impacts of priority wetland weeds – Part 2*. Department of Environment, Land, Water and Planning, Victoria.

Bartle, J., Graham, G., Lane, J., and Moore, S. (1986). *Forrestdale Lake Nature Reserve Management Plan 1987-1992,* Department of Conservation and Land Management, Como.

Department of Biodiversity, Conservation and Attractions (DBCA, 2018). *Ramsar Information Sheet: Ord River Floodplain, Western Australia.* Government of Western Australia.

Department of Environment (2003). *Kununurra Water Reserve Drinking Water Source Protection Plan*, Department of Environment, Perth.

Department of Primary Industries and Water (2007). *Cumbungi/Bullrush (Typha spp.) Control Guide,* Department of Primary Industries and Water, Tasmania.

Department of Primary Industries and Regional Development (DPIRD, 2018). *Ord River Irrigation Area Stage 2 M2 Supply Channel - Compliance Assessment Report 2017*, WA. https://www.wa.gov.au/system/files/2022-11/Compliance%20Assessment%20Report%20%20Statement%20938%20EMP%201%20January%20-%2031%20December%202017.pdf?utm_source=chatgpt.com

Department of Water (DoW, 2012). *Kununurra Water Reserve Drinking Water Source Protection Plan – WRP 51*, Department of Water, Perth.

DoW (2013). *Ord Surface Water Allocation Plan,* Department of Water, Perth.

Dixon, I. and Douglas, M. (2007). *Riparian Condition in the Ord River Catchment, Western Australia: application of Rapid* Assessment *Tool,* Tropical Savannas CRC, Darwin.

Hall, N. G. (2000). *Development of research methodology and quantitative skills for integrated fisheries management in Western Australia*. FRDC Project 2000/311, Centre for Fish and Fisheries Research, Murdoch University Western Australia.

Kimberley Development Commission (KDC, 2025). *Ord River Irrigation Area Stage 2 (M2 supply channel),* WA. https://www.kdc.wa.gov.au/our-focus/projects/ord-river-irrigation-area-stage-2-m2-supply-channel/?utm_source=chatgpt.com

Lake Kununurra Foreshore Committee (2006). *Lake Kununurra Foreshore Plan,* Shire of Wyndham East Kimberley, Kununurra.

Li, X., Zhang, Y., Chen, H., Wang, L., Liu, Q., and Zhao, J. (2024). *Insights into the natural and cultural history of Typha orientalis*. PLOS Water, 3(1), e0000XXX.

Pandey, A. & Verma, R.K. (2018). *Taxonomical and pharmacological status of Typha: A review*. Annals of Plant Sciences, 7(3), pp.2101–2106

Rangelands NRM (2015). *Rangelands Natural Resource Management Strategy 2015–2025*. Rangelands NRM, Western Australia.

Shire of Wyndham East Kimberley (1987). *Lake Kununurra Foreshore Draft Management Plan,* Kununurra.

Shire of Wyndham East Kimberley (2004a). *Lake Kununurra Foreshore Plan*, Kununurra.

Shire of Wyndham East Kimberley (2004b). *Bushfire Risk Management Plan 2024 - 2026*, Kununurra.

Sinclair Knight Mertz (1995). *Management Plan: Lily Creek Scoping Study Management Plan Lake Kununurra*. Report prepared for the Water Authority of Western Australia, Perth.

Trudgen, M. (1991). *A Flora and Vegetation Survey of the* Coast *of the City of Mandurah,* Department of Planning and Urban Development, Perth.

Watkins, D., Jaensch, R. & Vervest, R. (1997). *Wetlands of the Ord River Floodplain, Western Australia*. Department of Conservation and Land Management, Perth.

Weeds Cooperative Research Centre (2004). *Introductory Weed Management Manual,* Adelaide.

Western Australian Museum (2005). *A biological survey of the Ord River catchment, Kimberley region, Western Australia*. Western Australian Museum, Perth.