Upper South Creek

Advanced Water Recycling Centre and Pipelines

Urban Design and Landscape Plan

Document Number: AWRC-TRA-PLN-DES-0001
Revision: 08

Recommend Documents to be Read in Conjunction

This management plan is to be read in conjunction with the Upper South Creek:

- Vegetation Management Plan (Appendix A)
- Landscape Management Plan (Appendix B)

Revisions

Draft issues of this document shall be identified as Revision 01, 02, 03 etc. Upon initial issue (generally Contract Award) this shall be changed to a sequential number commencing at Revision A. Revision numbers shall commence at Rev. A, B etc.

Date	Rev	Remarks	Prepared By	Reviewed By	Project Principal
29/05/2023	00	Draft Issue for review	Julie Lee	Matthew Easton	Julie Lee
19/06/2023	01	99% Issue for Review	Julie Lee	Matthew Easton	Julie Lee
26/07/2023	02	Final Issue	Julie Lee	Matthew Easton	Julie Lee
24/08/2023	03	Final Issue Revised	Julie Lee	Linda Hoang	Julie Lee
22/10/2023	04	Final Issue Revised	Julie Lee	Matthew Easton	Julie Lee
13/11/2023	05	Final Issue	Julie Lee	Matthew Easton	Julie Lee
05/05/2024	06	Internal update and review to incorporate addition of the VMP and LMP	Julie Lee	Matthew Easton	Julie Lee
16/09/2024	07	Internal update and review to incorporate addition of the VMP and LMP (and response to comments)	Eliza Fagan	Julie Lee	Julie Lee
04/10/2024	08	Closeout of VMP and LMP comment and re-issue to DPHI	Alyce Harrington	Julie Lee	Julie Lee

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Glossary

PROJECT DEFINITIONS	
Stage 1 (2026)	(Operational Site/Zone) The Project and basis of UDLP
Stage 2 (2035)	Potential Expansion within Operational Site
Masterplan	Potential Future Green Space

ABBRIVIATIONS	DEFINITION
AEP	Annual Exceedance Probability
AWRC	Advanced Water Recycling Centre
CPTED	Crime Prevention Through Environmental Design
CPW	Cumberland Plain Woodland
CSSI	Critical State Significant Infrastructure
DCP	Development Control Plan
D&C	Design and Construction
DPE	Department of Planning and Environment
ECI	Early Contractor Involvement
EIS	Environmental impact Statement
ESD	Ecological Sustainable Development
FPL	Flood Plain Level
ISC	Infrastructure Sustainability Council
IQL	Independent Qualified Individual
IS	IS Rating Scheme
ISC	Infrastructure Sustainability Council
LMP	Landscape Management Plan
MCoA	Ministers Conditions of Approval
MoU	Memorandum of Understanding
PMF	Probable Maximum Flood
RAP	Registered Aboriginal Participant
Reference Design	Upper South Creek Advanced Water Recycling Centre Urban Design Report (Sydney Water July 2021)
RFT	Request For Tender
SSI	State Significant Infrastructure
UMM	Updated Management Measures
USC	Upper South Creek
VMP	Vegetation Management Plan
WSUD	Water Sensitive Urban design
WSA	Western Sydney Aerotropolis
WSAP	Western Sydney Aerotropolis Plan
WHMP	Wildlife Hazard Management Plan

Acknowledgement of Country

We acknowledge and pay our respect to the Traditional Custodians of the AWRC site, the Darug people, and acknowledge their continuing connection to Country for thousands of years. We extend that respect to the Dharawal people who also have custodial obligations for this area and Wianamatta South Creek, which flows from Dharawal into Darug Country. We also extend that respect to the many other Aboriginal and Torres Strait Islander peoples who have lived in Western Sydney for many generations.

We understand that Wianamatta South Creek is significant to Darug and Dharawal people. Her name means ‘the Mother Place’, and like all water bodies, she is critical to the cultural and spiritual health of Country.

The AWRC project provides Sydney Water with an opportunity not only to learn about the cultural value of Wianamatta, but also to help restore and rehabilitate her, while also educating the broader community about her role in Country. We hope to be part of that process.

Executive Summary

The response to Country and culture in the design of places builds on engaging and being guided by the Aboriginal community and recognised knowledge holders. Connecting to Country principles have been utilised to guide the planning of the Advanced Water Recycling Centre (AWRC) and will be developed during the Design and Construction phase to assist in the delivery and management of the site.

Urban design sets a strong foundation for the aspirations and desired outcomes for the USC AWRC by embedding place making and landscape-led design principles as core pillars. Importantly, the site will contribute to place-based outcomes through designing and caring for Country and supporting biodiversity through providing a restored landscape and a sustainable wastewater service for now and into the future. A balanced perspective promotes the environment as an opportunity for water cycle education.

The AWRC site is within a developing Western Parkland City and is an important infrastructure asset that has local and regional significance. It will build upon the retention and enhancement of blue and green networks linking open space and recreational systems to cool an emerging polycentric city.

This UDLP sets the strategy for the urban, landscape and architectural design at the AWRC. It outlines the context, opportunities and constraints that have informed the development for Stage 1 (Operational Site) and Stage 2 (potential expansion within Operational site - 2035) and the Green Space Masterplan. Sydney Water has developed design objectives to guide a landscape led masterplan. Urban Design for the AWRC is a policy-driven initiative to implement planning objectives to lead transformational outcomes.

Design Approach

Establishing a benchmark in integrating essential infrastructure with the provision of broader community and ecological benefits, the development of the AWRC site will build upon existing character and heritage through:

- Building on existing features
- Creating a landscape led biodiverse environment.
- Showcasing water on the site
- Human scale and nature-based solutions
- Providing opportunities for the future
- Ensuring a feasible and sustainable outcome
- Integrating a cultural heritage response

The guiding principles of Wastewater Treatment, Resource Recovery, Sustainability, Community and Built Environment Approach identified in the reference design *Upper South Creek Advanced Water Recycling Centre Urban Design Report* (Sydney Water July 2021) have been adopted to develop a joint vision with Sydney Water.

The Upper South Creek AWRC is a place where the connection of people to the land, water and sky is appreciated and deepened, bringing community together to restore, discover, meet and enjoy.

Connecting with Country, heritage interpretation and public art objectives have been identified in the *Upper South Creek Advanced Water Recycling Centre Heritage Interpretation Strategy* (Extent Heritage October 2021) and incorporated into the planning for the Project.

Sydney Water has made a commitment to improved sustainability outcomes at the Upper South Creek AWRC and is targeting an Infrastructure Sustainability Council (ISC) IS rating of “Gold”, aspiring to “Platinum” for the Design and As-Built categories. More broadly, Sydney Water’s approach to Climate Change and sustainability includes a commitment to achieving a net zero carbon in its operations by 2030.

The urban design approach for the AWRC to manage potential visual and landscape impacts has been considered by creating a parkland setting, architectural treatments and developing a landscape within an ecological and heritage context. The AWRC is located in an area that is expected to change to industrial and employment land uses and will likely reduce the significance of the impact of the AWRC over time. In addition, a landscape-led approach to urban design provides opportunities to positively enhance the visual impact of the AWRC.

Environmental Impact Statement

The Project is critical State Significant Infrastructure and Sydney Water has prepared the Upper South Creek Advanced Water Recycling Centre Environmental Impact Statement (EIS) which assesses environmental and community impacts. The EIS was placed on public exhibition on 21 October to 17 November 2021. Comments and submissions are captured in the Submissions Report March 2022 including recommendations for future stages. The Project was approved on 28 November 2022. Sydney Water expects to begin construction in mid-2023.

Detailed Engagement

Sydney Water has confirmed a more detailed engagement process with the community, external stakeholders and Traditional Custodians of the land will continue to inform the future green space development, cultural heritage interpretation and ongoing caring for Country. During the design and construction phase, elements of this engagement that Sydney Water feel are beneficial to support the delivery and outcomes of the Stage 1 works will be considered.

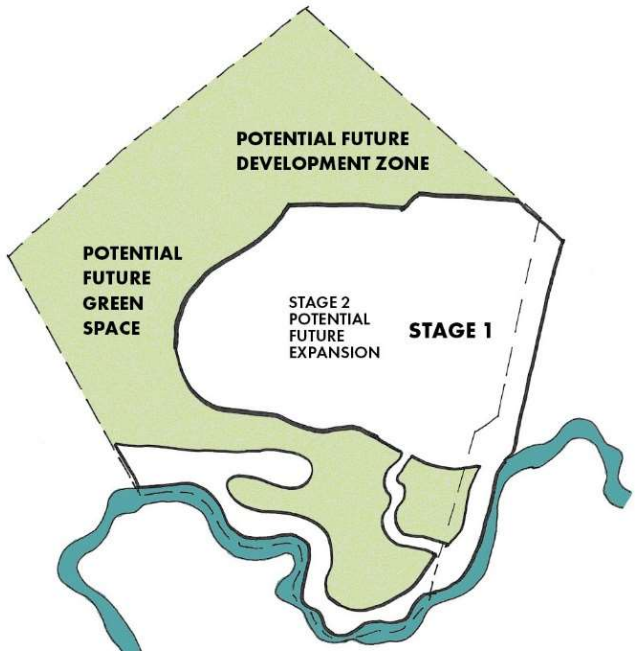

Figure 1 Staged development of the AWRC

Figure 2 Wianamatta South Creek

Figure 3 Context Map: Upper South Creek Advanced Water Recycling Centre

1 Project Overview

1.1 Introduction

Preamble

The Upper South Creek Advanced Water Recycling Centre (AWRC) was approved on 28 November 2022. The AWRC will be delivered in stages, with the Stage 1 AWRC Operational Site (this Project and UDLP) being delivered by 2026, Stage 2 is for the expansion of assets within the same operational site with ultimate capacity in approximately 2035. The Green Space Masterplan is part of the Stage 1 CSSI approval however, the urban design and landscaping is subject to ongoing consultation which extends beyond the plans included in this UDLP. The Green Space Masterplan will either form another stage in Stage 1 or be delivered as part of Stage 2.

This Urban Design and Landscape Plan (UDLP) has been established to demonstrate Sydney Water's approach to urban design for the Project and addresses the relevant Ministers Conditions of Approval, and applicable guidelines and standards. The UDLP establishes the framework for the staged development of the AWRC, ensuring consistency of integration.

The Upper South Creek Advanced Water Recycling Centre Urban Design Report, (Sydney Water July 2021) Reference Design formed the basis for the development of the urban design to the preliminary Concept Stage. The site is strategically located within a developing city and the UDLP presents a vision and principles that will see the delivery of critical infrastructure within a restored environment.

The Green Space Masterplan will be advanced during the Design and Construction (D&C) phase to establish future implementation strategies.

Water, land, and the sky are the greatest assets of the Western Parkland City. The waterways and green networks will define the character of the city. Sydney Water is providing a strategy to embed a seamless landscape that will enhance and cool the City and be an extraordinary place that links into its neighbourhood, recycles water, recovers resources, promotes biodiversity, heritage, education, play and recreation.

Greening is essential for the broader connections within the Western Parkland City. The landscaping for the site emphasises the importance of connected ecological systems along with physical networks, setting the thoughtful bench marking that can guide the development of future segments of Wianamatta South Creek and Kemps Creek.

The precinct is undergoing significant transformation that is being driven by infrastructure and land use initiatives associated with the Western Sydney Airport and Aerotropolis. The majority of rural lands will transition towards urban development (residential and employment) and existing urban hubs will increase in density to house a growing population.
Urban Design addresses the staged nature of the Project, current and future needs in restoring and enhancing greening along Wianamatta South Creek, providing a level of certainty and flexibility to match the planned capacity growth of the AWRC. Connections across the site and linkages to planned open space networks have been identified.

The UDLP recognises the objectives and strategic directions for the implementation of the local Green Grid. Wianamatta South Creek is a priority project and will be developed from the principles as set in the Sydney Green Grid. The Green Space Masterplan forms the basis of enhancement that will keep the AWRC green and cool, encourage healthy lifestyles, support walking and cycling, provide better access to open spaces, enhance bushland and support ecological resilience.

Making use of the attributes of the site, along with a range of other goals, the Masterplan will ensure the Western Parkland City becomes a more equitable and liveable city which evolves with a genuine sense of place woven throughout.

Background and Scope

Stage 1 Operational Site for the wastewater treatment infrastructure includes catalyst and high priority elements due to their important place making characteristics. Preserving and enhancing the natural attributes of the site is a tangible way in which our community respects and cares for Country and our natural environment.

The desired future outcomes for the site have been used as a basis for short (Stage 1- 2026), medium and longer-term (Stage 2 -2035) planning. Implementation requires Sydney Water to lead collaborative planning and responsible management of the environment through sustainable natural resource management practices that

respect ecosystem functions. Sydney Water will be a custodian acknowledging the importance of creating and maintaining the AWRC as an asset for all. Further collaboration with Sydney Water and the broader community will occur during the D&C Phase.

The Environmental Impact Statement submitted to DPIE includes a Project Description on which impacts have been based. This UDLP is materially consistent with the Project as outlined in the EIS and will not cause impacts exceeding those assessed.

1.2 Minister's Conditions of Approval

An environmental Impact statement (EIS) for the Project was on exhibition from 21 October to 17 November 2021 submitted by Sydney Water for public exhibition and comment. In October 2022 a submissions report was prepared in response to submissions received during the EIS exhibition period. The Project was approved on 28 November 2022.

The UDLP has been prepared to satisfy clauses E23, E59, E61, E62, E63, E64, E65, and E66 of the Ministers Conditions of Approval (CoA). In addition, the UDLP captures Updated Management Measures (UMM) items UD01, UD02, SW02, G14, WW11 and Infrastructure Sustainability Council (ISC) IS Rating Scheme for Level 1 and Level 2.

CoA, UMM and ISC are contained in Chapter 3 of this Plan. Compliance with the Conditions, measures and design criteria are noted and referenced in this Plan where each condition is addressed.

The UDLP focuses on the Stage 1 AWRC Operational Site (this Project) and aligns the project vision and principles with the ultimate capacity (2035) and green space development.

1.3 Suitably Qualified Experts

Tract Consultants has been engaged to prepare this UDLP. Tract is a national consultancy practice with expertise in urban design, landscape architecture and planning, established in 1973. Julie Lee is a fellow of the Australian Institute of Landscape Architects and is a member of the NSW State Design Review Panel. Matthew Easton is a Senior Principal at Tract and Environmental Manager, and also serves as the Revegetation consultant on the Project. Julie and Matthew each have over 30 years professional experience.

Other experts include:

- Bushfire consultant – GHD and Jacobs
- Revegetation consultant – Matthew Easton
- Ecology consultant – Biosis
- Flooding consultant – GHD and Jacobs
- Soil consultant – SESL Australia
- Heritage consultant – Extent Heritage

Table 1 Consultant advice

Consultant	Document	Date	UDLP Chapter Reference
GHD and Jacobs	Bushfire Assessment – Review of Bush Fire Constraints and Opportunities	28 July 2023	9.2
Tract	Vegetation Management Plan	30 September 2024	8.3, 8.4, 10.3, 10.6, 11.1, 17.1
Biosis	Review of the UDLP and VMP for the Upper South Creek – Advanced Water Recycling Centre	13 September 2023	8.3, 10.5, 10.6, 11.1, 17
GHD and Jacobs	Upper South Creek existing flood modelling results	14 June 2023	9.3, 12.1
SESL Australia	Soil Re-Use Assessment and Advice – Advanced Water Recycling Centre (AWRC)	20 September 2023	8.5, 17.1
Extent Heritage	Incorporation of outcomes and opportunities included in the Heritage Interpretation Strategy (HIS) (Extent Heritage October 2021). HIS is a comprehensive review of potential interpretation opportunities to ensure that traditional, historical, and contemporary values and meanings are integrated.	October 2021	7.1, 14

Figure 4 AWRC view looking southwest

2 Connectivity

2.1 Country

The Project continues to be Country led to inform the design, advising the design principles, project values, landscape, architecture and local needs. Using water to tell a new story about Place, we have and will continue to engage with local Aboriginal people and Traditional Custodians.

Water is life, linking our ecosystems. Building on the Connecting to Country Framework and Designing with Country discussion paper established by the Government Architect of NSW, the Recognise Country- Guidelines for the development in the Aerotropolis and the Consultation Outcomes Report Aerotropolis Stormwater Catchment Scheme Plans- Aboriginal Engagement (Sydney Water Corporation GHD Zion, Waters 29 November 2022).

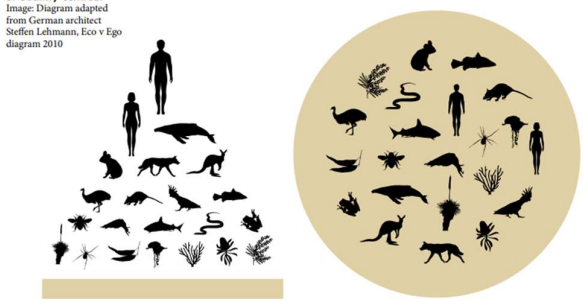

Figure 5 Human Centred vs. Country Centred (Image: GANSW 2023)

Figure 6 Designing with Country Paper

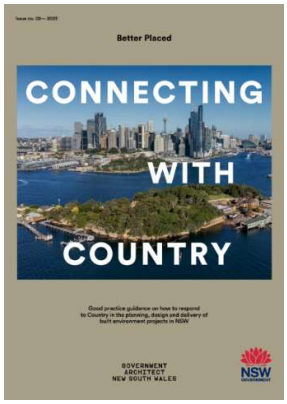

Figure 7 Connecting with Country Framework

The Upper South Creek Advanced Water Recycling Centre Heritage Interpretation Strategy (Extent Heritage for Sydney Water October 2021) outlines the need to engage with Aboriginal and broader community before an Interpretation Plan can be prepared.

A comprehensive and integrated approach will include a range of initiatives that develop an increased understanding and response to Darug Country and the cultural context of Wianamatta South and Kemps Creek to guide landscape outcomes more meaningfully. The engagement strategy is expanded upon in Chapter 14 Community and Stakeholder engagement.

Through this methodology, social, cultural and built form considerations are elevated beyond ‘business as usual’ to focus on Country, stewardship and cultural heritage.

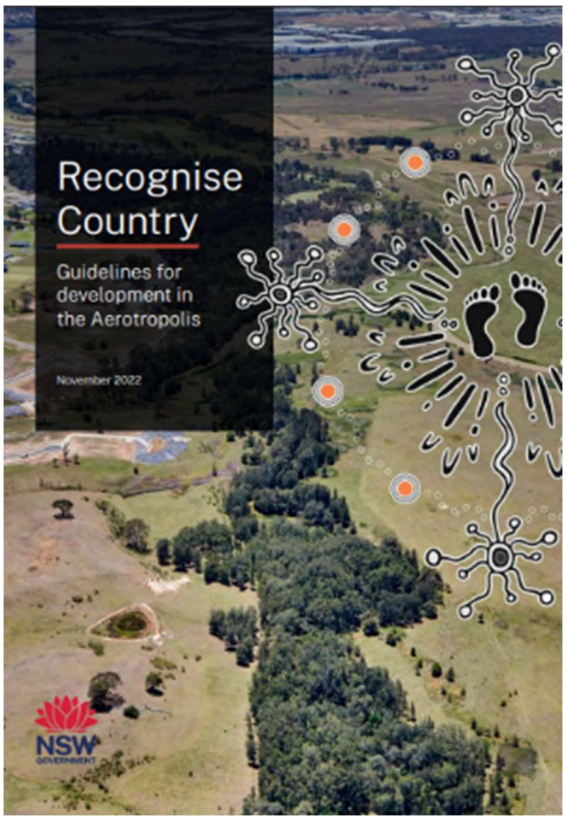

Figure 8 Recognise Country Guidelines

3 Urban Design Vision, Objectives and Principles

3.1 Vision

The AWRC is a legacy project that is grounded in a shared vision developed during the tender stage.

Upper South Creek AWRC is a place where the connection of people to the land, water and sky are appreciated and deepened, bringing community together to restore, discover, meet and enjoy.

Project Urban Design Principles and Objectives

Background

Urban design is a significant element of the Project as Sydney Water has identified place making and landscape-led design vision and supporting principles to underpin the desired outcomes in the near and long-term. As part of the emerging Western Parkland City, restoring natural systems will assist in the mitigation of environmental loss associated with Climate Change and Stage 1 of the AWRC will establish the framework for the stewardship of a significant site for both Sydney Water and the community.

Principles and Objectives

The primary urban design principles and objectives support the delivery of the urban landscape design vision and are aligned with those principles and objectives identified in the Reference Design report Upper South Creek Advanced Water Recycling Centre Urban Design (Aurecon Arup July 2021). The vision, supporting principles and objectives have been developed for this plan in line with urban design principles set out in the Australian Urban Design Protocol (Commonwealth of Australia 2011).

These supporting principles and objectives are implemented throughout the detailed design optioneering process to contribute to place-based outcomes by designing and caring for Country through supporting biodiversity through the provision of a restored landscape. The design of the AWRC site will further consider Country during the development of the Green Space Masterplan when detailed engagement with the local Indigenous community and key stakeholders will continue to occur to inform the design of the green space and cultural heritage interpretation.

Principles, objectives, and urban and landscape design aspect consideration and alignment are detailed in Table 2.

Connection to Country is the overarching principle for engaging with Country – and therefore community and cultures.

Urban and Landscape Design Vision and supporting Principles, Objectives and Aspect alignment

The following table details how the urban design principles, objectives, and urban and landscape design aspects are explored during objective development. Urban design objectives and principles that align with

Connecting to Country, Culture and People are expressed within this plan. Table 2 details the design options and selections made by the Project that evidence this alignment and how these design options and selection achieve the vision and its supporting principles and objectives. Additional information can be found in the section of the UDLP as identified.

Table 2 Alignment of urban design principles, objectives and design aspects

CONNECTING TO COUNTRY, CULTURE AND PEOPLE			
Principles	Objectives	Aspect	UDLP Chapter Reference
Placemaking (P1) To create and support a sense of place drawing on the character of the local area	Placemaking. Create a strong sense of place that derives a narrative from "Connection to Country' (O1)	Urban Form Response to natural landscape	Section 7 (7.1, 7.2 & 7.3)
	Existing natural context. Rediscover the natural context of the site to provide a strong set of visual and physical markers through contextual planting that reference the sites' natural identity. (O2)	Biodiversity and habitat connectivity	Section 7.5, 8, 9 & 10, 10 & 11.1
	Integration with strategic urban design principles of district, precinct plans and policy. (O3)	Integrating with existing and likely future infrastructure and development. Public and Active Transport	Section 6.1, 6.2 & 6.3, 9 & 13
	Built form and facility that is integrated with landscape urban character (O4)	Urban Form	Section 7.2, 11.4 & 13.1
	Consideration of aerial view experienced from flights as part of the experience. (O5)	Urban Form	Section 7.5 & 11.4
	Creation of a vibrant place for workers and visitors as a regional asset. (O6)	Activity Centres and employment. Green Infrastructure integration, including water urban sensitive design.	Section 11.2, 11.4 & 12.2
	Landscape led design approach aligned with WSAP and Western Parkland Vision and connecting networks Integration of water to support a landscape that mitigates urban heat island effect in Western Sydney (O7)	Integrating with existing and likely future infrastructure and development. Biodiversity and habitat connectivity. Response to natural landscape.	Section 6.1, 12.2 & 17 (Vegetation Management Plan & Landscape Management Plan)

CONNECTING TO COUNTRY, CULTURE AND PEOPLE			
	Integration of water to support a landscape that mitigates urban heat island effect in Western Sydney (O8)	Green Infrastructure integration, including water urban sensitive design. Response to natural landscape.	Section 7.2, 7.3, 8.4, 10.2, 10.4, 11.1 & 12.2
Leading edge environmental responsiveness (P2) Leading edge environmental responsiveness Ensure environmental practices respond to the natural systems of the area and promotes sustainability	Existing vegetation. Provide a robust revegetation strategy that features Indigenous plant species that are suitable for the local climate and references the Cumberland Plain plant communities. (O9)	Biodiversity and habitat connectivity	Section 10 & 17
	Protect and enhance waterways. Capitalise on the opportunity to restore the Wianamatta South Creek and its billabongs. Landscape restoration. Provide a landscape restoration strategy that allows for landscape to be restored. (O10)	Biodiversity and habitat connectivity. Community Connectivity	Section 7.2, 7.3, 8.4, 9, 10.2, 10.4 & 11.1
	Landscape restoration. Provide a landscape restoration strategy that allows for landscape to be restored. (O11)	Biodiversity and habitat connectivity	Section 10 & 17
	Green infrastructure and biodiversity. Integrate natural patterns and ecology into the design, protect Wianamatta South Creek and manage drainage to support new landscape. (O12)	Response to natural landscape. Biodiversity and habitat connectivity.	Section 10, 11.3, 11.4, 17 & Figure 94-100
	Incorporate leading edge WSUD strategies into the design. Provide measures to reduce the urban heat island effect. (O13)	Green Infrastructure integration, including water urban sensitive design.	Section 6.1, 10, 11.4, 12.2 & 17
Urban renewal and liveability (P3) Fit the AWRC sensitively into the unique natural, built, and cultural environment of the bridging landscape between Kemps Creek and Wianamatta South Creek	Improved environment. Develop a unified landscape strategy that enhances and improves the site. (O14)	Biodiversity and habitat connectivity	Section 10 & 17 (Vegetation Management Plan & Landscape Management Plan)
	Improved Cultural Awareness through interpretation strategies that reflect Country. (O15)	Community Connectivity Urban Form	Section 7 & 10

CONNECTING TO COUNTRY, CULTURE AND PEOPLE			
	Improved Connectivity. Provide improved access and connections. (O16)	Community Connectivity Public and Active Transport	Section 6.2, 6.3, 8.5, 11.2, 11.5 & 13.1
	Safety and Security. Integrate CPTED strategies into all aspects of the design to ensure that they are safe and comfortable to use at all times. (O17)	Community Connectivity Public and Active Transport	Section 11.2 & 11.5

4 Planning Approval Framework and Compliance

4.1 Minister's Conditions of Approval, Updated Management Measures and Infrastructure Sustainability Council (ISC) IS Rating Scheme

The relevant Conditions of Approval, Updated Management Measures and Infrastructure Sustainability Council IS Rating Scheme Level 1 and 2 requirements specific to the urban design, landscape and place making for the Project are listed in Table 3, Table 4 and Table 5, respectively, with reference to where each condition or measure is addressed within the relevant Chapter of this UDLP.

Table 3 Minister's Conditions of Approval in the UDLP

MINISTER'S CONDITIONS OF APPROVAL		
ID	Condition	UDLP Chapter Reference
	BIODIVERSITY	
	Re-use of native vegetation and other habitat features	
E23	Stage 1 of the CSSI must maximize the reuse of native vegetation and other habitat features that have been approved for removal. Where reuse by the CSSI is not possible, relevant council(s), NSW National Parks & Wildlife Service, Western Sydney Parklands Trust, Greater Sydney Local Land Services, local Landcare groups, DPI Fisheries and any additional relevant government agencies must be consulted prior to the removal of vegetation and other habitat to determine if: a) hollows, tree trunks (greater than 25-30 centimeters in diameter and 2-3 metres in length), mulch, bush rock and root balls salvaged from native vegetation impacted by the CSSI; and b) (b) collected plant material, seeds and/or propagated plants from native vegetation impacted by the CSSI, could be used by others in habitat enhancement and rehabilitation activities, before pursuing other disposal options. If the native vegetation and other habitat features can be reused by others, the Proponent must advise them and facilitate access for salvage.	Chapters 8.3, 8.4 Chapter 10.5
	FLOODING	
E27	Prior to the commencement of construction within the green space area as mapped in Figure 4- 7 and Figure 4-8 of the Environmental Impact Statement listed in **Condition A1**, the Proponent must prepare a **Flood Impact and Risk Assessment (FIRA)** for the proposed concept design of the green space area. The **FIRA** must incorporate all proposed elements (including but not limited to vegetation, walking paths, fences, irrigation area and outdoor learning spaces). The FIRA must be prepared by a suitably qualified and experienced flood consultant in consultation with EHG and provided to the Planning Secretary for approval. ***Note: Condition E27*** *excludes construction of elements required for effective operation and management of operational components of the AWRC plant. This includes release*	Chapters 9.3, 12.1

MINISTER'S CONDITIONS OF APPROVAL		
	infrastructure to South Creek, fences around the AWRC operational area and fire trail around the AWRC operational area.	
	PLACE, DESIGN AND VISUAL AMENITY	
	Lighting and Security	
E59	Stage 1 of the CSSI must be constructed and operated with the objective of minimising light spillage to surrounding properties. All lighting associated with the construction and operation of Stage 1 of the CSSI must be consistent with the requirements of AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting, relevant Australian Standards in the series AS/NZ 1158 – Lighting for Roads and Public Spaces, and National Airports Safeguarding Framework (NASF) Guideline E: Managing the Risk of Distractions to Pilots from Lighting in the Vicinity of Airports. Additionally, mitigation measures must be provided to manage any residual night lighting impacts to protect properties adjoining or adjacent to the CSSI, in consultation with affected landowners. Note: The outcomes of this condition must be demonstrated in the Urban Design and Landscape Plan.	Chapter 13.2
	DESIGN OUTCOMES	
E61	The place making, design and landscape outcomes for the AWRC site of Stage 1 of the CSSI must be: **(a)** informed by and be consistent with the Upper South Creek Advanced Water Recycling Centre Urban Design Report, dated July 2021 (provided as Attachment A to RFI 1, dated 1 June 2022) and identified in the documents listed in Condition A1, including but not limited to the objectives and design principles, requirements, and opportunities; and **(b)** prepared in consultation with the community (including the affected landowners and businesses or a representative of the businesses), LALCs, RAPs and relevant council(s).	Chapter 3.1 Chapter 14
E62	Where work results in the temporary removal of a recreational or community use, and no similar use with sufficient capacity for regular users is located within two (2) kilometres of the site, then a temporary facility of comparable scale must be provided for the duration of the use of that site.	Not applicable - The project did not identify any location (recreational or community) where CoA E62 will be triggered.
	URBAN DESIGN AND LANDSCAPE PLAN	
E63	An **Urban Design and Landscape Plan (UDLP)** must be prepared for the AWRC site to document and illustrate the permanent built works and landscape design of Stage 1 of the CSSI and how these works are to be maintained. The UDLP must be: **(a)** prepared by a suitably qualified and experienced person(s) in place, urban and landscape design and bush regeneration. **(b)** prepared in consultation with relevant council(s) and the community, including affected landowners and businesses. **(c)** submitted to the Planning Secretary for approval no later than one month before the construction of permanent built surface works and/or landscaping in the area to which the UDLP applies; and **(d)** implemented during construction and operation of Stage 1 of the CSSI. Note: The UDLP may be developed and considered in stages to facilitate design progression and construction. Any such staging and associated approval would need to facilitate a cohesive final design and not limit final design outcomes.	Chapter 1.3 Chapters 1.1, 6.4, 14

MINISTER'S CONDITIONS OF APPROVAL		
E64	The **UDLP** must document how the following matters have been considered in the design and landscaping of the project:	
	(a) the requirements of **Conditions E61** to **E62;**	Chapters 3.1, 14
	(b) the requirements of the **Wildlife Management Plan under Condition E130;**	Chapter 9.1
	(c) demonstrated integration of Crime Prevention Through Environmental Design (CPTED) principles;	Chapter 11.5
	(d) Designing with Country and the principles and objectives of the draft Connecting with Country Framework;	Chapters 2, 7.1, 7.2, 14
	(e) the finalised version of the draft guideline 'Recognise Country – Draft Guidelines for development in the Aerotropolis';	Chapters 2, 6.1, 14.1
	(f) constraints associated with bushfire, flooding, and airport safeguarding;	Chapter 9.2
	(g) vegetation management that considers the principles of Guidelines for Vegetation Management Plans on Waterfront Land (NSW Office of Water, DPI 2012), draft Western Sydney Aerotropolis Riparian Revegetation Strategy, and the tree planting provisions in the draft Western Sydney Aerotropolis Development Control Plan – Phase 2 (October 2021);	Chapter 17
	(h) architectural design to soften the industrial aesthetic;	Chapter 11.3, 11.4
	(i) integrating heritage character of the site with treatment and finishes of the new design; and **(j)** inputs from relevant experts in architecture, landscape architecture, bushfire management, heritage, revegetation, ecology, wildlife hazard management and flooding.	Chapter 7, 11.1 Chapter 1.3
E65	The UDLP must include descriptions and visualisations (as appropriate) of: NSW Government 47 Department of Planning and Environment Conditions of Approval for Upper South Creek Advanced Water Recycling Centre – Concept and Stage 1 (SSI 8609189) **(a)** the design of the permanent built elements for the AWRC site including their form, materials and detail;	Chapter 11
	(b) place, design, and landscape outcomes for the proposed green space area, consistent with the Upper South Creek Advanced Water Recycling Centre Urban Design Report, dated July 2021 (provided as Attachment A to RFI 1, dated 1 June 2022) and identified in the documents listed in Condition A1;	Chapters 6.4, 7.2, 8, 10.4, 11.1, 12.2, 17.1
	(c) the design of the project landform and landscaping elements;	Chapters 6.1, 8, 9.1, 10
	(d) the type and design of public and open space;	Chapters 6, 7, 8, 9.1, 10.1, 10.2, 10.3, 10.4, 11.1, 11.2
	(e) details of strategies to rehabilitate, regenerate or revegetate disturbed areas with local native species; and	Chapters 8, 9.1, 10, 11.1, 17
	(f) management and routine maintenance standards and regimes for design elements and landscaping Work (including adequate watering of plants following planting depending on forecast weather conditions and weed management) to ensure the success of the design and landscape outcomes.	Chapter 17
	OPERATIONAL MAINTENANCE	
E66	The ongoing maintenance and operation costs of urban design, open space, landscaping and recreational items and work implemented for the AWRC site as part of this approval remain the Proponent's responsibility until satisfactory arrangements have been put in place for the transfer of the asset to the	Chapter 17

MINISTER'S CONDITIONS OF APPROVAL		
	relevant authority. Before the transfer of assets, the Proponent must maintain items and work to at least the design standards established in the UDLP, required by Condition E65.	

Table 4 Updated Management Measures and reference in the UDLP

UPDATED MANAGEMENT MEASURES		
ID	Measure	UDLP Chapter Reference
G14	Incorporate the requirements of the Planning for Bush Fire Protection 2019 into the detailed design of the AWRC.	Chapter 9.2
UD01	Visual impact of AWRC site structures and parkland area	Chapter 13.1
	The UDLP must include descriptions and visualisations (as appropriate) of: Prepare an Urban Design and Landscaping Plan for the AWRC site aligning with the themes and principles outlined in Table 4-4 and consider the opportunities identified in Table 4-4 as the urban design progresses. This plan will also:	This UDLP
	Address constraints associated with bushfire, flooding, and airport safeguarding;	Chapter 9
	Incorporate vegetation management that considers the principles of Guidelines for Vegetation Management Plans on Waterfront Land (NSW Office of Water, DPI 2012) and the Western Sydney Aerotropolis Riparian Revegetation Strategy (once finalised) and the tree planting provisions of the Phase 2 Aerotropolis Development Control Plan (once finalised);	Chapters 8.3, 8.4, 17
	Include architectural design to soften the industrial aesthetic;	Chapters 11.3, 11.4
	Consider integrating the heritage character of the site with the treatment and finishes of the new design;	Chapters 7, 11.1
	Consider the finalised version of the draft guideline 'Recognise Country – Draft Guidelines for development in the Aerotropolis';	Chapters 2, 6.1, 14.1
	Incorporate inputs from relevant experts in architecture, landscape architecture, bushfire management, heritage, revegetation, ecology, wildlife hazard management and flooding.	Chapter 1.3
UD02	Alignment of AWRC site urban design with NSW Government aspiration for Wianamatta South Creek green spine. Consult with the DPIE teams responsible for place management and green spaces in preparing the Urban Design and Landscaping Plan to ensure the project aligns with the NSW Government's vision for the green spine along Wianamatta South Creek.	Chapters 6.2, 6.4, 8.1, 10.2, 14
WW11	Consider riparian planting and natural bank stabilisation measures in the detailed design phase.	Chapter 11.1
SW02	Increased runoff, reduced infiltration and pollutant loading to Wianamatta- South Creek, including exacerbated downstream flooding conditions. • Design, install and maintain stormwater management measures on the AWRC site. • Including a range of Water Sensitive Urban Design measures to ensure: • Operational releases to South Creek achieve DPE EES water quality and flow objectives by considering stormwater quality and flow targets in the draft Western Sydney Aerotropolis DCP – Phase 2 (October 2021); • Operational efficiency of installed measures.	Chapter 12

UPDATED MANAGEMENT MEASURES		
	• Post-development peak flows do not exceed pre-development peak flows for the 50%, and 1% AEP storm events.	

Table 5 ISC design criteria

INFRASTRUCTURE SUSTAINBILITY COUNCIL (ISC) IS Rating Scheme		
ID	Design Criteria for PLA-2 Credit	UDLP Chapter Reference
Level 1	DL1.1 An Urban and Landscape Design Plan has been developed and design options implemented	
	Evidence for DL1.1 • The urban and landscape design plan, as specified above. • Evidence of urban and landscape design option implementation e.g., Design drawings; urban and landscape design report. • Documentation for the suitably qualified professional	This UDLP
	DL1.2 The maintenance arrangements for the project's urban and landscape design components have been reviewed.	
	Evidence for DL1.2 • Documentation and review of on-going maintenance arrangements, as specified above. • Documentation for suitably qualified professional.	Chapter 17 Vegetation Management Plan Landscape Management Plan Operator Maintenance Plans 100% Designs and Design Report
Level 2	DL2.1 An urban and landscape design statement has been prepared.	
	Evidence for DL2.1 • Documented urban and landscape design statement, as specified above.	Chapter 15 Urban & Landscape Design Statement
	DL2.2 The urban and landscape design plan and statement have been independently reviewed at key stages throughout the design.	
	Evidence for DL2.2 • Independent report (or documented meeting outputs) for each design review, as specified above including justification of review frequency. • As applicable, specifics of the independent members of the Design Review Plan or of the independent qualified reviewer. • Actions taken as a result of the Design Review feedback and recommendations.	Chapter 15 Urban & Landscape Design Independent Review Report

5 Reference Documents

All relevant standards, guidelines, assessments, and reports that have been referenced and complied with during the development of the UDLP are listed in Table 6 below.

Table 6 Complete list of reference documents

REFERENCE DOCUMENTS		
Reference	Governing Body	Date
14 Patterns of Biophilic Design report	Terrapin Bright Green	2014
A Liveability Framework for Sydney	NSW Government Department of Planning and Environment, ARUP	2017
AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting	Standards Australia	2019
ASTM E1980-11 Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces	ASTM International	2001
Australian Standard AS1428.1 Design for access and mobility	Standards Australia	2009
Aviation Safeguarding Guidelines – Western Sydney Aerotropolis and surrounding areas	NSW Government	November 2022
Australian Urban Design Protocol	Commonwealth of Australia	2011
Better Placed	Government Architect NSW	2017
Circular Economy and Resource Recover Strategic Blueprint	Sydney Water	2022
Commonwealth Environment Protection and Biodiversity Conservation Act 1999	NSW Government	1999
Connecting with Country framework	Government Architect NSW	2023
Consultation Outcomes Report Aerotropolis Stormwater Catchment Scheme Plans – Aboriginal Engagement	Sydney Water, GHD, Zion	November 2022
Cumberland Plain Conservation Plan	NSW Government Department of Planning and Environment	2022
Cumberland Plain Conservation Plan	NSW Government	August 2022
Cumberland Plain Recovery Plan	NSW Department of Planning and Environment	August 2022
Cumberland Plain Western Sydney Interpretation Guidelines	National Parks and Wildlife Service	2002
Dark Sky Planning Guideline	NSW Department of Planning and Environment	June 2023
Designing with Country discussion paper	Government Architect NSW	March 2020
Development and Assessment BASIX	NSW Government	2023
Greener Places Design Guide	Government Architect NSW	June 2020
Ecological Sustainable Development tool	Infrastructure Sustainability Council	2023

REFERENCE DOCUMENTS		
EIS amended flood impact assessment	Sydney Water	2022
Environmental Impact Statement	Sydney Water	September 2021
Everyone Can Play grant program	NSW Government Department of Planning and Environment	2021-2022
Floodplain Development Manual	NSW Office of Environment and Heritage	2005
Floodplain Risk Management Guidelines	NSW Office of Environment and Heritage	2015
Greater Sydney Regional Plan – A Metropolis of Three Cities	NSW Greater Sydney Commission	2018
Guidelines for Vegetation Management Plans on Waterfront Land	NSW Office of Water	2012
Heritage Interpretation Strategy	Extent Heritage	October 2021
Infrastructure Sustainability Council IS Rating Scheme for Level 1 and Level 2	Infrastructure Sustainability Council	2023
IS v2.1 Design & As Built	Infrastructure Sustainability Council	2023
Local Strategic Planning Statement 2020	Penrith City Council	2020
Ministers Conditions of Approval	NSW Government	2023
National Airports Safeguarding Framework Guideline E: Managing the Risk of Distractions to Pilots from Lighting in the Vicinity of Airports	Australian Government Department of Infrastructure, Transport, Regional Development, Communications and the Arts	October 2014
National Airports Safeguarding Framework Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports	Australian Government Department of Infrastructure, Transport, Regional Development, Communications and the Arts	October 2014
National Construction Code	Australian Building Codes Board	2023
Net Zero Directional Statement	Sydney Water	November 2022
Net Zero Plan 2030	NSW Government Department of Planning, Industry and Environment	2020
Net-Zero Carbon Plan	Sydney Water	November 2022
NSW Biodiversity Conservation Act 2016	NSW Government	2016
NSW Climate Change Policy Framework	Office of Environment and Heritage	2016
Penrith Green Grid Strategy	Penrith City Council, Tract	2021
Penrith Local Environmental Plan 2010	Penrith City Council, NSW Government	2010

REFERENCE DOCUMENTS		
Planning for Bush Fire Protection 2019	NSW Rural Fire Service	2019
Recognise Country – Guidelines for the development in the Aerotropolis	NSW Government	November 2022
Recovering bushland on the Cumberland Plain – Best Practice Guidelines for the Management and Restoration of Bushland	NSW Department of Environment and Conservation	2005
Regulation 94 of CAR 1988	Australian Government Department of Infrastructure, Transport, Regional Development, Communications and the Arts	1988
Re-Imagining water in Western Sydney – Western Sydney Regional Master Plan	Sydney Water	March 2020
Review of Bushfire Constraints and Opportunities report	Sydney Water	2022
Safer by Design	NSW Police Force, NSW Government	2001
Scoping Report Upper South Creek Advanced Water Recycling Centre	Sydney Water	July 2020
Section 78A (8) of the Environmental Planning and Assessment Act 1979	NSW Government	1979
Soil Re-Use Assessment and Advice – Advanced Water Recycling Centre (AWRC)	SESL Australia	September 2023
Standard Secretary's Environmental Assessment Requirements	NSW Government	1979
State Environmental Planning Policy	Western Sydney Aerotropolis	2020
State Environmental Planning Policy (Western Sydney Aerotropolis) 2020	NSW Government	2020
Submissions Report March 2022	Sydney Water	March 2022
Sub-Plan A: Conservation Program and Implementation	NSW Government	2020
Sydney Green Grid	Government Architect NSW, Tyrrell Studio	2017
Sydney Green Grid Plan 3 – South West District	Government Architect NSW, Tyrrell Studio	2017
Sydney Water Environmental Policy	Sydney Water	October 2021
Sydney Water Strategy 2020-2030	Sydney Water	2020
Sydney Water Upper South Creek – Advanced Water Recycling Centre Vegetation Management Plan	Sydney Water, Tract	July 2023
Technical guidelines for Urban Green Cover in NSW	NSW Office of Environment and Heritage	2015
The Penrith Community Plan 2017	Penrith City Council	2017
Updated Management Measures	Sydney Water	June 2021
Updated South Creek Flood Study	Penrith City Council, WorleyParsons	2015
Upper South Creek Advanced Water Recycling Centre Final Submission ECI Deliverables	John Holland, Trility, Jacobs, GHD, Tract	May 2022
Upper South Creek Advanced Water Recycling Centre Heritage Interpretation Strategy	Sydney Water	October 2021

REFERENCE DOCUMENTS		
Upper South Creek Advanced Water Recycling Centre Urban Design	Aurecon, ARUP	July 2021
Upper South Creek Advanced Water Recycling Centre Urban Design Report	Sydney Water	July 2021
Western City District Plan	NSW Greater Sydney Commission	2018
Western Sydney Aerotropolis Development Control Plan	NSW Government	November 2022
Western Sydney Aerotropolis Draft Wildlife Management Assessment Report	Western Sydney Planning Partnership, Avisure	May 2020
Western Sydney Aerotropolis (Initial Precincts) Riparian Corridors Assessment	Sydney Water	December 2021
Western Sydney Aerotropolis Precinct Plan	NSW Government Planning and Environment	March 2022

6 Urban Design Context

6.1 Strategic Context

Greater Sydney Regional Plan – A Metropolis of Three Cities

In 2018 the NSW Greater Sydney Commission released 'A Metropolis of Three Cities – The Greater Sydney Region Plan' to plan for the needs of a changing and growing city. The plan sets out a vision for a Sydney with three productive, liveable, and sustainable cities:

- The Eastern Harbour City
- The Central River City
- The Western Parkland City

The plan advocates for 30-minute cities whereby all residents live within 30 minutes of their jobs, education and health facilities, services, and amenities. Each city has its unique character and landscapes with a focus on different industries and economies.

Western City District Plan

The AWRC is located within the Western Parkland City - a city in the landscape. The Western District Plan is a 20-year integrated plan to guide and manage the growth of the Western Parkland City.

The following metropolitan-wide actions will deliver sustainability objectives:

Objective 25
The coast and waterways are protected and healthier

Objective 26
A cool and green parkland city in the Wianamatta South Creek corridor

Objective 27
Biodiversity is protected, urban bushland and remanent vegetation is enhanced

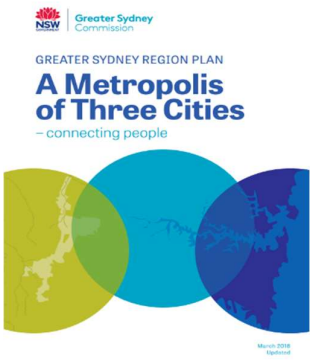

Figure 9 Greater Sydney Region Plan 2018

The catalyst for growth and the development of the Western Economic Corridor is the future Western Sydney Airport. This will see the construction of major transport infrastructure, such as the North South Rail Line and the M12 Motorway (which adjoins our site), to support the transformation of predominantly peri-urban lands into a region that will be the home for over 1.5 million by 2056. The Western Economic Corridor will attract globally significant commerce and trade, generating highly skilled, knowledge intensive jobs.

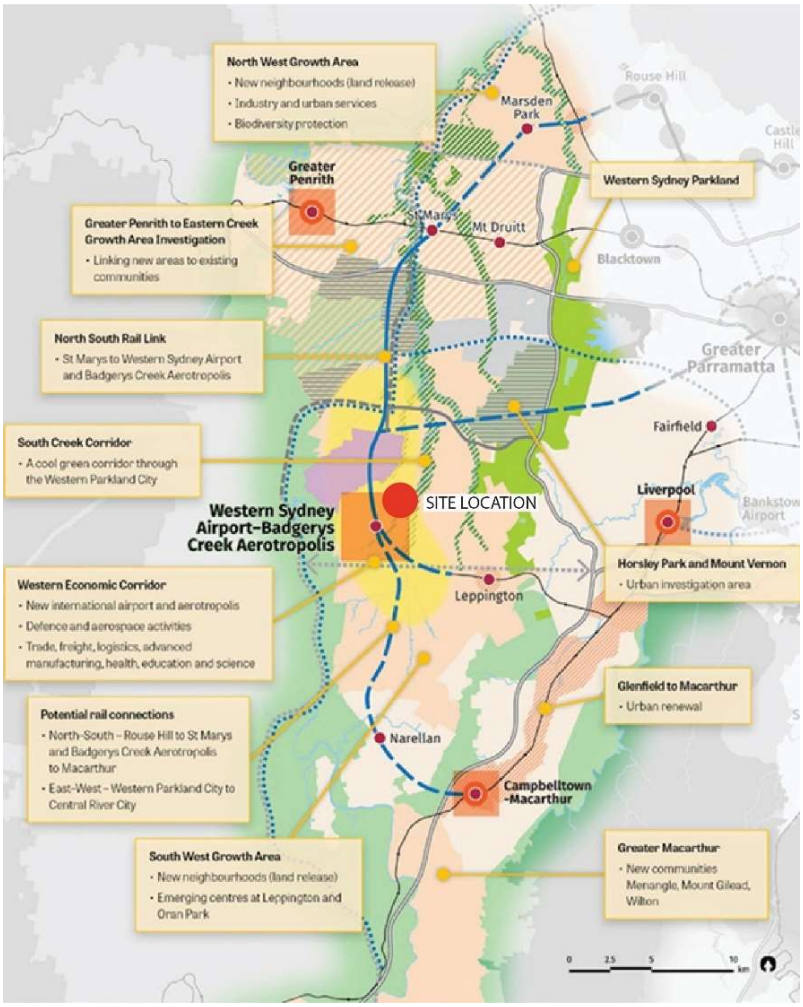

Figure 10 A Metropolis of Three Cities: Western Parkland City (Greater Sydney Commission)

Wianamatta South Creek Corridor

Wianamatta South Creek is the central urban element of the Western Parkland City. Bordering the western boundary of the site, it forms approximately 80% of the Western Parkland City's catchment, running through one of the flattest, driest, and hottest parts of Greater Sydney.

Wianamatta South Creek forms one of the thirty-eight objectives outlined in 'A Metropolis of Three Cities' and the 'Western City District Plan':

Objective 26/Planning Priority W13: A cool and green parkland city in the Wianamatta South Creek Corridor.

The objective reflects the vision of the Corridor as forming the identity and acting as a defining spatial element at the heart of the parkland city. Wianamatta South Creek will create linking corridors of active and passive recreation and open spaces, parks, walking and cycling trails and community facilities to promote a connected, healthy, liveable, and sustainable city.

An important tributary of Sydney's water catchment, the role of the Corridor in providing essential ecological services such as nutrient capture, urban cooling and habitat will be strengthened through innovative approaches to future development in the area.

Aspects around stormwater and wastewater management, flood mitigation, the introduction of wetlands to retain more water and increasing tree canopy to mitigate the urban heat island effect are a few of the strategies outlined under the objective.

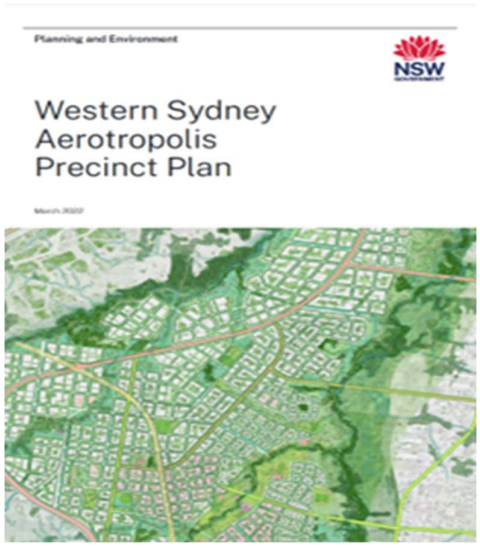

Figure 11 Western Sydney Aerotropolis Precinct Plan

Western Sydney Aerotropolis Precinct Plan

The Western Sydney Aerotropolis Precinct Plan provides the place-based objectives and requirements to guide development in the Aerotropolis in a consistent and sustainable manner over time.

Western Sydney Aerotropolis, Phase 2 Development Control Plan, includes two accompanying documents:

- Draft Recognise Country Guideline: Guidelines for development in the Aerotropolis (Guidelines)
- Draft Aviation Safeguarding Guidelines: Western Sydney Aerotropolis and surrounding areas

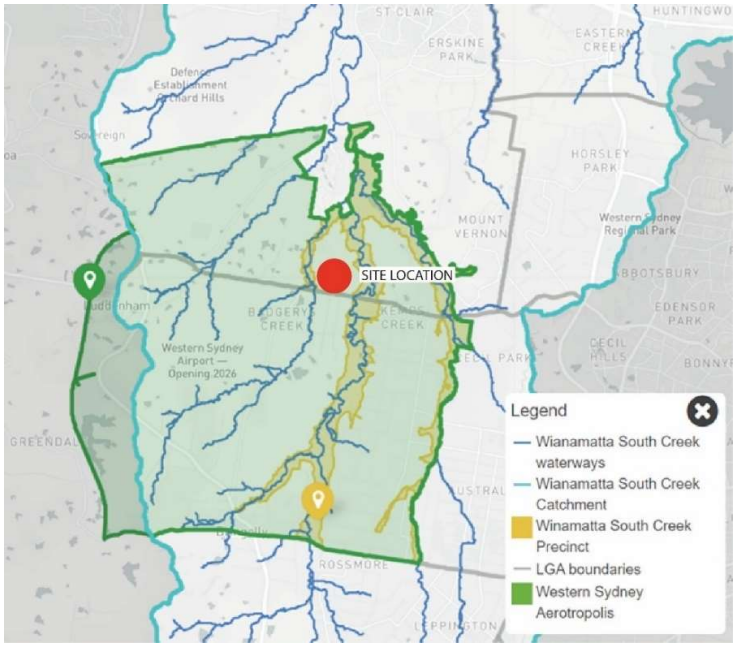

Figure 12 Wianamatta South Creek Precinct (Image: Department of Planning and Environment)

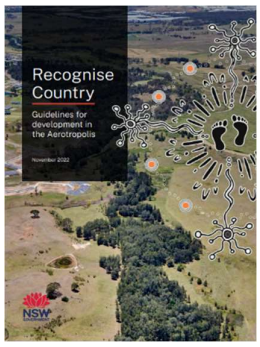

Figure 13 Recognise Country Guidelines

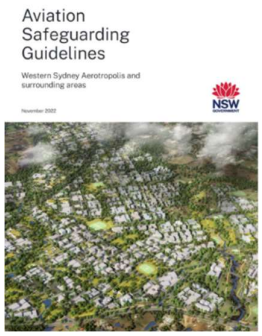

Figure 14 Aviation Safeguarding Guidelines

Cumberland Plain Conservation Plan 2020-2056

The Cumberland Plain Conservation Plan (The Plan) is one of the largest strategic conservation plans to be undertaken in Australia, aiming to protect the region's important conservation values. Covering 200,000 hectares The Plan details:

Twenty-Eight commitments under four categories, building knowledge and capacity to improve ecological resilience and support biodiversity and growth in the Western Parkland City. The four categories are:

- Avoiding and minimising impacts
- Mitigating indirect and prescribed impacts
- Conserving flora, fauna, and associated habitats
- Managing landscape threats

The Plan has been prepared to meet requirements for strategic biodiversity certification under the NSW Biodiversity Conservation Act 2016 and strategic assessment under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

Adopting a landscape-led approach to delivering the AWRC presents a major opportunity to minimise the environmental impacts of the centre and contribute to the ecological restoration of the waters and surrounding region.

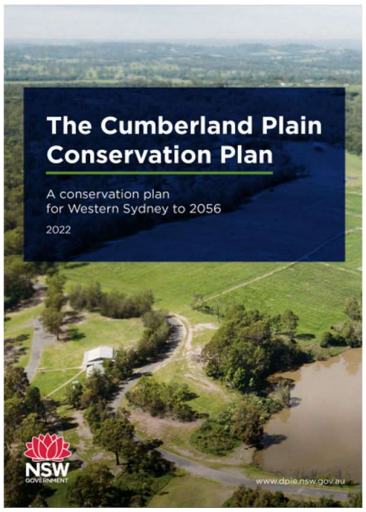

Figure 15 The Cumberland Plain Conservation Plan

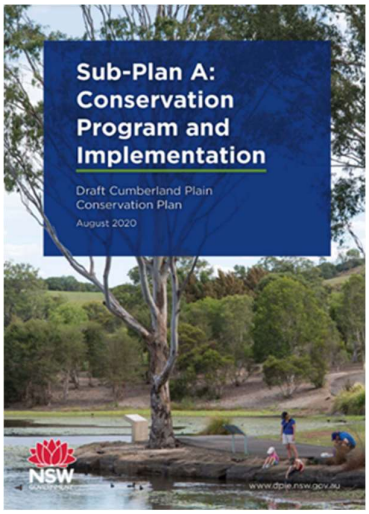

Figure 16 Sub-plan A

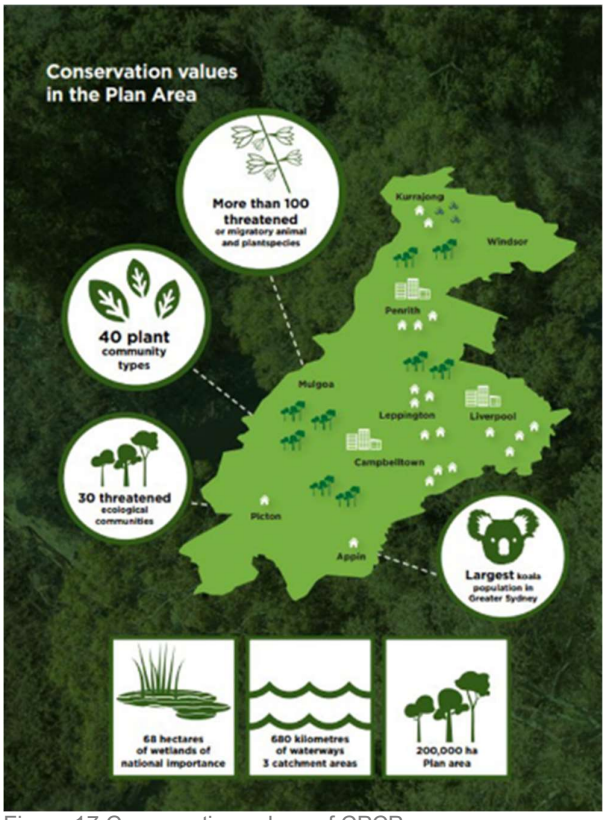

Figure 17 Conservation values of CPCP

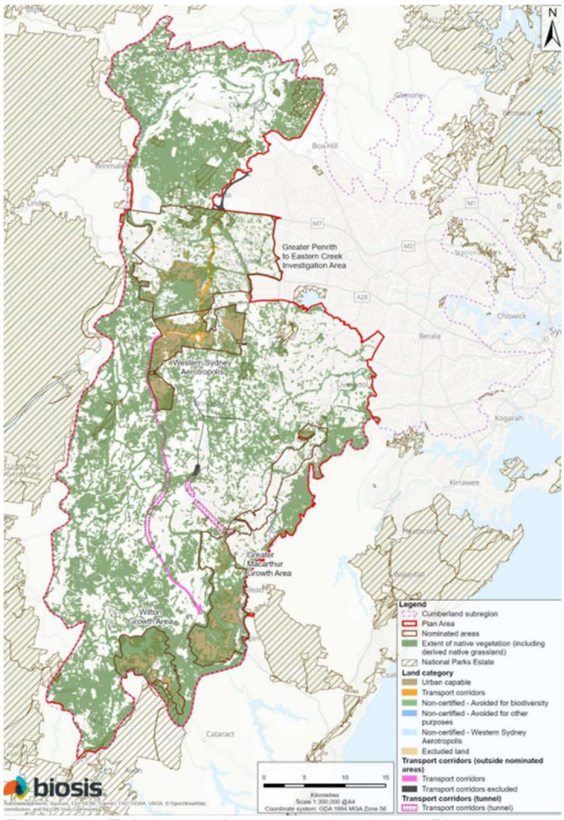

Figure 18 Existing native vegetation in the Plan area (Biosis)

Sydney Green Grid + South West District Grid

Underpinning Objective 32 of 'A Metropolis of Three Cities,' Sydney's Green Grid analysed spatial qualities, open space, waterways, context, and key natural features to develop preliminary prioritisation of Green Grid opportunities. Their strategic potential serves as catalysts for the establishment of an interconnected high performance green infrastructure network which will support healthy urban growth.

The Sydney Green Grid is delivering an interconnecting network of open space that will keep the city cool, encourage healthy living, enhance biodiversity, and ensure ecological resilience.

Linkages between open spaces are fostered within the wider public realm through enhancing creek corridors, transport routes, suburban streets, footpaths, and cycle ways.

Sydney Green Grid Government Architect of NSW

South and Kemps Creek Corridors

"South Creek is a major tributary of the Hawkesbury-Nepean River, starting from Narellan in the South West District, it flows north all the way to Windsor where it connects to the Hawkesbury River. It runs over 50 km and passes through more than 20 suburbs. The water quality of South Creek has a major impact on the Hawkesbury River, and it also has important ecological communities along its banks. The Project aims to create a continuous open space corridor along the entirety of South Creek that provides ecological protection and enhancement, improved stormwater treatment and a regionally significant recreation and active transport corridor for Western Sydney. The Project passes through the South West Growth Area and will act as a major open space corridor for the future development of the region. There is an opportunity to set riparian zones

along the creeks that provide open space, habitat and to improve water quality" (Sydney Green Grid Plan 3 South west district 2017).

Figure 19 Sydney Green Grid 2017

Figure 20 South West District 2017

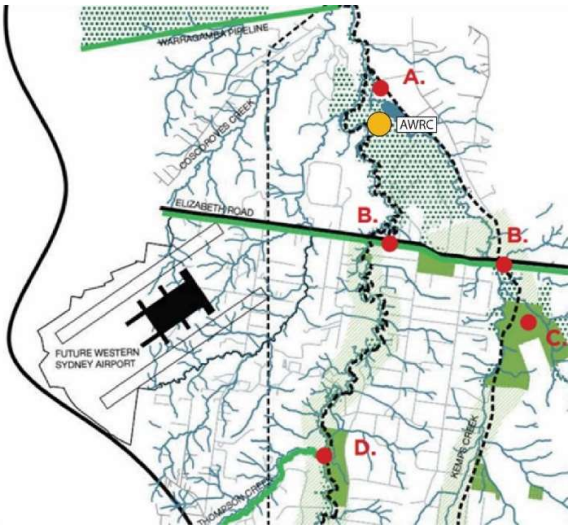

Figure 21 Sydney Green Frid Plan 3 South West district 2017 item A identifies South Creek is identified as a potential focus area in the Sydney Green Grid

SW1.7 SOUTH AND KEMPS CREEK

"Western Sydney is defined by its network of creeks and river systems. Currently many of the creeks suffer from poor water quality due to surrounding land uses and reduced or fragmented vegetation cover. Ropes and South Creek corridors have the potential to be enhanced to provide a greater contribution to the development of healthy urban environments. With a balanced approach to access, biodiversity, development, and recreation these networks can form valuable green infrastructure opportunities supporting future growth in the district. There is also opportunity to complete the regional trail connecting South Creek with the Great River Walk on the Hawkesbury Nepean River."

Green Places

Aligned with the Premier's Priorities: 'Greening Our City' and 'Greener Public Spaces,' Greener Places builds on the Sydney Green Grid, which forms part of the 'Plan for Growing Sydney and the District Plans.' Greener Places is a state green infrastructure policy which aims to create healthier, more liveable, and sustainable communities by improving the quality and access to natural and semi-natural systems such as parks and recreation, and waterways and bushland.

Greener Places highlights the social, environmental, and economic benefits of green infrastructure and the need for well designed, planned, and green infrastructure to support the ecological health of our environments, supporting biodiversity and habitat, and strengthening climate resilience.

The four principles for designing green infrastructure are:

- Integration - Combine Green Infrastructure with urban development and grey infrastructure.
- Connectivity - Create an interconnected network of open space.

- Multi-functionality - Deliver multiple ecosystem services simultaneously.
- Participation - Involve stakeholders in development and implementation.

Better Placed

The state's first design-led policy, Better Placed recognises the role our built environment has on shaping our lives and how the quality of design affects how places and spaces function and integrates with the broader context.

The policy defines well designed architecture, public spaces, and environments as being: Healthy; Responsive; Integrated; Equitable; and Resilient.

The seven key objectives are:

- Better fit - Contextual, local and of its place
- Better performance - Sustainable, adaptable and durable
- Better community - Inclusive, connected and diverse
- Better for people - Safe, comfortable and liveable
- Better working - Functional, efficient, and fit for purpose
- Better value - Creative and adding value.
- Better look and feel - Engaging, inviting and attractive

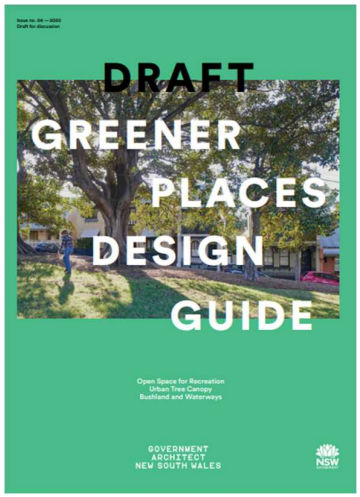

Figure 22 Draft Greener Places Design Guide

Figure 23 Better Placed Design Guide

Connecting with Country

This framework established by the NSW Government Architect aims to unite all involved in delivering built environment projects to adopt the following commitment:

All NSW built environment projects will be developed with a Country-centred approach guided by Aboriginal people, who know that if we care for Country, Country will care for us.

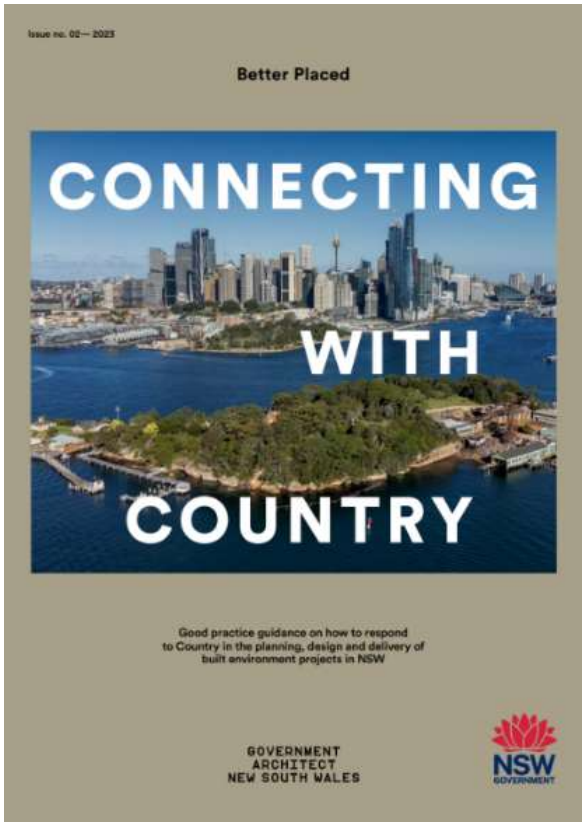

Figure 24 Connecting with Country Framework

The health and wellbeing of Country will help to:

- Reduce the impacts of natural events such as fire, drought, and flooding through sustainable ways of using land and water
- Value and respect Aboriginal cultural knowledge with Aboriginal people co-leading design and development of all NSW infrastructure projects
- Ensure Country is cared for appropriately and sensitive sites are protected by Aboriginal people having access to their homelands to continue their cultural practices.

Sydney Water Strategy 2020-2030

Responding to key challenges of today and the future, this strategy outlines the activities and ambitions of Sydney Water in achieving their vision to create a better life with world-class water services over the next decade.

The strategy identifies four outcomes, detailing what success looks like, and what is required to accomplish this.

- The four strategic outcomes include:
- First choice of customers and partners
- Successful and innovative business
- High performance culture
- Thriving, liveable and sustainable cities

The development of the AWRC aligns and contributes towards Sydney Water's 'thriving, liveable and sustainable cities' outcome. In doing so, it will need to deliver on the following objectives:

- Our cities' waterways are clean, healthy, and safe for swimming and recreation.
- Our system is resilient to shocks and disruptions (e.g., we have achieved advanced system reliability and performance).
- Our water and waterways are world class and support thriving liveable and sustainable cities.
- Our environmental performance is world class.
- We are a resource recovery business with an increasing portfolio of circular economy products and services.
- We have made substantial progress towards zero impact on the environment (focusing on water, waste, and carbon).

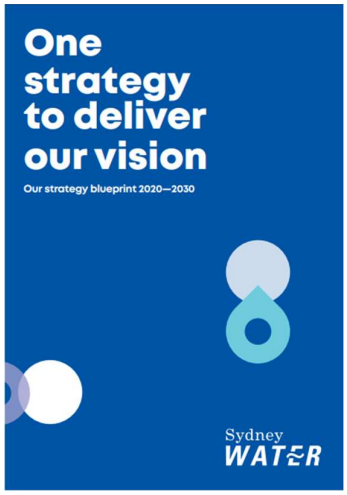

Figure 25 Sydney Water Strategy Blueprint

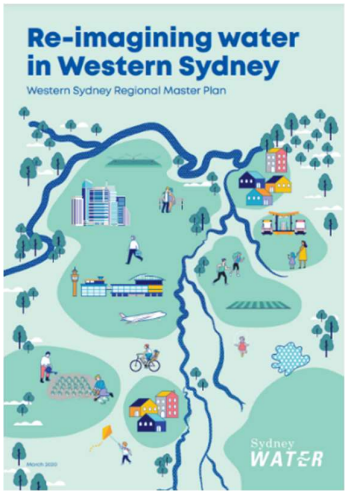

Figure 26 Re-imaging water in Western Sydney

Re-imagining water in Western Sydney: Western Sydney Regional Masterplan Policies and Guidelines

In support of these government policies and aspirations, Sydney Water developed the 'Western Sydney Regional Masterplan.' To deliver on the vision of a green and blue Western Parkland City, the Plan identifies the opportunity to manage water and wastewater in a more integrated way. In addition, increasing water recycling would deliver more economic value and enable opportunities for water reuse and for the circular economy. The Project forms a part of delivering the site's flexible, adaptive, and high-value pathways for whole-of-community benefits.

Sydney Water's Environmental Policy outlines the commitment to protect, restore and enhance the natural environment, with commitments to:

- Having no net impact from discharges to the air, water, or land.
- Maximising resource value and supporting a circular economy by responsibly managing energy, water and materials, and minimising waste creation.
- Managing the entire integrated water cycle in the catchment, including capturing, treating, distributing drinking water and collecting, treating and releasing wastewater.
- Protecting, restoring and enhancing natural and cultural heritage assets.
- Social responsibility by having at the forefront the wellbeing of the community to improve overall environmental performance.

Sydney Water Circular Economy and Resource Recovery Strategic Blueprint

Water has a central role to play in transitioning the world out of the linear cycle of production and consumption of resources, and towards their circular use. The successful transition to a circular economy requires a true nexus approach to water, energy and materials; to go beyond traditional silos and develop innovative partnerships with customers, business, communities and all levels of government.

Sydney Water's Circular Economy & Resource Recovery (CE&RR) Strategic Blueprint is a framework to guide embedding circular economy principles within the organisation. Sydney Water is committed to the three circular economy principles: 1) to design out waste and pollution, 2) to keep resources in use at their highest value, and 3) to restore and regenerate natural systems.

The Strategic Blueprint seeks to realise the three principles across five outcome areas – Water, Nature, Materials, Energy & Carbon, and Partnerships. Each outcome area has its own set of measures through which progress can be benchmarked and measured. The measures have been developed with guidance from leading-edge circular economy assessment tools and aligned with directions from other Sydney Water Strategic Blueprints.

Sydney Water's Net-Zero Carbon Plan sits within the Circular Economy Blueprint and is a response to the importance of climate change abatement, to enable our Thriving, liveable and sustainable cities strategic outcome and achieve our vision of creating a better life with world-class water services. The Net-Zero Carbon Plan presents an outcome to reduce carbon emissions aligned with customer ambitions and its Net Zero Directional Statement provides direction on how to make decisions to enable the Plan.

Sydney Water has an aspirational net zero carbon target of 2030 across our operations and 2040 in our supply chain. By quantifying the impact of carbon emissions, it will enable the identification of reduction pathways to achieve this target through energy efficiency, renewable energy, low emission technologies, innovation, and the supply chain.

Net Zero Plan 2030 and NSW Climate Change Policy Framework

Outlines the State Government's long-term objectives and plan to achieve net-zero emissions by 2050, increasing the State's resilience to a changing climate.

Department of Planning and Environment: A Liveability Framework for Sydney + Department of Planning and Environment: Everyone Can Play

The guides identify the most important considerations for achieving liveability improvements and suggest example ways to achieve these outcomes.

Complementing the Western Parkland City and WSA visions, while not binding, they are good references for best practice principles to achieving improved liveability within Greater Sydney.

The AWRC has the potential to assist the government in achieving the State Government's climate and energy goals outlined in the above guides and frameworks.

Legislation and policy relevant to the Urban Design and Landscape Plan

The strategic guidelines detailed on previous pages together with local policy and legislation (Table 7) has informed the development of the Urban Design and landscape Plan.

Table 7 Legislation and policy

LEGISLATION AND POLICY RELEVANT TO THE UDLP		
Legislation / Policy reference in full	Brief description of legislation, salient parts and intent	How legislation / policy is relevant to the urban design
Australian Standard AS1428.1 Design for access and mobility (Australian Standard, 2009)	Specifies the design requirements for new building work as required by the Building Code of Australia (BCA) and the Disability Standards to provide access for people with disabilities.	All areas including the administration office, facilities and publicly accessible outdoor areas will need to comply to AS1428.1.
State Environmental Planning Policy (Western Sydney Aerotropolis 2020)	The SEPP facilitates development in the WSA in accordance with the objectives and principles of the WSAP.	The AWRC must comply with this SEPP. It replaces conflicting policies identified under the Penrith Local Environmental Plan 2010.
Technical guideline for Urban Green Cover in NSW (OEH, 2015)	Provides practical advice on best practices to increase community resilience to Climate Change.	Complements the Western Parkland City vision. While not binding, it is a good reference for best practice principles.

6.2 Regional Context

The Greater Sydney Regional Plan identifies the Western Parkland City as one of the strategic Three Cities for Sydney. The plan is structured around infrastructure, productivity, sustainability, and implementation. The population of the Western Parkland City is projected to grow from 740,000 in 2016 to 1.1 million by 2036, and well over 1.5 million by 2056.

The city will emerge with the development of new neighbourhoods and centres, and with urban renewal close to existing centres. Place-making will help to design neighbourhoods with fine grain fabric and human scale. This will support healthy lifestyles and connected communities.

Development along the spine of Wianamatta South Creek and its tributaries will re-imagine liveability and sustainability, providing new cool and green neighbourhoods and centres with generous open space in a parkland city.

Greater Sydney Regional Plan

The AWRC is located at the confluence of the Wianamatta South Creek and Kemps Creek and is within an open space and environmental corridor.

It is directly below Western Sydney Airport's flight path and will be bordered to the south by the proposed M12 Motorway.

The M12 Motorway will provide an active transport link connecting broader communities from the Penrith, Blacktown, and Fairfield Local Government Areas.

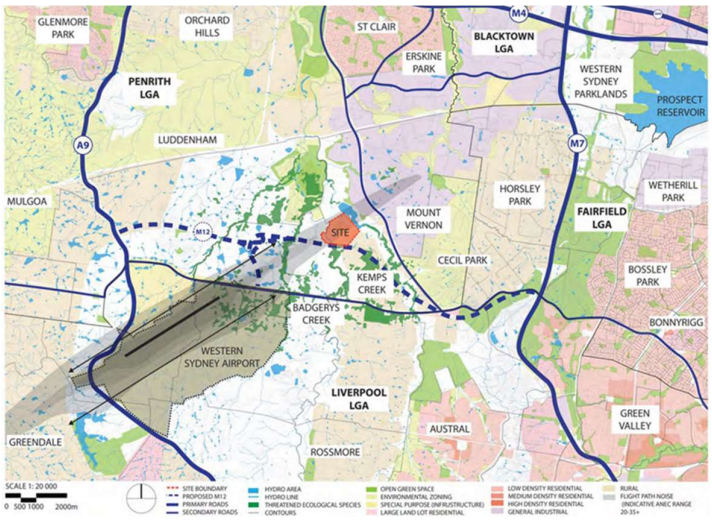

Figure 27 Regional context (Tract)

6.3 Local Context

Penrith City

The AWRC site is located in Greater Sydney's peri-urban region between the Blue Mountains and the Sydney CBD, approximately 30 km south-west of Parramatta CBD, within the future Western Parkland City. Strategically positioned six kilometres north-east of the future Western Sydney International Airport, under the flight path, the proposed site forms part of the Western Sydney Aerotropolis – the future international gateway to Sydney in the west.

Sitting on the confluence of Wianamatta South Creek and Kemps Creek, the proposed site forms a part of the Hawkesbury-Nepean catchment within the Cumberland Plain Bioregion. Wianamatta South Creek accounts for around 80% of the Western Parkland City's catchment, running through some of the flattest, driest, and hottest parts of Greater Sydney.

The AWRC site is located within the Penrith Local Government Area and key strategic documents include:

- The Penrith Community Plan 2017
  The Plan outlines broad strategies to guide Penrith's future and build its resilience over the next 10-20-year period.
- Local Strategic Planning Statement 2020
  The Strategy relates to and must be considered in conjunction with a range of other Council policy and strategic documents including Cooling the City, Sport and Recreation Strategy, Penrith.
- Penrith Green Grid Strategy Penrith City Council /Tract
  The strategy sets the strategic framework for the implementation of the local Green Grid linking, recreational open space, waterways, environmental corridors, and future development.

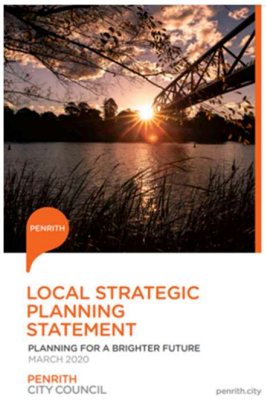

Figure 29 Penrith City Council Community Plan 2017

Figure 28 Penrith Local Strategic Planning Statement 2020

Figure 30 Penrith Green Grid Strategy (Tract)

Opportunities and Constraints

Relevant opportunities and constraints were identified for the Project. Opportunities considered include:

- Aboriginal cultural landscape and European heritage interpretation.
- Restoring the critically endangered Cumberland Plain native woodlands to riparian corridor conservation areas to provide critical habitats for endangered species.
- Linking to active transport on proposed M12 Motorway.

Engagement with and understanding water:

- Integrating water sensitive urban design across the site.
- Creating pathways and trails that will connect to broader networks.
- Maintain existing views and visual connections and create new ones, maximising viewing opportunities out from the site, along the creeks, and into the site from the M12 Motorway.
- Linking to the Sydney University site through creek restoration and future access.
- Co-locating habitat areas with community uses to encourage stewardship.
- Embedding long term resilience.

Constraints that have been considered in the design include:

- Land ownership boundaries including boundaries shared with Sydney University.
- A portion of the site is subject to 1 in 100-year flood events.
- Design for bushfire within the Asset Protection Zone.
- Wildlife strike mitigation design and management of the landscape.
- Urban Heat Island Effect in Western Sydney.

Figure 31 Local context plan

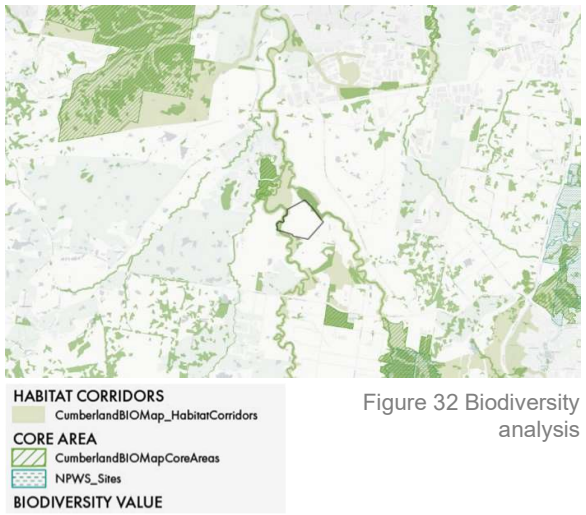

Figure 32 Biodiversity analysis

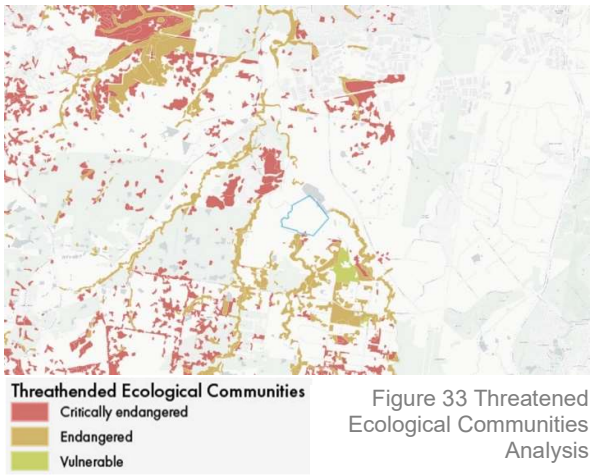

Figure 33 Threatened Ecological Communities Analysis

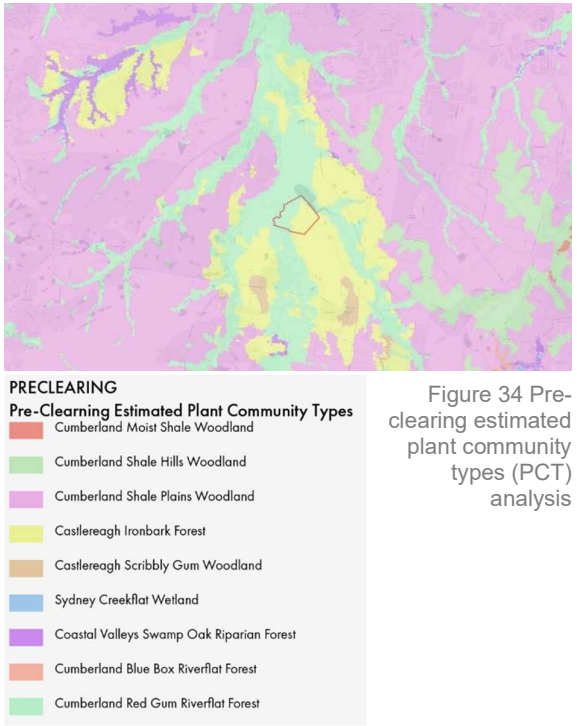

Figure 34 Pre-clearing estimated plant community types (PCT) analysis

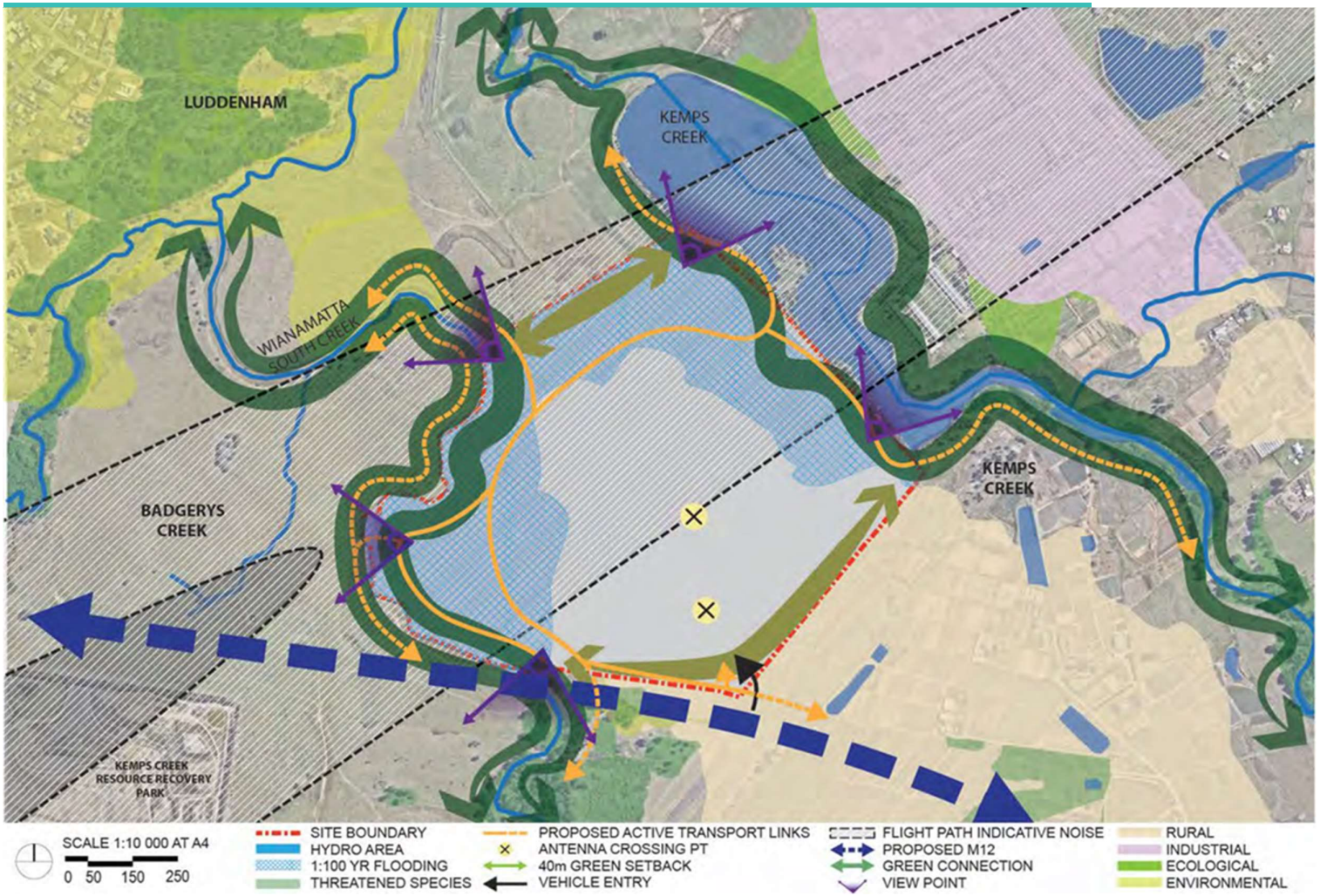

Figure 35 Opportunities and constraints (Tract)

Existing Environment

The AWRC is located between Wianamatta South Creek and Kemps Creek. The land is relatively flat, and part is located within a flood plain. The site has been largely cleared of native vegetation with some remnant planting along its boundaries and a covering of pasture grass. Formerly used for research and grazing, the site is heavily compacted. The site is zoned as Rural Land and Environmental/ Recreational Land. The land immediately surrounding the site to the east, north and west is currently zoned as Environmental Conservation and Future/ Environmental recreation. To the south and beyond the Environmental conservation area, the land is zoned as Rural Land/Flexible Employment Land.

6.4 Urban Design for AWRC

A preliminary plan was developed that reflects the staged development of the AWRC site. It will be implemented in stages comprising of:

Stage 1 - Operational Site, this Project (2026)
Stage 2 – Potential expansion within Operation Site (2035).

The development of a Green Space Masterplan outside of the operations zone will be undertaken to allow Sydney Water to assess implementation opportunities as the site and surrounds evolve.

Urban Design brings together several key elements by balancing opportunities and constraints to achieve an optimum constructed outcome. Maximising environmental outcomes with functional attributes of the AWRC will ensure the development supports the creation of a biodiverse environment where the broader precinct goals of open space and biodiverse networks are achieved.

Stage 1 Operational Site Plan

The Stage 1 Operational Site Plan has been refined through working with Sydney Water, and includes the treatment plant, relevant landscaping, and the riparian planting along Wianamatta South Creek. During the D&C phase, refining and developing of the Stage 1 Plan and Green Space Masterplan design will ensure the future proofing of the AWRC site through the incorporation of outcomes from key stakeholders and community engagement.

Opportunities include:

- Implementation of native plant species.
- Integrated cultural heritage interpretation.
- Retaining water on the site to recharge groundwater systems to support landscape establishment.
- Showcasing water on site by reinstating existing billabongs.

Green Space Masterplan / Future Opportunities

The Green Space Masterplan will support the ongoing evolution of the AWRC, as the restoration of natural systems and implementation of a new landscape takes time. The plan will provide a level of certainty and flexibility to match the planned capacity growth of the AWRC. The strategy to enhance and cool the Western Parkland City and deliver ecologically connected systems with a physical network across the site and linkages to planned open space networks will be considered in developing the green space opportunities.

Restoration activities will provide connection to community, Caring for Country and knowledge sharing through creating a benchmark for revegetation projects that restore the Cumberland Plain landscape on pasture and denuded creek environs.

Opportunities include:

- Retaining water on the site to recharge groundwater systems to support landscape establishment.
- Walking and cycling networks connected to the creeks and the broader regional networks.
- Integrated cultural heritage interpretation across the site.
- Locations for recreation, education, and play.
- Biodiverse communities across the site.
- Maximising viewing opportunities out from the site, along the creeks and into the site from the M12 Motorway.
- Green Grid links along Wianamatta South Creek and Kemps Creek.
- Potential linkage to the University of Sydney lands to the south.
- Active transport connections to the M12 Motorway and future creek networks.
- Greening of the western edge of Wianamatta South Creek (currently outside of Sydney Water ownership).
- Greening of the western edge of Kemps Creek (currently outside of Sydney Water ownership).

Whilst the Green Space is part of the Stage 1 CSSI approval, the urban design and landscaping is subject to ongoing conversations which extends beyond the plans included in this UDLP. Stakeholders will have the opportunity to be involved with the Green Space Masterplan later this year and will either form another stage in Stage 1 or be delivered as part of Stage 2.

Potential Future Development Zone

A potential waste to energy facility has been located on the Future Commercial and Circular Economy Zone (refer Figure 75).

Figure 36 USC AWRC site

Design Approach

Establishing a benchmark in integrating essential infrastructure with the provision of broader community and ecological benefits, the development of the AWRC site and development of the future Green Space Masterplan will build upon the existing character and heritage of the site through the following:

- Building on existing features
- Creating a landscape-led biodiverse environment
- Showcasing water on the site
- Human scale and nature-based solutions
- Providing opportunities for the future
- Ensuring a feasible and sustainable outcome
- Integrating a cultural heritage response.

Figure 37 USC AWRC site looking south

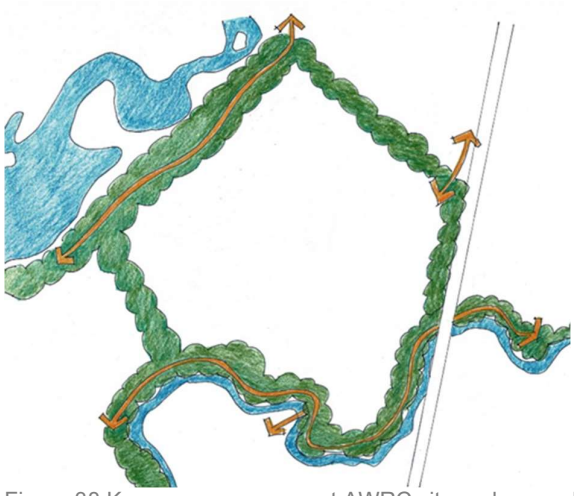

Figure 38 Key moves - reconnect AWRC site and expand the Green Grid - Green Space Masterplan

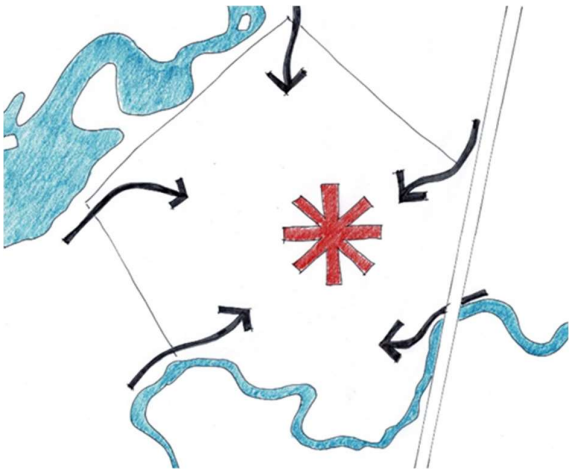

Figure 39 Create a destination that connects natures and people locally and regionally - Green Space Masterplan

7 Connecting to Country

7.1 Historical and Cultural Significance

Context

The site of the AWRC has strong historical and cultural significance. Interpretation will be woven into the design of project elements to reinforce a sense of place. A co-design approach across all disciplines will be realised in the design, including the integration of an Indigenous voice to the design and implementation.

The design of all elements will be undertaken so that they are perceived as a family of elements to provide a cohesive and unified design outcome. The Heritage Interpretation Strategy (Extent Heritage October 2021) is a comprehensive review of potential interpretation opportunities to ensure that traditional, historical, and contemporary values and meanings are integrated. Three preliminary interpretative themes from Country were identified:

The Ebb and Flow (water),
The Infinite Land (land), and
To The Stars (sky).

Figure 40 Night sky

Figure 41 AWRC site - The infinite Land, Water and Sky

These themes will be refined after engagement with key knowledge holders to understand Wianamatta South Creek as a source of life, how the local topography was used as way-finding markers and how the spaces between stars guided journeys at night.

The three themes form the basis of three significant and circular stories:

- Night sky used for navigation by Aboriginal people and how the site's former use as Fleurs Field Station for radio astronomy researched the sun's outer atmosphere.
- The story of the creeks as a water source and the proposed AWRC to produce water suitable for reuse.
- The Lands were rich in food for Aboriginal communities and subsequently used for farming and grazing.

This Project has come full circle with the re-establishment of lost networks and the restoration of a denuded landscape. Through knowledge sharing to broaden our understanding, interpretation will be informed by feedback and guidance from the Aboriginal community during the Design and Construction phase. Refer to Chapter 14 Community and Stakeholder.

7.2 Recognising Country

Multiple chapters of the Recognise Country: Guidelines for Development in the Aerotropolis (NSW Government 2022) have been considered in this UDLP. These considerations are an introduction to the design and design thinking, with further details to follow in subsequent chapters.

Starting with Country (2.1)

The design and in particular the master planning for the future green space considers how values can be revitalised through a cultural lens. The initial planning for the AWRC preceded the establishment of the Designing with Country and Recognise Country Guidelines. This design team were not involved in the masterplan framework and did not have the opportunity to engage with Traditional Custodians during the early planning stages. The nature of the procurement process (competitive tender) also limited access to Traditional Custodians due to consultation fatigue and project timing. However, the need to start with Country and making appropriate design decision responding to Country's needs have been considered and continue to be considered in the development and post construction management of the site.

Traditional Custodians have been consulted and will continue to be part of this process, including social impact opportunities associated with building enterprise. Walks on Country with Traditional Custodians and Registered Aboriginal Participants has occurred, and engagement outcomes and recommended actions are being incorporated into the project outcomes. This will ensure that the local Traditional Custodian values and assets are not only maintained but further enhanced.

The AWRC site is primarily cleared, heavy compacted from grazing with soils of high salinity and within a flood plain (SESL 2023). The design responds to Country through the emphasis on healing Country. A focus on minimal impact and maximum benefit to ecological systems and community.

The proposed restoration of fragmented ecological systems associated with the Cumberland Plain Woodland landscape across the site will support a biodiverse environment that will enhance existing fauna numbers and create opportunities for a networked environment that reinforces a greater number of species interactions.

The restoration of Wianamatta South Creek will improve waterway quality, reduce erosion, and support aquatic species. The establishment of tree cover and improved water quality supports the broader Aerotropolis and Western Parkland City objectives including the need to mitigate heat island effects. Water, land and sky are key principles for the project interpretation strategy.

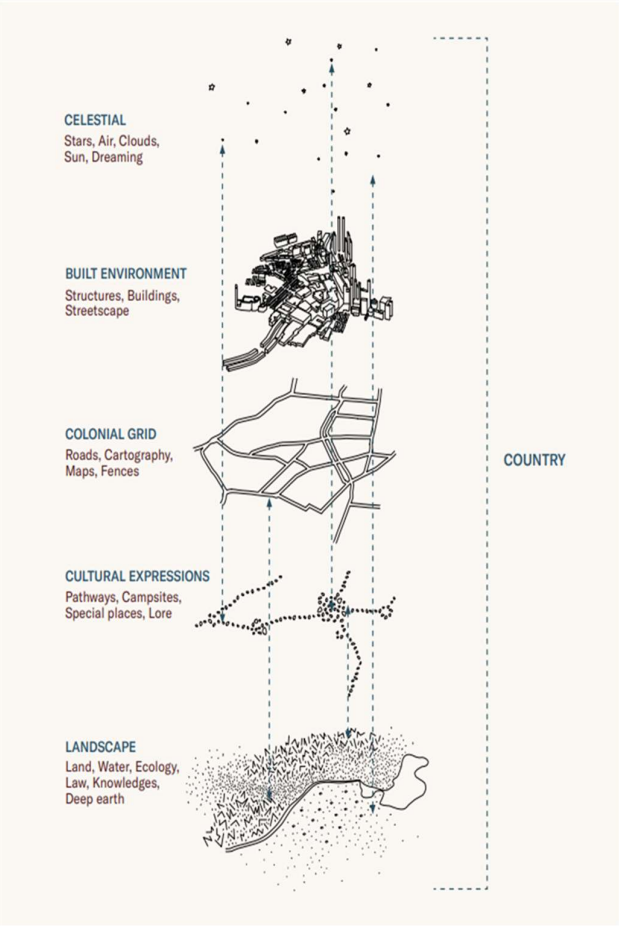

Figure 42 Layers of Country

Cultural Safety (2.1.1)

A balance in engagement is being established to reduce the cultural load on Traditional Custodians. Engagement will focus on the opportunity to revitalise place through a cultural lens to establish AWRC as Country that is living and offers different experiences at different times of the day and year. There is potential to incorporate areas for cultural practice and activation within the future Green Space and consideration of post construction opportunities for co-management will be explored.

Economic development opportunities (2.1.3)

Sydney Water's Aboriginal Procurement Participation Plan 2021-2023 informs the procurement process for the development of the AWRC. Specific employment opportunities include archaeological investigations, seed collection for the establishment of local plant material suitable for the site, supply of goods and services, including the establishment and on-going maintenance of the landscape. There are also opportunities in the development of the interpretation strategy and implementation for the site.

Cultural Landscape (2.2)

The AWRC is within the expansive waterway system of Western Sydney and the 'site' does not exist in the broader context when viewed as land, sky, and water. It is clear when approached in this way the site is within land that is communal, reflecting traditional, scientific, ecological and knowledge values. There is a

specific identity associated with the Darug as a unique people and language. We are focusing on the restoration of a living culture at the AWRC.

Landscape (2.2.2)

The Green Space Masterplan will include sightlines and views to nearby landforms and key geographic markers such as the Blue Mountains, Kemps Creek, and Wianamatta South Creek, and offers opportunities to connect to the broader cultural landscape.

The existing vegetation will be supplemented with the local Cumberland Plain Woodland species to retore a networked system to create a nature-based solution maximising biodiversity outcomes. In particular, the creek networks within and beyond the site.

Developing the landscape design to include select indigenous species focusing on the use of plant material grown from seeds of provenance honours the original landscape. Alongside this is understanding the challenges of the salinity in the on-site soils in reestablishing plant communities.

Water (2.2.3)

The UDLP has used the water systems (including riparian corridors) and flood mapping as a base layer to inform spatial decisions. The Operational Zone is located above the 1% AEP flood extent to protect assets, while the remaining Green Space topography will be retained. The restoration of billabongs and landscape along the Wianamatta South Creek promotes the opportunity to engage with water and the story of water.

Parks and open space (2.2.4)

Aboriginal interpretation is to be embedded into the Interpretation Strategy elements for the site's development, in particular the Green Space. Opportunities include stories of place, cultural activation, and sensing County. The site has been identified as part of a broader area of cultural practice. There is the opportunity to establish areas of cultural practice within the proposed Green Space. Further engagement with Traditional Custodian will inform this opportunity.

Built Form (2.3)

The refined layout has minimised visual impact by consolidating built forms and designing the facility to be economical in layout and footprint to minimise built form extents. The road layout has been designed to minimise pavements and maximise permeable surfaces. Building façades reflect local earth and landscape colours. The orientation and shaping of the Administration Centre maximise views towards Wianamatta South Creek and away from the M12.

Culturally responsive public art (2.3.3)

Public art will be incorporated as part of the site's interpretation strategy that will be considered during the development of the Green Space Masterplan. Aligning art with cultural heritage values and Country will reinforce the significance of the site.

Language and naming, wayfinding and signage (2.4)

Sydney Water has considered the naming of the entry road and AWRC in the Dharug language in consultation with the Traditional Custodians. The name of the entry road has been confirmed as *Badu Muru Grove* and street signage has since been erected in place. The naming of the AWRC is yet to be confirmed. The Dharug language will also be considered in the development of wayfinding and signage.

7.3 Connecting with Country

This section outlines how we will achieve the principles and objectives identified in the Connecting to Country Framework (GANSW 2023) chapters 4.1, 4.2, and 4.3.

Where is our project located

The project team recognises the Darug People as the Traditional Custodians of the AWRC land and acknowledges their continuing connection to Country for thousands of years.

Language use and first placenames

Revitalise and raise awareness of the Darug language through integration as a placename, interpretative signage, history, geography, family and human relationships, stories and art. Continuing engagement with Traditional Custodians to establish the correct language.

Connect to the broader landscape

This UDLP recognises that healing Country is not restricted to the boundary of the site. The AWRC is a piece of a larger puzzle that is the greater Western Sydney landscape and its inhabitants. By restoring the Cumberland Plain Woodland and the health of Wianamatta South Creek within the AWRC site, it is a starting point of a systems connectivity into Country.

Promote and protect Aboriginal cultural heritage

Aboriginal Cultural Heritage investigations (excavations) have been undertaken to further understand the history of the site and its significance. Future Aboriginal cultural heritage opportunities on site will be respected and planned for, overseen by the Traditional Custodians. Cultural awareness heritage training will be incorporated into project activities and actions under the guidance of Traditional Custodians.

Acknowledge our shared history

Cultural Awareness Heritage Training for the project includes Traditional Custodian input and the need for ongoing conversations. A timeline is included in the training package with an emphasis on Wianamatta South Creek.

Country-centred approach

Recognising the importance of restoring the Cumberland Plain Woodland and Wianamatta South Creek as the start of a broader strategy to healing and caring for Country to reestablishing biodiversity and acknowledging that all living things exist as part of an interconnected system where humans should not be the dominate species.

Supporting Living systems: Earth, Water, Sky

The purpose of the AWRC and its landscape is to work towards an environmentally sustainable future, considering the interconnectivity of humans, nature and culture where humans are not the dominate species. Aside from earthworks for the built form where essential, the Green Space retains the existing topography of Country, and the objectives and principles outlined in this UDLP ensure that the living systems that have emerged and evolved from this topography will continue to be naturally expressed.

Restoring Wianamatta South Creek ensures that not only Water Country, but Earth and Sky systems can continue to function healthily, benefitting all living beings. Restoring the billabongs to their natural state by removing the dam wall in between them further supports the natural topography and water systems of the site to be expressed. Existing fauna will be relocated from trees that are to be removed and non-weed species tree trunks will be retained on site for fauna habitat and resources.

Reawakening memory

Archaeological investigations have shown that the AWRC site was a place of cultural practice. There is potential to carry this memory into the future through
landscape design subject to the guidance of Traditional Custodians. Additionally, memory of place is being expressed in the urban design through the use of building materials and colours inspired by Country.

In-between spaces

In-between spaces will be explored and developed in the Green Space Masterplan.

Indirect Connections

How the site is sensed through the creation of visual, physical and ephemeral connections will strengthen a living culture. The Green Space Masterplan will include sightlines and views to nearby landforms and key geographic markers such as the Blue Mountains and waterways.

Precinct scale

The development of the Aerotropolis and the identification of the Western Sydney Parkland City as place informs the precinct wide connections, landscape and placemaking attributes. The landscape within the AWRC is only a piece of the Greater Western Sydney landscape puzzle. Wianamatta South Creek and Kemps Creek are key connections to many peoples, stories, cultures and ecosystems.

Building scale

The urban design places nature as a key component by only taking up space that is essential to the AWRC's function. Building and road axes have been aligned with the former Fleurs parabolic antennae cross arrays and align to key water bodies surrounding the site: north-east to Kemps Creek and west to Wianamatta South Creek. Building colours have also been considered to reflect those naturally occurring on Country.

7.4 Designing with Country

In line with the Designing with Country Framework (GANSW 2020), this UDLP recognises the importance of having a Country-led design to ensure the sustainable future of the site and all that is connected with it – Water Country, Sky Country, biodiverse plants and animals, and resources. It considers the greater connections the AWRC has with the wider landscape, and that human needs are not weighted above all other living entities.

Continuing engagement with Traditional Custodians will occur to embed a Country-centred approach to ensure their values and assets are maintained and enhanced.

Further details on the design will be elaborated in the following chapters of this UDLP.

7.5 Country, Heritage and Aboriginal Interpretation, and Public Art

The development of an Interpretation Plan will be shaped by the Interpretative Strategy objectives. A seamless integration of heritage to the physical environment of place will need to occur in conjunction with the determination and confirmation of the audience for interpretation. Interpretative devices can be incorporated progressively, and some initial interpretation opportunities include:

Aboriginal cultural interpretation	• Connecting to Country through the establishment of Cumberland Plain Woodland species and care for Country actions such as seasonal cold burning of understorey plant species. • Potential establishment of Aboriginal cultural spaces within future Green Space for the connecting of Traditional Custodians to their culture. Spaces to be designed in collaboration with Traditional Custodians. • Incorporation of Aboriginal language in naming and wayfinding and signage. • Interpretation Strategy opportunities include planting, growing and cultivating to create cultural spaces, storytelling on site, art installations (e.g. murals) and temporal works that respond to longer narratives of place. • Interpretative work can focus on the passing of time
Restoration of Cumberland Plain Woodland, creek health and biodiversity corridors to promote a diverse range of flora and fauna, food sources and medicinal plants	• The establishment of a range of local native species will reconnect the site with its pre-colonial identity, increase biodiversity through the provision of habitat and food for native fauna. • The restoration of the Wianamatta South Creek will improve water quality and reestablish a key cultural element for Traditional Custodians
Connecting trails and networks to the broader precinct	• If implemented, proposed trails will connect to places of significance, i.e., Wianamatta South Creek, Kemps Creek and link with future networks within the Western Sydney Parkland City
Colour of built form and landscape materials including stone material used as tools reflected in paving and architecture and gravel surfaces	
Understanding of the night sky and views to local landforms	• Interpretative signage and potential educational tours can showcase the site's Aboriginal and colonial connection to the night sky. Tours can convey information through story telling. • Vantage points to local landforms can be reinforced in the Green Space Masterplan.
Language, Story, Place naming	• Interpretative signage with the Darug language, street and place names, and stories throughout the site where appropriate.
A gathering place, education programs including tours, demonstrations, and interactive elements	• Opportunities for learning and interpretation will be identified in the Green Space Masterplan. The site offers a variety of potential interpretation opportunities associated with storytelling, water, food, local fauna and flora.
Artwork, murals, sculpture, and digital media	• Aboriginal art and media can be developed and curated with local Aboriginal artists and incorporated on site where appropriate and incorporated into the educational programs. This will be incorporated into the Green Space masterplan development

Fleurs Field Crosses

The site was used for Radio Astronomy when it was leased to CSIRO. The Fleurs Field Station accommodated the Mills Cross, Shain Cross, and Chris Cross arrays that were major technological innovations in cross type telescopes.

- Community engagement during the D&C phase will include Astronomy groups with an interest in Fleurs Field Station.

The proposed road network of the facility has been orientated to the crosses of the former field station. At the crossing points of the former arrays, the landscape will be marked with feature pavements and interpretative signage, thereby preserving, and maintaining its significant place in the history of astronomy in Australia.

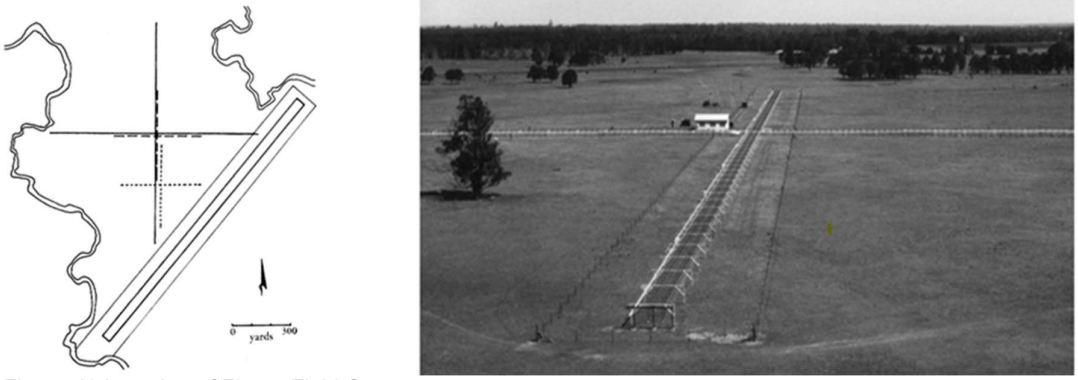

Figure 43 Location of Fleurs Field Crosses

Parabolic Antennae

The two remaining parabolic antennae can be interpreted within the future green space. How these are incorporated to ensure that they are viewed but not accessed and used as climbing frames will require consideration. The site's European history can be reflected in interpretation and art strategies to be developed as part of the Green Space Masterplan.

Figure 44 Mills Cross Array (ATNF Archive 3476-3)

Figure 45 Antenna at Fleurs (ATNF Archive)

Figure 46 Antennae remnants zoomed in

Figure 47 Antennae remnants on ground

Figure 48 Antennae remnants full view on site

Sydney University Water Harvesting Project

The local area was used as a research facility by Sydney University in the early 1950s to apply science to farm management. Associate Professor H.J Geddes developed water harvesting to improve the optimisation of rainfall for pastures which informed P. A. Yeoman's Keyline Design techniques where amplified contour ripping captured and conserved water to restore soil depth and fertility.

The Green Space Masterplan incorporates a layout along contour lines as an element that can be seen from the air and as a landscape organisational element.

Water in the landscape can be interpreted as play and educational elements throughout the site from facility tours to understanding the flora and fauna within the creek environs and proposed wetlands.

Figure 49 Keyline Design (Image: Volterra)

Figure 50 Keyline Design (Image: Volterra)

Benchmarking the scale of the AWRC

To understand the opportunities that the AWRC site offers, a benchmarking exercise to compare the scale and use of the site against established green spaces has been undertaken. Sydney Park, Centennial Park and Bicentennial Park were reviewed and mapped. Centennial Park is twice the size of the AWRC with significant water bodies, cultural heritage elements and regional recreational facilities. Bicentennial Park has two distinct zones, the conservation wetland area and the recreational parklands which are comparable in scale to the green space area at the AWRC.

Figure 51 Sydney Park

Figure 52 Centennial Park

Figure 53 Bicentennial Park

Figure 54 Sydney Park bioretention (Image: City of Sydney)

Figure 55 Sydney Park wetlands play (Image: City of Sydney)

Figure 56 Sydney Park art interpretation (Image: City of Sydney)

Figure 57 AWRC grassland

Sydney Park's site area is similar to the AWRC when the Treatment Plant and future commercial zone is not included. Sydney Park has significant bio detention water bodies with a variety of recreational and open space elements and is centrally located within a growing population. Established on a former municipal waste facility, the Park is of regional recreational importance and has been successfully remediated and transformed in stages. Based on our assessment, the potential carrying capacity, local and regional importance of the AWRC site is significant and will be used as the basis of the master planning of the future green space.

Figure 58 Area comparison benchmarking

8 Landscape Design

8.1 Landscape and Biodiversity

Landscape and biodiversity are significant elements of the Project as Sydney Water has identified place making and landscape-led design principles underpin the desired outcomes in the near and long-term. As part of the Western Parkland City, ecological resilience and restoring natural systems will assist in the mitigation of environmental loss associated with Climate Change. Stage 1 of the AWRC will establish the framework for the stewardship of a significant site for both Sydney Water and the community. A landscape approach will improve biodiversity on site.

The site will contribute to place-based outcomes by designing and caring for Country, support biodiversity and provide a restored landscape. The design of the AWRC site will further consider Country during the D&C stage when detailed engagement with the local Indigenous community and key stakeholders will occur to inform the design of the green space and riparian corridors.

The restoration of fragmented ecological systems will repair our ability to support species. Through the facilitation of the movement of different species across the landscape, the AWRC will become an ecological linkage and the first stage of a connectivity along Wianamatta South and Kemps Creek to support biodiversity. Aboriginal custodians are deep and rich sources of traditional knowledge of how to care for the landscape and will be consulted to refine the proposed landscape and biodiversity outcomes.

Noted benefits that come from the retention or creation of ecological linkages across a landscape (Molloy et al. 2009) include:

- Increased ecological effectiveness
- Increased migration rates
- Increased foraging and home range areas for species
- Provision of cover for escape from predators between large patches
- Provision of alternative refuge from major disturbances
- Provision of green belts to limit the effects of urbanisation on species and ecological communities

Figure 59 Quote from ECI deliverable item 25

Aims of the Landscape and Biodiversity

Landscape and Biodiversity is aligned with the Project's urban design principles whilst addressing key constraints and opportunities. To achieve this, a balance between habitat improvement and public amenity is needed and a balanced framework is therefore proposed:

- Protect, rehabilitate and recreate creek line habitat to create broader regional links.
- Provide adequate spatial coverage of habitat for native flora and fauna, including longitudinal connectivity, riparian width and habitat complexity.
- Stabilise creek banks by retaining or planting deep rooted trees.
- Enhance the visual experience by creating a more natural environment.

- Adopt best practice management strategies and techniques.
- Stage works to maintain ecosystem functions.

8.2 Cumberland Plain Recovery Plan

We will create an enduring landscape for the AWRC that aligns the site's potential biodiversity to regional networks by realising a landscape and ecological strategy that meets the objectives of the Cumberland Plain Recovery Plan, Department of Environment, Climate Change and Water (NSW) 2011 and the Cumberland Plain Conservation Plan 2022 The Recovery Plan has been designed to provide for the long-term survival and protection of the threatened biodiversity of the Cumberland Plain as the area develops.

Restoration works will align with Recovering Bushland on the Cumberland Plain – Best Practice Guidelines for the Management and Restoration of Bushland and the Cumberland Plain Recovery Plan, NSW Office of Environment and Heritage (OEH).

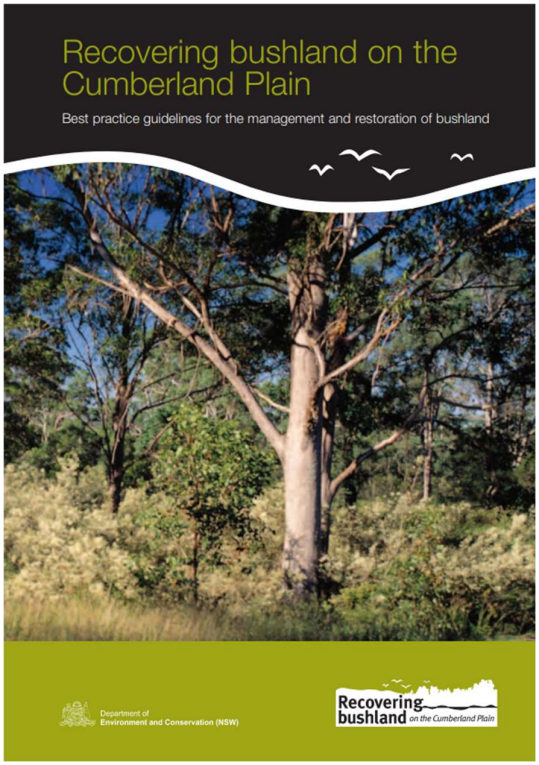

Figure 60 Recovering bushland on the Cumberland Plain

8.3 Vegetation Management Plan

The Sydney Water Upper South Creek – Advanced Water Recycling Centre Vegetation Management Plan has been developed and considers the principles of Guidelines for Vegetation Management Plans on Waterfront Land (NSW Office of Water, 2012), the tree planting provisions in the Western Sydney Aerotropolis Development Control Plan – Phase 2 (November 2022), and the Draft Western Sydney Aerotropolis Riparian Revegetation Strategy in Section 4 of the Western Sydney Aerotropolis (Initial Precincts) Riparian Corridors Assessment (December 2021).

The Vegetation Management Plan details how the restoration and rehabilitation will be carried out. The main objective of this Plan is to provide a stable watercourse and riparian corridor which will emulate local native vegetation communities. Of relevance to this project's Vegetation Management Plan is the action to support and promote the adoption of best practice standards for bushland management and restoration.

The Vegetation Management Plan for Stage 1 of the AWRC is included in Appendix A of this Plan and has been prepared in accordance with the MCoA E64(g).

Future master planning activities by Sydney Water may require that the Vegetation Management Plan be amended to ensure any relevant information is applied consistently across all stages of the AWRC.

8.4 Re-use of native vegetation and other habitat features

The Cumberland Plain Woodland is reflected in three Plant Community Types (PCTs) in the Project site: Cumberland River-flat Forest, Cumberland Shale Plains Woodland, and Cumberland Swamp Oak Riparian Forest. All plant species used in revegetation and regeneration will be local provenance species from the Cumberland Plain Woodland.

All non-weed species have been salvaged to be relocated on site as habitat opportunities for local fauna, where possible. Locations include under the existing trees to the northeast of the Project site near Kemps Creek. The existing dead tree in the billabong will be retained for birdlife.

Habitat features such as tree hollows and logs will be salvaged where feasible during clearing and stockpiled on site for future use. Stored habitat features will be placed within reconstructed areas where they will not harm new plantings in coordination with an ecologist.

Figure 61 Existing Casuarina sp. along Wianamatta South Creek

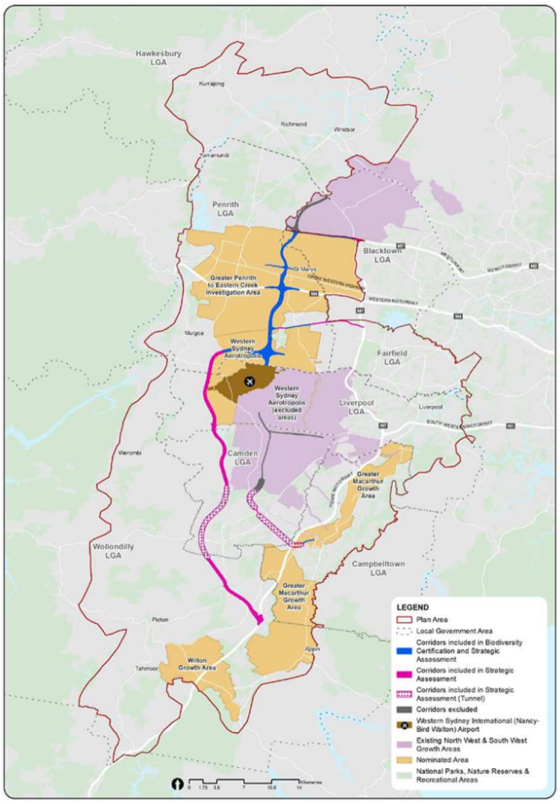

Figure 62 Draft Cumberland Plain Conservation Plan area and scope (2020-2056)

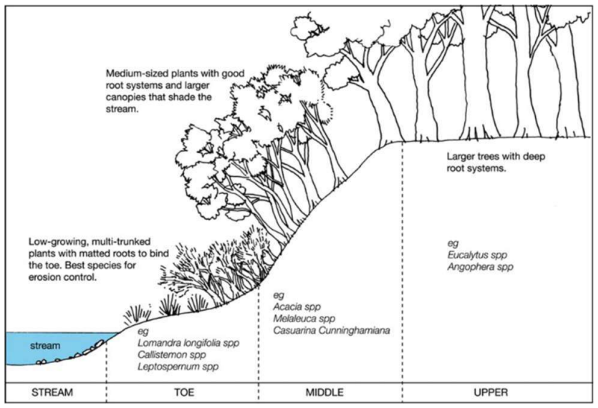

Figure 63 Typical riparian cross section - Adapted from Rivercare: Guidelines for Ecological Sustainable Management of Rivers and Riparian Vegetation (Rain, A.W & Gardiner, J.N, (1995), Land and Water Resources Research and Development Corporation, Canberra)

The Vegetation Management Plan for AWRC provides guidance on the future management of the site's riparian vegetation and:

- Describes the physical and biological characteristics of the site, including endangered ecological communities and threatened species habitat.
- Describes management issues, including prioritised actions, riparian guidelines, and recommended plant species for different zones within the site.
- Provides baseline conditions including species lists.
- Defined monitoring and reporting methods to be used as a reference for future performance monitoring.

The Vegetation Management Plan will be implemented as part of the development of the AWRC.

8.5 The Site

The AWRC site is located six kilometres north-east of the Western Sydney Airport and under its flight path. Wianamatta South Creek and Kemps Creek form the southern and north-west boundaries. These waterways are part of the Hawkesbury-Nepean catchment and are the key catchments for the developing Western Parkland City. The proposed elevated M12 Motorway will run along the south-eastern edge of the AWRC.

The existing flat and cleared landscape comprises of former pastoral land with very few remnant trees. A portion of the site (below RL 39.00+) is subject to flooding during 1:100-year events. The riparian corridor

along Wianamatta South Creek is eroded and generally accessible. Access to the site will be via an access road off the realigned Clifton Avenue.

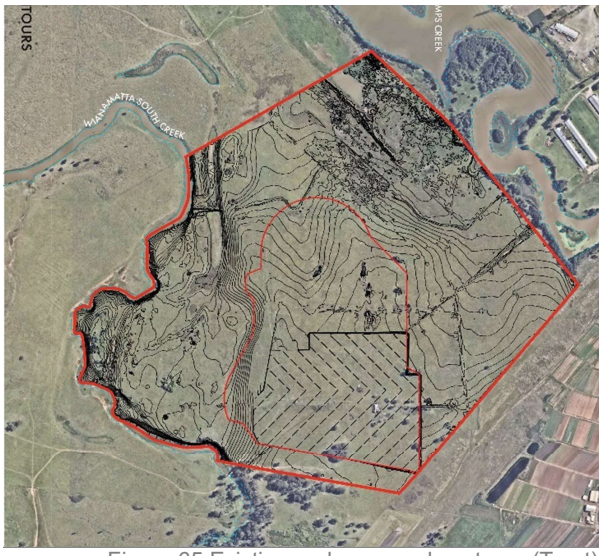

Figure 65 Existing and proposed contours (Tract)

Figure 68 Site photo of creek edge

Figure 67 Existing creek conditions

Figure 66 View of field

Figure 64 Existing grassland

Figure 69 Field wider view

Soils and geology

AWRC is located on Quaternary Alluvium soil type and geology, with a small section of the southern area on Tertiary Alluvium soil type. This geology is characterised by floodplains, valley flats, drainage depressions and fertile soils.

The soil landscapes within the AWRC site include Blacktown (bt) and South Creek (sc) which have an acidic pH, low fertility and high erodibility (SESL 2023).

Cumberland Plain Woodland

The site is part of the Coastal Valley Grassy Woodlands subregion of the Sydney Basin Bioregion. Native vegetation in the subregion is characterised by Cumberland Plain Woodland (CPW) in flat or hilly terrain with an open tree canopy and groundcover of grasses and herbs. Our site is part of a ‘Shale Plain Woodland’ and is the most widely distributed form of Cumberland Plain Woodland.

The Cumberland Plain Woodland has been listed by the Australian and NSW Governments as a critically endangered ecological community. The community is characterised by:

- Canopy species are dominated by Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*E. tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Spotted Gum (*Corymbia maculata*) and Thin-leaved Stringybark (*Eucalyptus eugenioides*) occurring sporadically.
- Small tree species include *Acacia decurrens*, *Acacia parramattensis, Acacia implexa and Exocarpos cupressiformis*
- Shrubs including *Bursaria spinosa, indigofera australis, Hardenbergia violacea, Daviesia ulicifolia, Lespedeza juncea, Dillwynia, Dodonaea viscosa* and grasses such as Kangaroo Grass (*Themeda triandra*) and Weeping Meadow Grass (*Microlaena stipoides*).

The development of the AWRC will create a place that achieves improved biodiversity relative to the existing conditions through the implementation of Cumberland Plain Woodland species. The Stage 1 landscape will establish biodiversity framework outcomes through the incorporation of soil amelioration and structure planting that allows for the reestablishment of ecological communities. Nominated existing site vegetation which contributes to the proposed community will be retained and protected during all construction activities.

Figure 70 Restore Wianamatta Creek and site with Cumberland Plain Woodland

Figure 71 Cumberland Plan Woodland in native grassland

The strategy for AWRC is to create an enduring landscape aligning the biodiversity of the site to regional networks by realising a landscape and ecological strategy that meets the objectives of the Cumberland Plain Recovery Plan and Conservation Plan whilst also mitigating the risk of bird strike. The site has many challenges due to its location under the Western Sydney Airport flight path, being within a flood plain and subject to fire risks.

These constraints have shaped the new landscape; however, they do not limit our ability to return the site to a broader natural system but encourages an approach that maximises environmental opportunities. Plant selection and habitat creation has responded to site risks. At a broader level, our proposals allow for

opportunities to work with the community and stakeholders to contribute to the open space and greening networks as the Western Parkland City develops.

For the creek and billabong environs, methods to increase soil stability to establish permanent vegetation cover have been considered. Soil networks and quality will have a major impact in the successful formation of vegetation cover and remediation of site soils is proposed for the landscape implementation.

The ongoing care for the landscape to ensure that it reaches its full potential will be guided by the Landscape Management Plan (refer Chapter 16 Management and Maintenance) outlines how the AWRC will be maintained during the operations period of the Contract. The Landscape Management Plan will encompass management and monitoring strategies including bushfire risks and the Wildlife Management Plan (WMP) which will guide the maintenance of the landscape to minimise all risks whilst supporting the environment to reach maturity.

9 Designing with Site Constraints

9.1 Wildlife Strike Mitigation

Two objectives of the Aerotropolis are to safeguard the 24-hour operations of the Western Sydney International (Nancy -Bird Walton) Airport (WSI) and to achieve the Western Parkland Vision which includes a landscape-led approach to planning and an increase in tree canopy cover to minimise urban heat island effects.

Aviation Safeguarding Guidelines Western Sydney Aerotropolis

Safeguarding the 24/7 operations of the airport and the vision of the Western Sydney Aerotropolis are essentially at odds. By its nature, safeguarding attempts to minimise the numbers, flock size and diversity of wildlife operating in and around the WSA airspace, by contrast the Western Sydney Aerotropolis aims to increase tree canopy cover across the area to 40%, enhance riparian zones and wetlands and generally maximise biodiversity across the area. Accordingly, we have had to take a balanced approach that affords the area amenity but minimises the main wildlife threats to aviation.

Western Sydney Aerotropolis Draft Wildlife Management Assessment Report Western Sydney Planning Partnership (2020)

The Aviation Safeguarding Guidelines Western Sydney Aerotropolis and surrounding areas (NSW Department of Planning, Industry and Environment 2021) sets out planning guidelines to inform land use planning decisions on land impacted by safeguarding controls. The objectives allow for the assessment on land surrounding Western Sydney International (Nancy -Bird Walton) Airport (WSI) where wildlife may present a risk operation and ensure wildlife management provisions when undertaking land use planning.

The activity of birds and animals in the vicinity of the WSI Airport is a recognised potential source of hazard to the safe operation of aircraft. This hazard results from the possibility of a collision between an aircraft and one or more birds or animals i.e., a bird strike. The site falls within the 8 km wildlife buffer zone, refer Figure 72: Wildlife Buffer Zone Map. National Airports Safeguarding Framework Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports has been incorporated into the Aerotropolis SEPP and Aerotropolis DCP provides a framework for how to manage the risk of wildlife strike on aircrafts. New land uses within 13km of airport property should be regularly monitored and action plans created to mitigate any unacceptable risk of bird strike.

Wildlife management will be an important aspect of operations at the AWRC. Aviation risks to be mitigated in the landscape design are around the creation of habitats that are attractive to birds and bats. Key considerations include ensuring that the design does not create wildlife attractive features (natural and built), bird and bat populations are monitored to assess strike risk. The Wildlife Management Plan (WMP) identifies mitigation actions where hazard is identified. Further the WMP integrates routine monitoring, wildlife awareness, wildlife management and performance standards, wildlife deterrent and surveillance patrols.

The wildlife strike mitigation strategy should not preclude the development of the site to improve biodiversity in the region by attracting and supporting microfauna. The design of the landscape has considered plant species selection, density of vegetation cover, depth of wetlands and the operation of the site to minimise habitats that attract wildlife hazards.

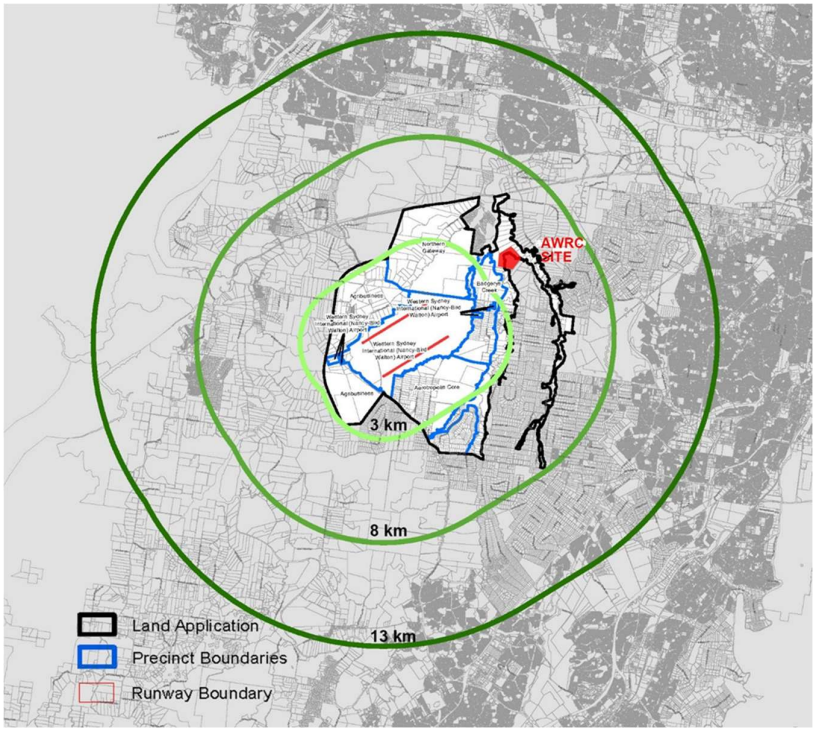

Figure 72 Wildlife buffer zone map, adopted from the State Environmental Planning Policy (Western Sydney Aerotropolis) (NSW Department of Planning, Industry & Environment 2020)

Species selection

The Western Sydney Aerotropolis Draft Wildlife Management Assessment Report (Western Sydney Planning Partnership & Avisure 2020) provides guidelines for planting species to minimise the attraction of birds and flying foxes within the Aerotropolis. It is recommended that "trees and shrubs planted in the area should not bear edible berries, fruits, seeds, nuts, nectar, or bear flowers profusely. Such vegetations attract flying foxes and birds such as lorikeets. Plants that attract insects may also pose a risk in attracting small numbers of birds.

Landscape implementation proposes a variety of different species sparsely inter- mixed to allow local biodiversity to evolve. For example, the planting of Acacia sp. will improve soil fertility through nitrogen fixation and allow cross pollination.

The Landscape Management Plan allows for the continual monitoring and maintenance of the landscape across the entire site to minimise wildlife hazards.

Density of vegetation cover

Planting density has been predominately determined using bushfire risk criteria, (refer next Section: Bushfire Risks) except for the planting proposed along the Wianamatta South Creek which is part of the regional green networks and falls within the category of enhanced riparian and wetland corridor landscape to improve biodiversity. Proposals include:

- Embankment restoration zone: Hydromulch mix of groundcovers with Casuarina glauca planting at 5m centres whilst allowing Casuarina seedlings to establish under existing trees by restricting slashing extents.
- Riparian and revegetation zone: trees at 1 per 50m2, shrubs and groundcovers at 6 per m2.

Additionally, to meet condition E64(b), hazardous wildlife deterrents have been considered in the design and ongoing management of the landscape. A Wildlife Management Plan will be prepared to inform the operation of the AWRC prior to operations commencing. Particular consideration includes the design and management of the landscape to deter bird populations. The facilities' grass areas will be kept to 100mm in height in accordance with guidelines for asset protection within fire zones. Large, still permanent water bodies will be netted. Monitoring will inform the need for the introduction of sonic devices or ultrasonic repellers deter wildlife.

The Landscape Management Plan describes the management activities to be undertaken for the long-term care of the environment. There will be focus on management activities which support the goals and objectives of wildlife and bush fire management.

Depth of wetlands

The restoration of Wianamatta South Creek has a strong emphasis on waterway and catchment health to satisfy commitments to tree planting, align with biodiversity principles in the Cumberland Plain Conservation Plan, enhance ecological value and mitigate impacts against threatened species. Slow moving water and where water accumulates for extended periods of time can be attractive to wildlife. Artificial wetlands can attract significant numbers of wildlife. Specific measures that will be incorporated into the Design Development of the landscape include:

- Bioretention and detention basins: Temporarily hold water and fully drain within 24-48 hours.
- Retention basin and wetland embankments: 4 Vertical to 1 Horizontal to basin bank slopes
- Drainage grass swale depth: 200-400mm maximum in height
- Billabong & wetland water depth: between 0.5m and 1.18m is less likely to attract hazardous flocking bird such as pelicans, swans, and cormorants; or upending ducks such as Pacific Black Ducks; or wading birds such as ibis and egrets.
- Sedge/wetland planting: designed with steeper slopes.
- *Biorention* basins: vegetation 300-600mm in height.

Figure 73 Existing billabong near Kemps Creek

9.2 Bushfire Risk

The Green Space Masterplan incorporates control measures to manage the risk of bushfire as outlined in the Review of Bushfire Constraints and Opportunities report and the Planning for Bush Fire Protection 2019 guide. Stage 1 will incorporate the following measures:

- A 10 metres Asset Protection Zone (APZ) around the facility including the perimeter fence and fire trail.

- A further 20 metres of pasture grass zone to the outside of the fire trail will be slashed to keep vegetation low.
- The future green space zone will be maintained to minimise fire risks.
- Within the Inner Protection Area:
- Low fuel condition (<100 mm in length) grass will be incorporated within the solar farm (native grass) and the Treatment plant (turf grass). Both species will be regularly mown or slashed.
- Tree canopy cover <15% at maturity, will not touch or overhang buildings and canopies separated by 2-5 m.
- Species selection will focus on smooth barked and low flammability trees and shrubs.
- Shrubs will not be directly placed under trees and form <10% ground cover.

The landscape will be maintained and monitored to minimise risks as part of the site's Landscape Management Plan.

Figure 74 Asset Protection Zone

9.3 Flooding

For the permanent USC AWRC site works, detailed hydrological and hydraulic modelling was undertaken for the EIS. Both the hydrology and hydraulic baseline models were validated against the Penrith City Council's reference flood study (WorleyParsons 2015) showing agreement.

The hydraulic model was updated with the topographical changes resulting from the proposed development to assess the impacts on baseline flooding conditions. Alignment of this study in response to a series of NSW guidelines including Floodplain Development Manual, Floodplain Risk Management Guidelines, and Standard Secretary's Environmental Assessment Requirements (SEARs).

The site area is located on a topographically high point between Wianamatta South Creek and Kemps Creek above the Flood Planning Level (FPL). This means that the built surface of the USC AWRC will remain free from inundation. While the AWRC operational area is above the 1% AEP, the Green Space area is below the 1% AEP and susceptible to flooding. A full flooding assessment will be undertaken once the Green Space Masterplan is developed to meet the requirements of MCoA E27 and an associated UDLP will be submitted to DPE. Depending on the nature and timing of future staging and the documentation prepared to address any approval requirements, Sydney Water are yet to confirm if this submission will be a revision to the existing UDLP (this plan) or a new, separate UDLP.

The Project would not cause any redirection of flow, significant changes in flow velocities, flood levels, hazards, and hydraulic categories. The creek edge restoration includes the reshaping of sloping embankments to minimise erosion. This change will increase the capacity of the creek during flooding events. The vegetation proposed for installation within the Green Space at the AWRC is minor in nature from the existing environment. Due to this there is no net impact to localised flooding within the area. In summary, no significant adverse effect is expected.

The AWRC development will not impact on the local flooding behaviour, or impede access to existing road networks, it is not expected to have any impacts on the existing community emergency management arrangements for flooding.

10 Landscape Communities

10.1 Cumberland Plain

Native Vegetation maps of the Cumberland Plain Western Sydney Interpretation Guidelines (National Parks and Wildlife Service 2002) indicate the site has the potential to contribute to two Cumberland Plain Communities, Alluvial Woodlands along the creek and Riparian Forest within the parkland precinct. Alluvial Woodlands occur exclusively along, or near minor watercourses draining soils derived from Wianamatta Shale. It is the most common community found on soils of recent alluvial deposition and found on the floodplains of the Hawkesbury-Nepean River, and grades into Riparian Forest on the terraces immediately adjacent to the river.

Alluvial Woodland

- The two most common species are *Eucalyptus amplifolia* and *E. tereticornis,* with *Angophora floribunda* occurring less frequently.
- Small trees stratum including *Acacia parramattensis subsp. parramattensis,* and less frequently *Casuarina glauca*, and *Angophora floribunda* and *Melaleuca linariifolia*.
- Shrub stratum is often sparse and dominated by *Bursaria spinosa*.
- Dense ground cover with grasses such as *Oplismenus aemulus, Microlaena stipoides var. stipoides*, *Entolasia marginata* and *Echinopogon ovatus.*
- Herb species including *Solanum prinophyllum, Pratia purpurascens* and *Commelina cyanea.*

Riparian Forest

- Tree species include *Eucalyptus botryoides, E. elata, Angophora subvelutina* and *A. floribunda*.
- Small tree stratum contains species of Acacia, such as A. *binervia, A. floribunda* and *A. mearnsii*, Ground stratum include *Oplismenus aemulus, Pteridium esculentum, Microlaena stipoides var. stipoides, Stipa ramosissima* and *Echinopogon ovatu*.

10.2 Landscape Character Zones

The landscape design aligns key principles to create a Place that is integrated and nuanced within restored Cumberland Plain Woodland environs. It will be a Place with amenity and a diverse landscape for wildlife habitats and for people to improve health and wellbeing. The AWRC will feature five landscape character zones and will be restored and planted to contribute to the overall Cumberland Plain community.

Riparian corridor: the restoration of the Wianamatta South Creek corridor and Kemps Creek (Stage 2) to minimise erosion and establish an ecological corridor to create habitats for fish and marine species. Alluvial Woodland community.
Billabongs: restoration and creation of new environments to support the retention of water on site with wetland ecosystem planting. Alluvial Woodland community.
Linking landscape: connecting corridor vegetation between Wianamatta- South Creek. Riparian Forest community.
Operational Zone Landscape: Cumberland Plain tree, bio detention and grass species. Riparian Forest community.

Refer Figure 75: Landscape Character Zones - Stage 1.

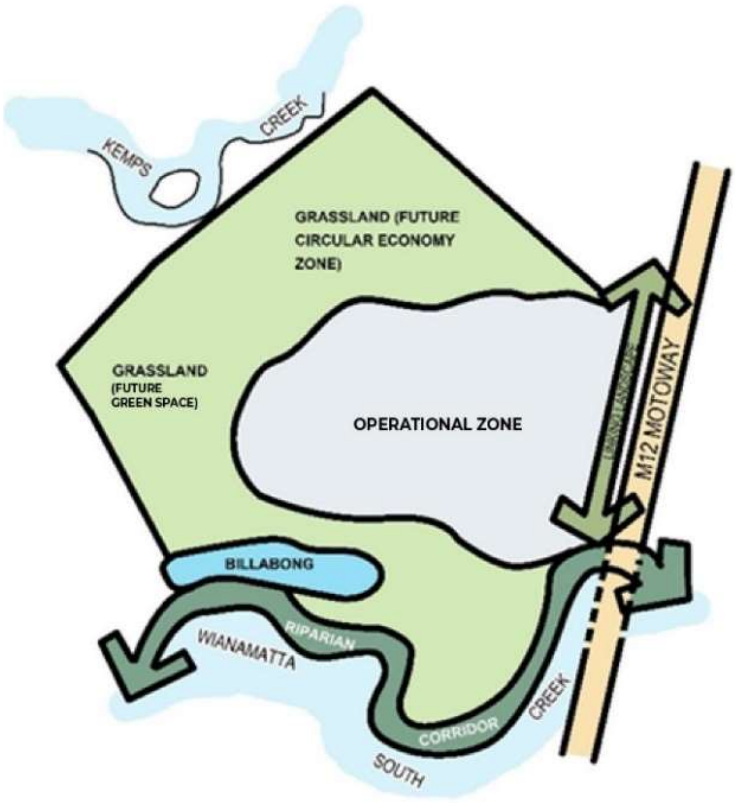

Figure 75 Landscape Character Zones - Stage 1

10.3 Establishment of the Cumberland Plain Woodland Community

The Cumberland Plain Woodland community will require staged and ongoing actions to ensure establishment with the following supporting actions:

- Soil testing to inform Remediation Action Plan
- Identifying sources for collecting seeds of provenance to germinate for use at the AWRC
- Translocating topsoil containing seeds of threatened species if encountered.
- Controlling noxious weeds before planting and as they arise
- Replanting as required to establish community.
- Controlling pest animal species
- Training staff in harm minimisation practices around vegetation
- Regular monitoring through ecological assessment and procedures.

The Vegetation Management Plan (VMP) includes additional information on specific Cumberland Plain plant communities that will be installed as part of Stage 1. Any areas beyond the VMP zone, but outside the AWRC Operational zone, will be addressed in future Green Space Masterplan activities to be progressed by Sydney Water.

Figure 76 Wianamatta South Creek to be restored with Cumberland Swamp Oak Riparian Forest community

Figure 77 Exiting landscape at the AWRC

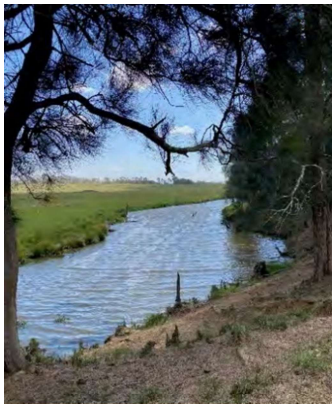

Figure 78 Wianamatta South Creek at the AWRC site

Figure 79 Aerial view of billabongs at AWRC site

10.4 Habitat Creation for Biodiversity

Urban biodiversity for Stage 1 works and how it supports future development of the wider site will be achieved through the following methods as identified in Table 8 Habitat Creation:

Table 8 Summary of habitat creation for the AWRC site

HABITAT CREATION FOR AWRC		
	Description	Outcome
Habitat Creation	Introduction of new habitat within existing pasture landscape.	*Proposed areas of new habitat:* Operational Zone • Native grass: 1,750 m^2 • Tree planting/planted beds: 3,100 m^2 Riparian zone: 7,100 m^2
Habitation Variety	Creation of a diversity of landscape character treatments, species selection, shape and form.	Landscape Character zones across site: • Operational Zone, • Grassland (existing pasture and future green space), • Riparian corridor including billabong, • Natural succession and preservation of natural vegetation
Habitat Quality	Protection of creek corridors through revegetation and creek line restoration utilising seeds of provenance for plant stock and linking to the ecosystems associated with the Cumberland Plain riparian ecosystems. Minimise light and noise pollution from Treatment Plant	• Improving habitat quality to support micro fauna, and plant species variety in multiple stratums. • Structured variety encompassing trees, shrubs, fallen branches, leaf litter, groundcover to ensure a greater diversity of wildlife species.
Habitat patch / corridor size and shape	Linking ecological habitat and landscape communities to enable migration, colonisation and interbreeding of plants, animals and fungi.	New enhanced continuous corridors: • **Stage 1** will create restored riparian corridor of 7,100 m^2
Habitat Connectivity	Linking Kemps Creek and Wianamatta South Creek/billabong habitat corridors to broader green networks outside of the site. Future green space.	**Linear linking** corridors restored:1000 lin.metres @30 metres wide **Wianamatta South Creek**: 1,300 lin. metres @ 40m. wide **Kemps Creek (Stage 2):**790 lin. metres @ 40m wide

10.5 Native species and seeds of provenance

The AWRC site is hot, dry, and subject to intermittent flooding. Plants in Western Sydney have grown and adapted to the conditions and through preserving local provenance, we will protect biodiversity by maintaining the genetic integrity of species. Seed collection from existing trees to be demolished will occur and utilised to grow plant stock to be used in establishing the new landscape.

The AWRC will utilise planting of provenance for trees, shrubs, and groundcover to ensure seed stock is grown from healthy plants of the local genetic variation and in similar environmental conditions. These local species have adapted to the local climate and soil conditions and are therefore more likely to lead to a successful self-perpetuating plant community.

Growing from seed will require additional lead times and this will be factored into the procurement of plant material for the site.

Native grasses suitable for cultural burning are proposed to be used outside of the fire Inner Protection Zone. All grass within the operational area will require mowing to be retained at a maximum height specified in the Vegetation Management Plan (Appendix A) or Landscape Management Plan (Appendix B).

Figure 80 Seeds of provenance (1)

Figure 81 Seeds of provenance (2)

Figure 82 Seeds of provenance (3)

10.6 Cumberland Plain species

The following photos show some of the flora species that characterise the Cumberland Plain ecological community. The species will be used as a guide in conjunction with seed availability and the recommended species from the Vegetation Management Plan for the creek and billabong restoration and revegetation. The Plant Community Types (PCTs) of the Cumberland Plain Woodland existing on the project site include:

- PCT 835 Forest Red Gum
- PCT 849 Grey Box
- PCT 1800 Swamp Oak Riparian Forest

Cumberland Plain Shale Woodlands Key Species

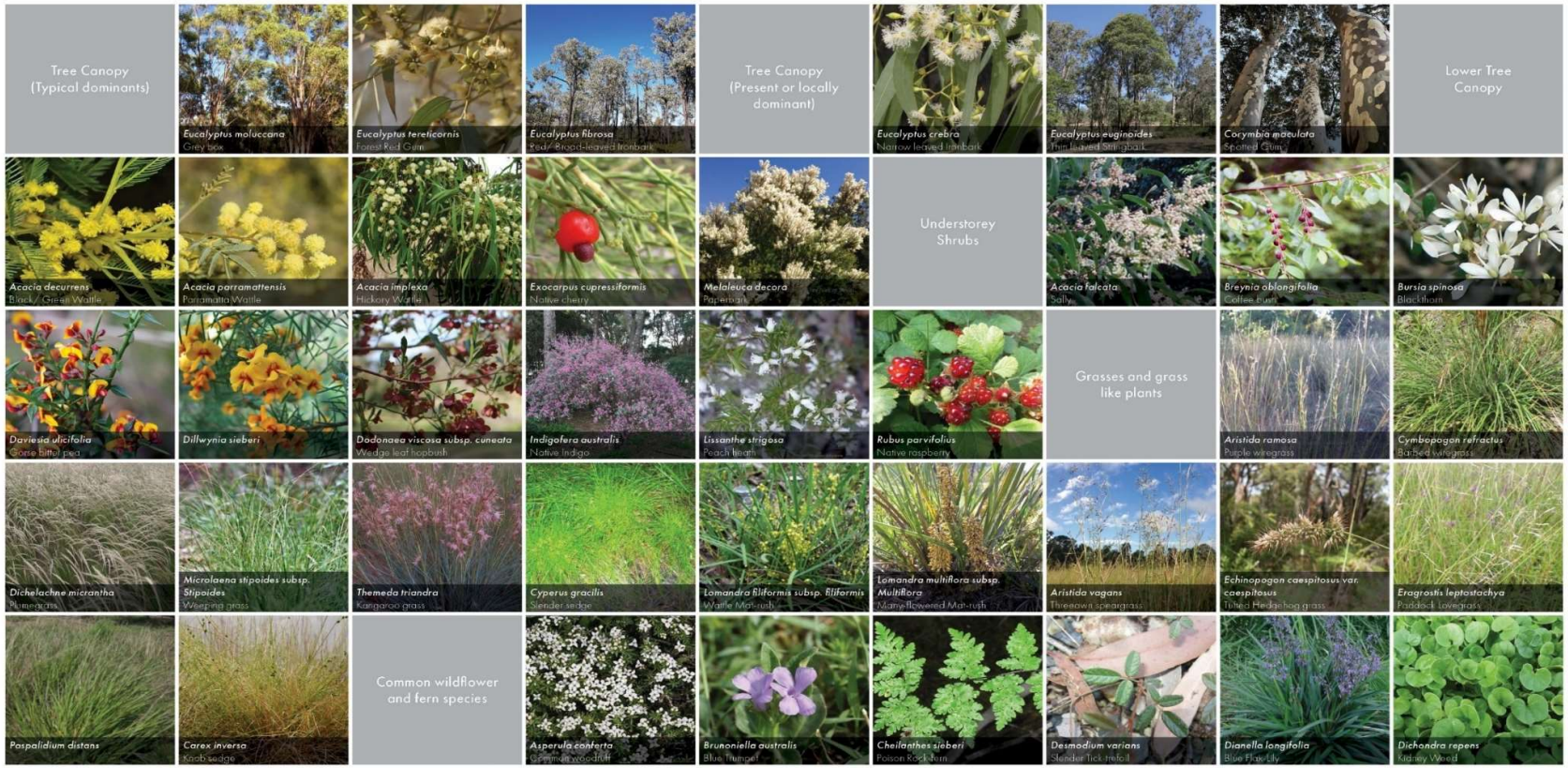

Figure 83 Cumberland Plain key species

Cumberland Plain Shale Woodlands Key Species

Biodetention and Riparian Species

Figure 84 Cumberland Plain key species

11 Urban Design

11.1 South Creek and Kemps Creek

The restoration and stabilisation of Wianamatta South Creek will be guided by the Vegetation Management Plan (VMP). The aim is to slow water speed and stabilise the bed and banks of the creek line, control and reduce weed species and to establish ecological communities through a combination of bush regeneration and native species planting.

To minimise disturbance to Country, replanting of native species and application of jute mesh where practical will be undertaken to stabilise deeply eroded embankments and to allow the establishment of new vegetation

The overall objective of the VMP is to emulate the native vegetation communities of the area and ensure a naturalised stable creek. Vegetation will establish and develop over several years to reduce risks associated with flood, drought, and pestilence. The maintenance period normally associated with creek restoration is up to 2 years.

Staging will assist in achieving the following:

- Allow regeneration of Casuarina sp. Adjoining exiting mature trees currently along the creek bank.
- A vegetated buffer to protect the environmental integrity of the core riparian zone from weed invasion, micro-climate changes, litter, trampling and pollution.
- Implementation of viable native riparian vegetation in conjunction with the natural functions of its aquatic and terrestrial qualities to provide a continuous, vegetated riparian corridor for the movement of flora and fauna species.
- To recognise that the creek is located within an urban context and will provide environmental benefits, valuable amenity, character, landscape, and open space benefits to the people who live, work and play in the local area.
- Restoration of adjoining billabongs that are part of the localised natural system.

Figure 85 Existing downstream creek condition

Figure 86 Casuarina sp. on eroded creek embankment

Figure 87 Location of billabong to be restored

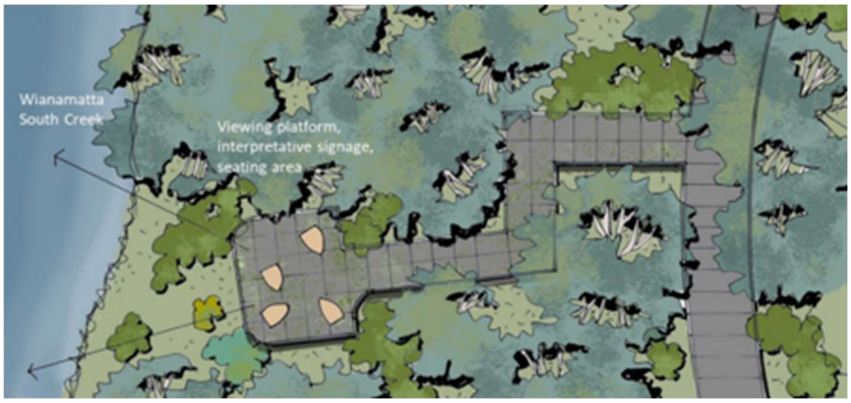

Figure 88 Wianamatta South Creek

Figure 89 Wianamatta South Creek

11.2 Access and Circulation

The development of a road hierarchy to service the treatment facility, access and circulation for vehicles and pedestrians have been aligned and co-ordinated to allow movement through the various areas of the site.

Earthworks and site material

The AWRC promotes an environmentally sustainable development with a focus on waste avoidance and resource recovery. There are environmental and economic benefits by minimising the need for imported fill material and reusing remediated site soil in the new landscape and minimising the need for transport to dispose waste soils.

Site soil testing will guide amelioration measures for in-situ and harvested soil from the Operational zone earthworks. Remediation of site won soil for reuse in the establishment of the proposed landscape will also support the local endemic species that are proposed for the site.

For future stages, suitable material from the biodigesters could be utilised within the green space in the establishment of the proposed landscape.

Where possible, the site has been designed to the existing topography to avoid the necessity of cut and fill. An existing flood level bench is being used for the Operational and Administration Centre zone and other site areas not required to be above the 1:100-year flood level such as the solar park and fire trail have been sited on existing contour levels.

Operational Site layout

The Operational Site layout has been refined to co locate facilities to meet operational requirements and to allow for the incorporation of the ultimate capacity. Stage 1 road layout is complimentary to the development of the Stage 2 with very little redundancy in road pavements. Digestors and potential Waste to Energy facilities are located to the east to allow interface with future circular economy initiatives. The layout has focused on minimising the interaction between heavy vehicles with visitors and maintaining secure and safe environs. Internal access paths for pedestrians are localised to key building entry points.

Vehicle Access

Access and circulation elements include:

- Secured site entry.
- Road hierarchy separating heavy vehicles from cars comprising of a loop for truck movements with narrower access roads for general circulation.
- Catering for operations associated with regular deliveries with separated service road link to the chemical dosing plant and digesters.
- Staff and visitors to the Administration Centre can access via the internal road or the proposed green space road through secure entry points. The access road is a direct link along the southern boundary from the entry point.
- The Administration Centre is located to service the facility and to take advantage of the outlook to the proposed green space.
- Staff and visitors parking area with twenty-three (23) spaces and two (2) accessible bays
- Solar Park gravel service roads.
- Perimeter gravel fire trail within Asset Protection Zone.
- Clear wayfinding signage will be incorporated within the facility layout.
- Future entry to Circular Economy Site has been considered for Stage 2 to allow the development of a suitable road network to suit the scale and type of operations that may occur, including a perimeter fire trail.

Pedestrian Access and Circulation

Access and circulation elements include:

- Pedestrian pathways linking the Administration Centre to Treatment Plant

- Footpaths and hardstand areas within Treatment Plant to allow small groups to safety walk within facility.
- The fire trail offers a pedestrian path around the perimeter of the site.
- Access links to restored Billabongs and Wianamatta South Creek.

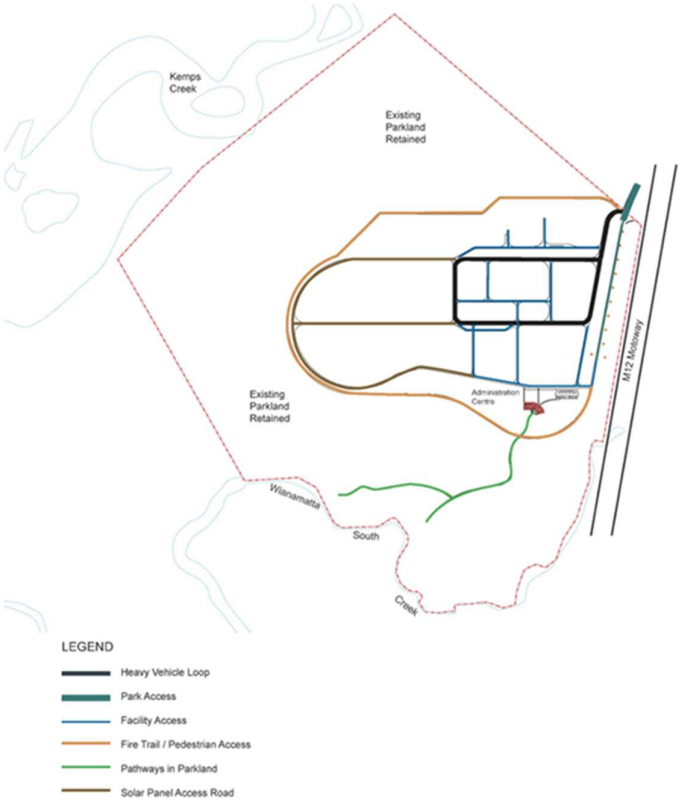

Figure 90 Access and circulation Stage 1 Operational site

Figure 91 Stage 1 Plan

Figure 92 Render of USC AWRC Stage 1 looking south

Figure 93 Render of USC AWRC Stage 1 looking north

11.3 Site Plan and Built Form Functional Layout

The operating facility is designed to meet compliance and Sydney Water criteria for the development of a wastewater treatment plant. The built form, materials, interrelations of functions is prescribed within the Sydney Water design criteria.

The site layout has been developed to meet urban design principles including:

- Heritage interpretation through developing the road geometry to reflect the Fleurs radar field cross arrays.
- Efficiency of movement to reduce road pavements by creating a one-way loop system.
- Minimising pavement areas between buildings and under pipework to achieve permeable surfaces.
- Creation of swales for the retention of runoff within the site.

External treatments

The following table captures the built form within the Stage1 works and the proposed external treatments. A cladding review proposes non-standard Sydney Water colours to create a site-specific facility that reflects Country and assists in the mitigation of heat absorption and therefore the island effect.

BASIX identifies "*A roof with a lower solar absorptance will reflect more heat than a roof with a higher solar absorptance and will keep the roof space and dwelling cooler on a hot day. While a lighter colour roof will have higher heat reflection (or lower solar absorptance) than a darker roof, it will not necessarily produce more glare or light reflection. It is possible to get a roof with low solar absorptance AND low light reflection*".

Table 9 AWRC Building Schedule

Building		Approved Footprint (L x W)	Approx Height (H) (m)	Approx No. of Personnel Doors	Approx No. of Roller Doors	External Roof Finish
1	Administration	42 x 13	4	4 (no single external)	0	Colourbond
2	Workshop	25 x 17	7	2	2	Colourbond
3	Main HV Switchroom (including Inlet Works)	35 x 14	5	7	0	Colourbond
4	Digestor Switchroom	25 x 10	5	4	0	Colourbond
5	Bioreactor Switchroom	26 x 12	5	4	0	Colourbond
6	AWTP Switchroom	23 x 12	5	4	0	Colourbond
7	TW / Brine Switchroom	30 x 14	7	6	0	Colourbond
8	Dewatering & Outloading Building	17 x 16	18	4	3	Colourbond
9	Thickening Poly System Carport	9 x 12	6	0	0	Colourbond
10	Blower Building	17 x 29	9	1	1	Colourbond
11	Chemical Dosing Carport	64 x 16	9	0	0	Colourbond
12	AWTP / RO Building	51 x 15	8	2	5	Colourbond
13	Treated Water / Brine Pump Station	44 x 14	9	12	1	Colourbond

Thermal values

Figure 94 Colourbond steel core colours with SA and SRI indexes identifies the following measurements.

SA = Solar Absorptance

Solar Absorptance (SA) is a measure of how much of the sun's heat that a material absorbs. Choosing a colour with a lower SA is a cooler option and may help to meet building regulations such as NCC or BASIX.

SRI = Solar Reflectance Index

Solar Reflectance Index (SRI) provides a guide of a surface's ability to reject solar heat on the basis of the relative temperature of surfaces, with respect to a reference black (SRI=0) and white surface (SRI=100). The SRI value of a surface is calculated from its solar reflectance and thermal emittance. These are nominal values based on new product and determined in accordance with ASTM E1980-11.

Preliminary concepts

Preliminary colour concepts to improve solar absorption and to reduce heat loading are indicated in Figures 95-100 Preliminary design studies for cladding to reduce solar absorptive criteria.

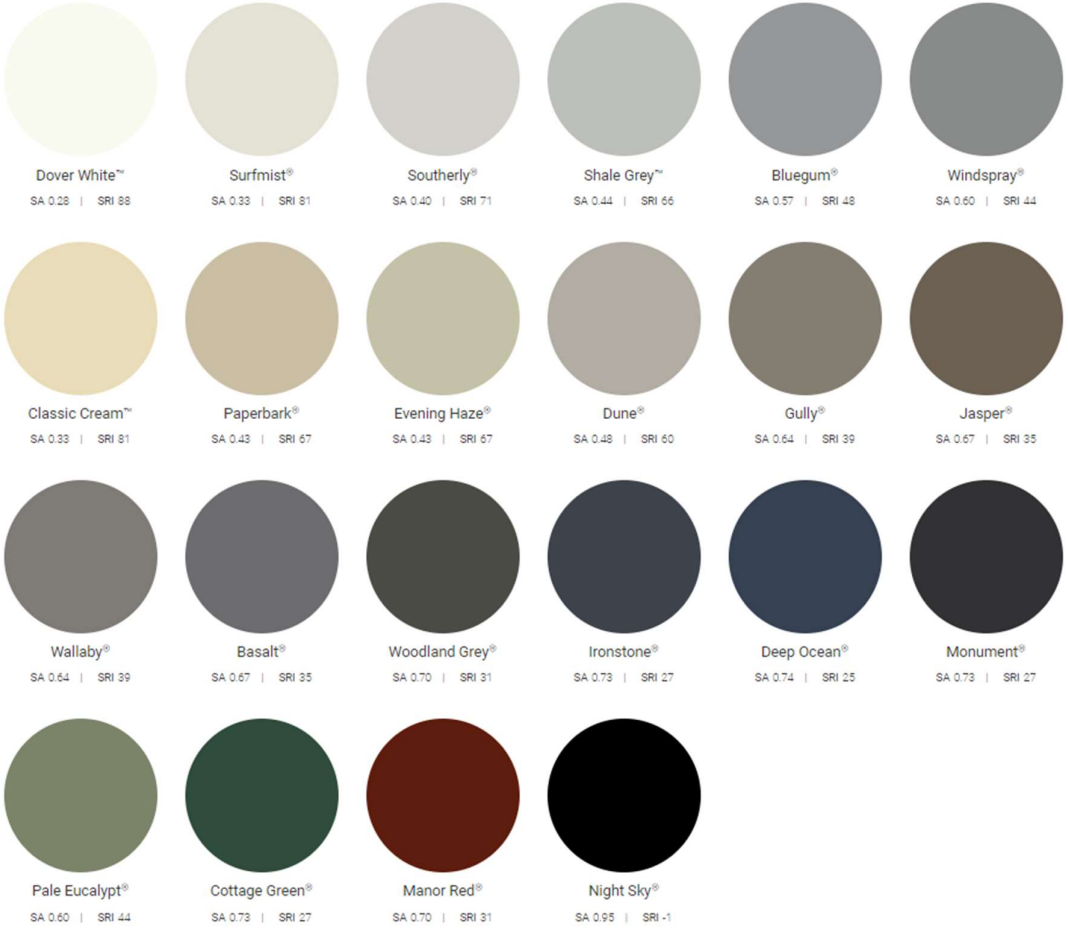

Figure 94 Colourbond steel Core Colours

Figure 95 Biosolids Outloading Building Colour Mark-up

Figure 96 AWTP RO Building Colour Mark-up

Figure 97 Preliminary design studies for cladding on Chemical Storage building to reduce solar absorptive criteria

Figure 98 Preliminary design studies for cladding on Sludge Thickening building toi reduce solar absorptive criteria

Figure 99 Preliminary design studies for cladding on Workshop building to reduce solar absorptive criteria

Figure 100 Preliminary design studies for cladding on Transfer Pump Station building to reduce solar absorptive criteria

Figure 101 Colourbond colours tested

11.4 Administration building architectural design approach

A master planning approach has been adopted for the administration building and immediate surrounds. Works delivered as part of the Stage 1 AWRC will include the administration building. The primary purpose of this building is to support the functional requirements of the operational wastewater treatment plant site. There is provision for future works in the precinct including a potential visitor centre and space for additional facilities.

The key concept underpinning the architectural design is the idea of the connection between water, land, and sky, with the main building elements – roof, walls and ground plane – responding to these ideas in a way that encourages building users to consider their relationship to the environment, and the ways in which we interact with, and are part of, the complex ecosystem in which we all exist.

Water

Water is vital to the site, the role of Wianamatta, and to the processes that will take place on the site in the future given its function as a water recycling centre. The facilities buildings (Stage 1 and future) are in a way the architectural manifestation of these processes, and there are key aspects of these that should be celebrated, rather than hidden or screened, to educate visitors on the innovative ways our water resources can be conserved.

The Stage 1 Administration/Operations Building and future Visitors Centre will provide an opportunity to further explore our relationship with water and the role of Wianamatta, and the importance of water by placing it front and centre in the design. The future Visitors Centre pavilion is defined by its circular roof form which provides shelter and acts as a rain capture device. At the centre of the roof is an oculus which allows rainfall to flow into the centre of the pavilion and fall through the centre, creating a feature where rainfall can also be captured and used for irrigation purposes. This is an architectural gesture that is both functional and symbolic of the notion of water being central to life.

Land

The materiality of the walls and ground plane elements should resonate and connect buildings with the landscape. Brick / masonry wall finishes are of the earth and highly sustainable, provide a solid perimeter to the Administration/Operations Building and function as an acoustic buffer to the nearby M12 Motorway. These walls take on more of a free form in the future Visitors Centre Pavilion, framing key views of the landscape and defining a series of informal spaces inside and outside the pavilion for sitting, standing, display and protection from the elements. The solidity of the brick / masonry walls to the perimeter of the Administration/Operations Building is countered by the highly glazed north and west facing curved façade, which wraps the central courtyard and permits views of the land and landscape beyond. Roof overhangs and operable screening devices are used to control sunlight penetration to these areas.

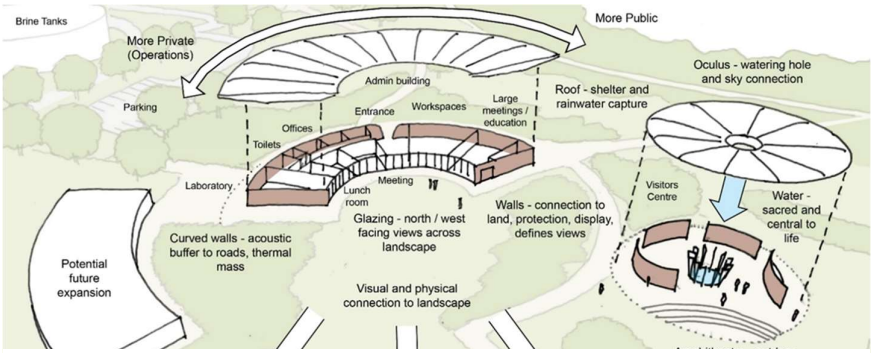

Figure 102 Early sketch showing architectural design concept for the Administration / Operations Building and Visitors Centre Pavilion

Sky

The potential future Visitors Centre oculus could connect visitors directly to the sky, by allowing light to penetrate the centre of the pavilion, and even sit directly beneath the sky. The lack of perimeter columns gives the roof a floating quality and provides unobstructed multi-directional views towards the landscape and horizon.

The roof form also has obvious connotations with the heritage parabolic antennae elsewhere on the site.

Figure 103 Administration building west elevation

The predominantly glazed façade provides views towards the landscape and is protected from unwanted solar penetration in summer by overhangs and external sun shading devices.

Figure 104 Administration building east elevation

Site layout

The Administration Building is 'J' shaped in plan, with the public facing areas and workspaces being within the crescent shaped portion of the plan, and the laboratory, toilets and 'back of house' areas within the rectilinear part. The crescent plan form of the Administration/Operations Building allows it to curve towards the landscape, gently embracing it, and offering views towards it with its primarily north and west facing curved glazed façade.

Biophilic design

Biophilic design improves health and wellbeing in the Built Environment. Biophilic design can reduce stress, enhance creativity and clarity of thought, improve our well-being and expedite healing.

A Visual Connection with Nature is a view to elements of nature, living systems and natural processes.

14 Patterns of Biophilic Design Terrapin Bright Green

At the AWRC, operational staff will be based within the administration centre. The floor plans where staff are located have been designed to orient to view the windows on the western side of the building to take advantage of the green space.

Proposals to restore the landscape and natural systems will increase nature sounds to site. Birds, frogs and other fauna will continue and increase within the sites landscape. Additional tree canopy will add nature based aural sounds reflecting climate.

Connection to natural systems will include Wianamatta South Creek and the seasonal variation in the grassland and changes in the proposed plants from flowering to spring growth.

Prospect is an unimpeded view over a distance for surveillance and planning.

14 Patterns of Biophilic Design Terrapin Bright Green

Adaptability

The layout and siting of the building is adaptable for future expansion to the north and southwest for visitor and educational facilities. A layout of the administration centre precinct is provided in Figure 105 with future opportunities for expansion including a Visitors Centre Pavilion, canopies, and shade structures to facilitate outdoor learning activities, and amenities. The site plan allows for the extension of the carpark and future expansion of the Administration/Operations Building to the north if required.

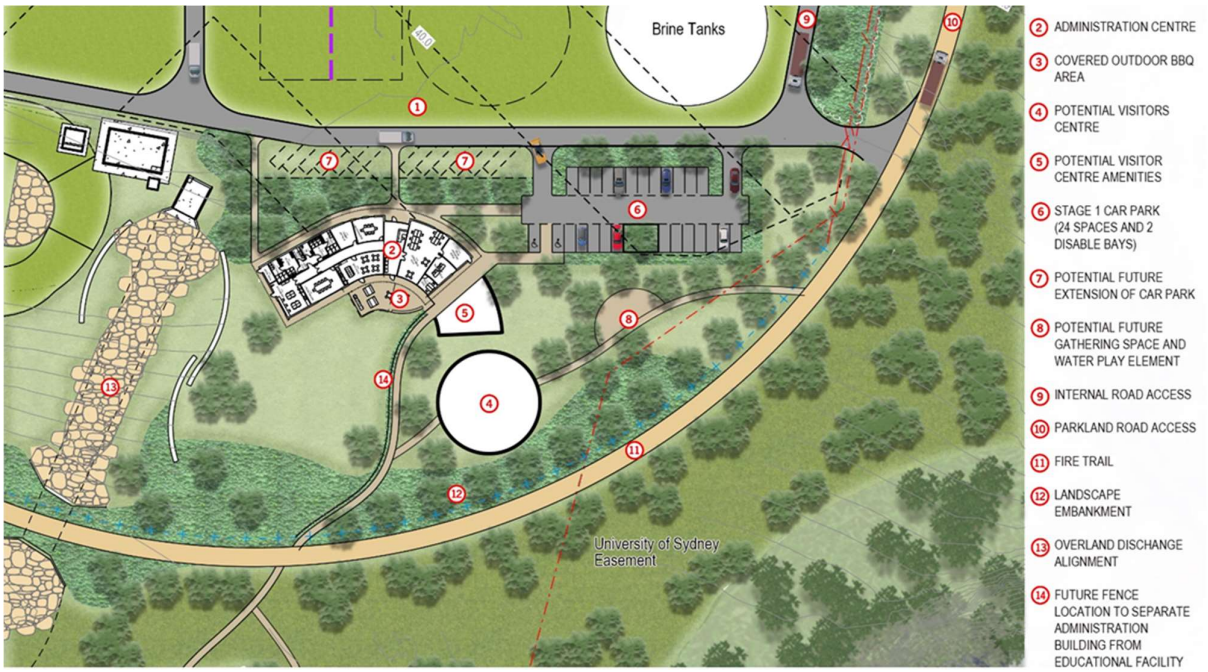

Figure 105 Administration Centre precinct - future opportunities

11.5 Crime Prevention Through Environmental Design

Crime Prevention through Environmental Design (CPTED) is a crime prevention strategy that focuses on the planning, design and structure of cities and neighbourhoods. It reduces opportunities for crime by using design and place management principles that reduce the likelihood of essential crime ingredients (law, offender, victim or target, opportunity) from intersecting in time and space (NSW Police Force 2001).

The four key CPTED strategies have been incorporated into the design of the AWRC site. These are territorial re-enforcement, surveillance, access control and space/activity management. All CPTED strategies aim to create the perception or reality of capable guardianship.

Figure 106 Entry drive interface with the facility showing access control / separation of Operaitonal area from Green Space

Territorial reinforcement

The proposed management and ownership of the AWRC green space is yet to be determined but community use will send positive signals as the green space feels owned and cared and is more likely to be used, enjoyed and revisited. As the restoration of the Wianamatta South Creek environs and future trails evolve

connecting to the broader open space network, visitors will provide effective supervision through being spatially 'connected' to the site.

Surveillance

A well supervised place ensures people feel safe in public areas where they can see and interact with others. Natural surveillance is achieved when place users can see and be seen by others. This is achieved through site planning layouts and design, landscape, and lighting.

At the AWRC, CPTED principles have been used to inform the urban design. The Operations and Administration Centre precinct is fenced from the green space limiting access to operators and approved visitors. The road layout provides passing trucks and vehicles as a surveillance asset. The landscape design considers clear lines of sight and surveillance at the vehicle entry point and around the Administration Centre.

A CCTV monitoring system is in place at the entry.

Access control

Well-designed access control treatments will restrict, channel and encourage people and vehicles into, out of and around the AWRC. Managed wayfinding, desire-lines and formal/informal routes are important crime prevention considerations. At the AWRC, access control has been achieved by using physical and symbolic barriers that direct user groups into particular areas, separating operational from educational/recreational uses. A combination of natural access control includes the use of landforms, existing creeks, design measures including building configurations, pathways, landscaping and fencing.

Space/Activity management

In the development of the AWRC, space/activity management strategies will be an important way to develop and maintain natural community control. Space management involves the formal supervision, control and care of the development. The proposed future green space needs to be effectively used and maintained to maximise community safety. An activation strategy for the site should be developed and aligned with future implementation strategies.

Lighting

External lighting within the Operational Zone consists of pole-mounted street lighting and lights on buildings to deter people from vandalizing assets. The lighting on the AWRC site access road is designed to meet the Sydney Water Electrical Specification CPDMS0022 Rev 12 E4.3.3, with a minimum horizontal illuminance of 3 lux around plant and storage areas and minimum of horizontal illuminance of 1 lux and minimum vertical illuminance of 3 lux in less important perimeter areas. The average horizontal illuminance along the access road is 5 lux and floodlights are cut-off type to minimise glare and unwanted spill into the surrounding landscape. Exterior vandal resistant light fittings will also be installed over external doors. This will minimise impacts on the airport operations.

Furthermore, the overall lighting plan for Stage 1 is designed to meet the Infrastructure Sustainability Council Rating: Achieve Env-5 Light Pollution Level 2 which requires no more than 1 horizontal lux level over the project boundary and 1% upward light ratio. The lighting arrangement is designed in such a way as to not be mistaken as airport lighting to reduce the potential impact on airport operations. A security fence separates the operational site from the broader future green space. Entry to the facility is controlled and only operational staff will be on site at night. A Greenspace Masterplan is being developed and Sydney Water will confirm the future level of access. CPTED principles will be incorporated into the detailed design of the Greenspace.

12 AWRC Stormwater Management Measures

12.1 Stormwater Management

A qualitative assessment of potential flood impacts has been undertaken based on the available flood studies and modelling results. Figure 107 presents the existing case 1% Annual Exceedance Probability (AEP) flood extent (intersecting with the existing ground surface) overlaid on the existing case and design case ground contours at the AWRC site. The 1% AEP flood level varies from 38.0m AHD at the northern end of the site to 38.9m AHD at the southern end of the site.

At the western side of the site, the toe of the proposed filled embankment is situated outside the existing 1% AEP flood extent. Hence, there is no interaction of the filled embankment with the existing case 1% AEP flood and therefore no flooding impacts are expected.

There is a proposed drainage channel for the AWRC local outfall and stormwater discharge from the AWRC site stormwater detention basin, which discharges to Wianamatta South Creek. The channel would be excavated into the existing terrain. The channel will not pose an obstruction to flood flows in Wianamatta South Creek and no significant or widescale flooding impacts are expected. There may be minor and localised impacts in small flood events near the channel outlet to Wianamatta South Creek.

The Probable Maximum Flood (PMF) event flood level varies from 39.3m Australian Height datum (AHD) at the northern end of the site to 40.2m AHD at the southern end of the site. The PMF would inundate small portions of the filled areas of the AWRC site on the eastern and western sides of the site, refer to Figure 107. The EIS amended flood impact assessment (Sydney Water 2022) for the USC AWRC reported minor flood impacts in the PMF event of up to 0.1m on the AWRC site and up to 0.05m outside the AWRC site, refer to Figure 107. The detailed design has been further developed such that there is a reduced volume of filling and reduced encroachment of the AWRC filled areas on the PMF extent. Figure 108 compares the areas of encroachment into the PMF extent by the current earthworks design and by the reference design, showing that the area of encroachment by the Stage 1 design (blue hatched areas) is minor and significantly less than in the reference design (red hatched areas).

Of particular note is that the red hatched areas of the reference design at the northern end of the site jut out laterally (eastward and westward) into the floodplains of Wianamatta South Creek and Kemps Creek, which would result in a greater impedance of flood flows in the PMF event, compared to the smaller impedance of the blue hatched areas for the current design. The red hatched areas for the reference design are also significantly larger at the northern end of the site which would result in greater loss of flood storage. Hence, it is expected that the potential flood impacts by the AWRC on the PMF would be less with the current design than those reported for the reference design in the EIS amended flood impact assessment (Sydney Water 2022).

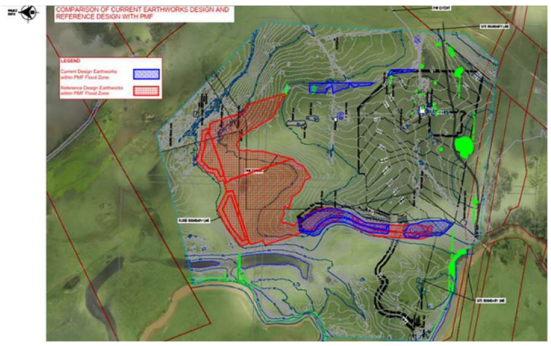

Figure 107 Flood extent line for pre-development case 1% AEP event with existing and developed cas ground surface contours, GHD Jacobs

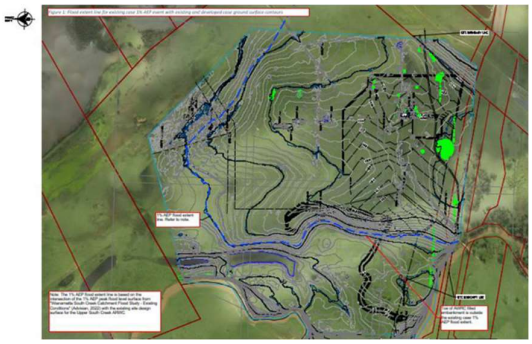

Figure 108 Comparison of encroachment into the PMF by the current earthworks design and by the reference GHD Jacobs

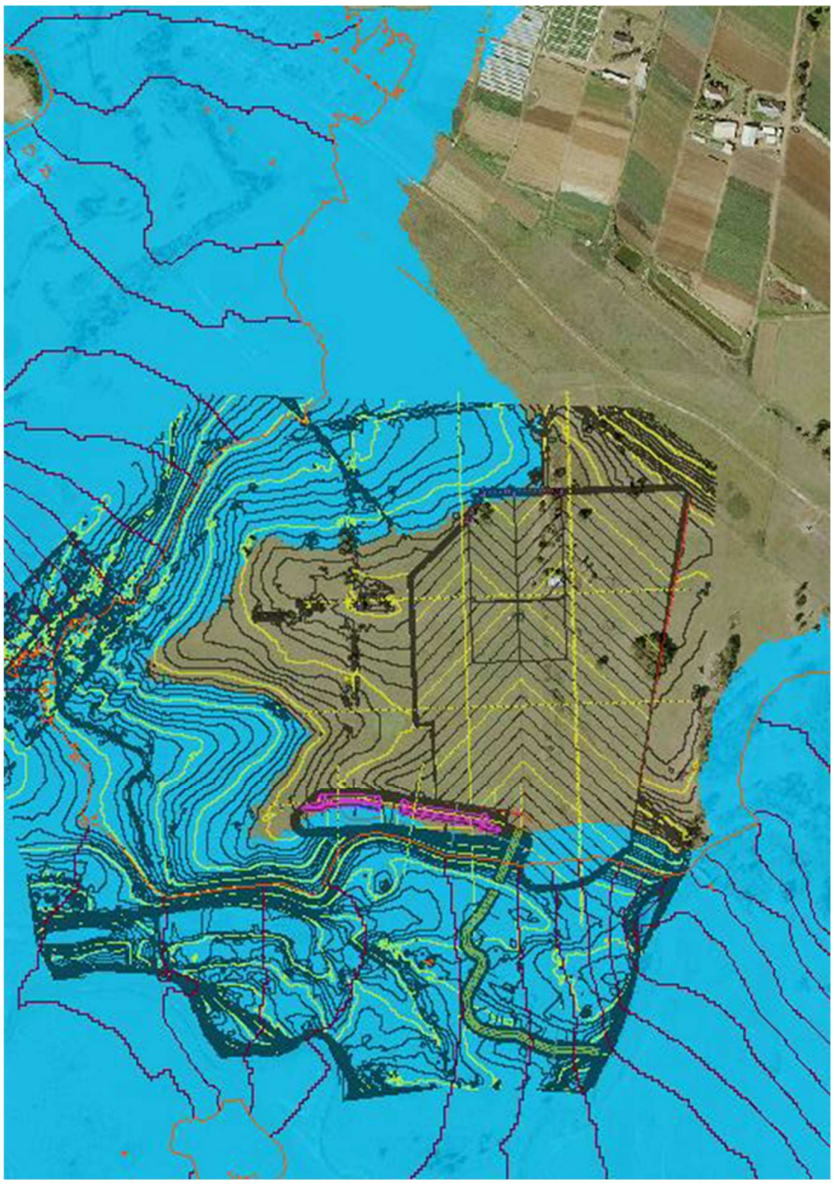

Figure 109 Existing case PMF event extent and inundation of AWRC site

12.2 Water Sensitive Urban Design

Sydney Water is telling a story about water and its importance to how we live. The design integrates stormwater management and water reuse and ongoing management of the site.

The Green Space Masterplan demonstrates an integrated stormwater management system that includes water quality protection, stormwater retention and detention and the creation of public open space and habitats. The AWRC will help protect the environment by improving the quality of stormwater runoff from the sites' catchment to help achieve local water quality and health objectives.

Our design includes the following Stage 1 WSUD initiatives:

- Slowing of stormwater runoff from hardstand, road pavements and the fire trail by runoff initially draining to grass swales within the landscape to recharge soil moisture.
- Most of the treatment Plant zone will be grassed and therefore permeable to ensure groundwater remains charged
- The removal of contaminants and sedimentation from stormwater runoff through a bioretention basin. The basin will attenuate peak runoff, remove stormwater pollutants and plant with species suitable for intermittent inundation and dry periods The bioretention basin is within a larger onsite detention system.
- The onsite detention will store the polished water from the bioretention basin and slowly release to the system and reduce peak runoff. The overflow spill way will disperse water across the landscape.
- New planting will retain water in the landscape for cooling and greening and contribute to improved microclimates across the site.
- To slow reduce erosion and pressure on the creek environments, the creek edge will be restored with suitable plant communities.
- The restoration and revegetation along the creeks will improve the waterways and natural systems
- The restoration of the billabong will retain and filter water on the site.

The above WSUD elements have been incorporated into the Green Space Masterplan to ensure they are fully integrated with the landscape design, amenity and aesthetic provisions.

Beyond the Stage 1 upgrades, there is an opportunity for expanding the billabong towards the treatment plant facility to include deep water, wetland filtration and biofiltration areas (ephemeral and dry). Onsite detention overflow can be directed to the billabong to ensure existing surface flows are maintained. These systems can be incorporated into the educational experience of the site.

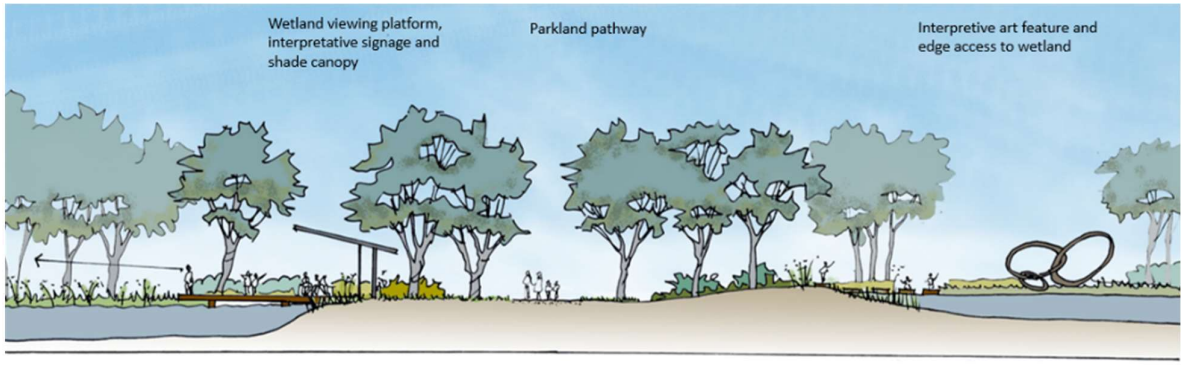

Figure 110 Section through billabong / artificial wetlands (future Green Space)

Figure 111 Sydney Park precedent wetlands play

Figure 112 Sydney Park wetlands

13 Visual Impacts, Lighting and Security

13.1 Visual Impact of AWRC site

Minimising visual impacts

Landscape and visual impacts are important considerations for the development of the AWRC. Our design will sensitively enhance landscape and visual outcomes and reduce physical and visual impacts. The site is at a low point within two creeks and on a relatively flat open flood plain. The AWRC is a new development within a relatively even floodplain and will be slightly visible from various catchments (see Figure 48).

The proposed elevated M12 Motorway will dominate the southern edge. Housing to the northwest is separated by open green space and ecological zones. The sensitive receivers are predominately to the east, i.e., rural residential dwellings on the hillsides at Mount Vernon and Kemps Creek.

Our approach to landscape and visual impacts includes:

- Minimising the degree of visual impact (i.e., the proposed operational facility does not contrast with the landscape character set by the parkland)
- Minimising visibility of the AWRC.
- Providing mitigation measures where visibility is inevitable.

Very few people will view the AWRC up close after Stage 1 construction. A palisade fence is proposed to the entry road frontage that will be planted with shrubs in keeping with the Asset Protection Zone requirements.

The built form of the site will adjoin a large green space to the west and the proposed M12 Motorway at an elevated position to the south which will form the major visual termination and receiver of visual impacts. The M12 Motorway, however, can celebrate the location of the AWRC through the careful integration of the tanks as visual markers. The scale and arrangement of the facility will be within a proposed landscape setting at the north, west and eastern edges. When mature, the planting will screen the facility from sensitive receivers.

Mitigation strategies with recommended principles or treatments for managing the identified landscape character and visual impacts are embedded in the design and be further investigated in the Green Space Master Plan development to reinforce urban design outcomes.

Preliminary ideas include artwork murals for the brine tanks (Stage 2) which are visible from the M12 Motorway and to clad or paint buildings, tanks and other elements in colours in keeping with the proposed landscape.

Landscaping of the AWRC will be implemented to achieve outcomes guided by the urban design principles. As the AWRC is located within eight kilometres of the future international airport, the landscaping for the AWRC will factor in airport safeguarding approaches, including those in relation to wildlife attraction.

There will be operational and maintenance constraints associated with the AWRC which may place revegetation limitations on some areas.

Key Mitigation Measures

The urban design approach for the AWRC to manage potential visual and landscape impacts will be further considered in the development of the future Green Space Masterplan. Stage 1 incorporates appropriate architectural treatments and the development of a landscape within an ecological and heritage context.

The AWRC is in an area that is expected to change over time to industrial and employment land uses and adjoining M12 Motorway. This change in the surrounding visual environment will likely reduce the significance of the impact of the AWRC over time. In addition, a landscape-led approach to urban design provides opportunities to positively enhance the visual impact of the AWRC.

Once completed, the AWRC will introduce large buildings and infrastructure into what is currently a rural setting. The visual impact will be high from some nearby viewpoints such as the M12 but there will also be some nearby locations from which the AWRC visual impacts will be low. Most close views will be from users of the M12 Motorway and the minority of receptors identified as high impact will have low impacts overtime, due to the intervening developments as the result of the Western Sydney Aerotropolis Plan.

Our approach to landscape and visual impacts includes:

- Minimising the degree of visual impact (i.e., the proposed facility does not contrast with the landscape character set by the parkland)
- Minimising visibility of the proposal
- Providing mitigation measures where visibility is inevitable.
- A palisade fence is proposed to the green space road frontage that will be planted with shrubs in keeping with the Bushfire Risk Asset Protection Zone requirements.
- The built form of the site will adjoin a large green space to the west.
- The M12 Motorway at an elevated position to the southeast will form the major visual termination and receiver of visual impacts. The M12 Motorway, however, can celebrate the location of the AWRC through the careful integration of the tanks as visual markers.
- The scale and arrangement of the facility within a landscape setting to the north, west and eastern edges will assist in the screening of the facility from sensitive receivers.
- Mitigation includes the strategic placement of trees in staggered clusters to screen the facility.
- Ideas that can be further investigated with the community include artwork murals for the brine tanks which are visible from the M12 Motorway and colour other elements in colours in keeping with the proposed landscape.

Figure 113 Potential interpretation murals on the brine tanks

The semi-rural, gently undulating topography surrounding the site will permit the AWRC to be observed as **filtered distant views from the adjoining rural residential properties** within the visual catchment. Clusters of existing trees along the waterways and in the recreational and environmental zones adjoining the site contribute to the filtering of views.

The facility's proposed future **green space landscape will filter views**. The planting will create a middle-distance greening band that will obscure the operational site from distant viewpoints. Views along Wianamatta South Creek and Kemps Creek provide localised views of water, in particular under the dual bridge spans of the M12 Motorway which allow views out from the site to the south.

The elevated M12 Motorway will have views into the site and there are opportunities to use the brine tanks as AWRC markers for motorists. The entry point to the site at Clifton Avenue will also be marked as a gateway to the facility.

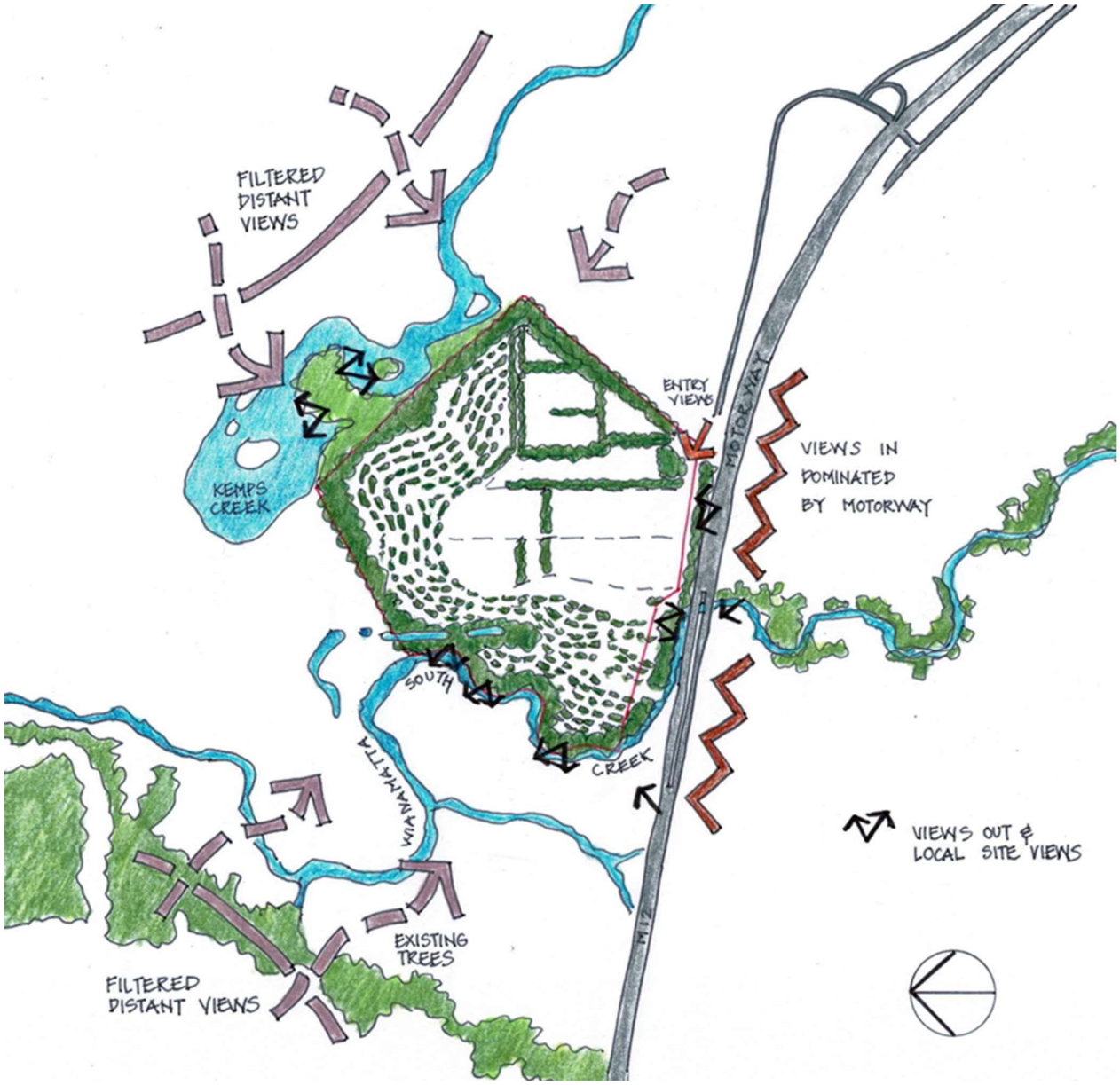

Figure 114 Visual impact amelioration and proposed green space and landscape

13.2 Lighting Impacts / Compliance

All lighting associated with the operational site will be constructed and function with minimal light spillage to surrounding properties and risk to pilots and in accordance with the following requirements.

AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting, and National Airports Safeguarding Framework (NASF) Guideline E: Managing the Risk of Distractions to Pilots from Lighting in the Vicinity of Airports.

The setting of the AWRC has limited lighting impacts due to the rural landscape character. Refer section 13.1 Visual impact of AWRC site. The Project Site is sensitive to the introduction of new lighting, however, the operational lighting impacts for the AWRC will not generate significant levels of lighting, given its distance

from existing sensitive receptors and the majority of lighting to be narrow focused downlights and restricted to security and access requirements. Mitigation measures include the arrangement of downlighting will be scattered and is not likely to be mistaken as airport lighting. Therefore, the lighting impacts for the Project are low.

The lighting at AWRC will not be configured in lineal patterns that can be mistaken as being ground lighting associated with an airport. Additionally, the intensity of light emission will meet the requirement of regulation 94 of CAR 1988.

Detailed documentation outlining specific locations, fittings and fixtures for all external lighting will be prepared to meet the requirements of AS/NZS 4282:2019.

14 Community and Stakeholder Engagement

14.1 Background

Past EIS engagement outcomes

The Department of Planning and Environment received 30 submissions during the exhibition of the project EIS. Only four of these submissions were from individuals from the community. The submissions included comments on the AWRC, the new treated water pipeline from the AWRC to the Nepean River and the new brine pipeline connecting to the Malabar Wastewater Treatment Plant. Analysis of these submissions is provided in the Submissions Report March 2022 and has been considered in the preparation of this UDLP. The majority of issues raised related to economic, environmental, and social impact. Most of these across the entire project related to:

- hydrodynamics and water quality
- flooding
- terrestrial biodiversity
- surface water
- aquatic ecology
- noise and vibration
- Aboriginal heritage

Engagement approach

We have set project objectives and engagement initiatives in line with the Recognise Country: Guidelines for Development in the Aerotropolis, the Minister's Conditions of Approval (MCoA) and the highest-level benchmarks from the Infrastructure Sustainability Council. The MCoA relating to the Urban Design and Landscape Plan (UDLP) are explained in Chapter 4.

The engagement approach for the UDLP was also guided by the Community and Stakeholder Engagement Plan for the project, which includes analysis of community and stakeholder issues and concerns based on past engagement activities and the exhibition of the EIS. The staging of the Stage 1 CSSI Works was also considered - the UDLP focuses on the AWRC operational site, the landscaping within and surrounding the operational site and the riparian planting corridor along Wianamatta-South Creek.

Opportunities for the community and stakeholders to influence aesthetic outcomes for the broader site will come during the Green Space master planning process. The UDLP will be subsequently revised to include the consultation outcomes captured during the development of the Green Space Masterplan.

Another factor in deciding the engagement approach was the level of stakeholder interest, the ability for stakeholders to influence decisions and the expected level of public interaction with the operational facility area. For example, despite an extensive community and stakeholder engagement program, there was limited interest from the wider community in the AWRC urban design and landscaping during the preparation and exhibition of the EIS. And decisions about the type, height, position and colour of AWRC operational structures have mostly already been made by Sydney Water based on planning regulations and technical requirements.

The engagement approach for the UDLP sought to provide the nearby community and project stakeholders the opportunity to learn and ask questions about the planned design and landscaping at the site, noting that further engagement about the Green Space area would occur at a late stage.

Engagement on the UDLP

Engagement with the community and project stakeholders was done through:

- A community information session in the Aerotropolis (with multiple government agencies and councils present)
- A community newsletter drop and email inviting people to review the draft UDLP
- Website information (on Sydney Water Talk)
- Phone calls

Additional engagement activities about the proposed urban design and landscaping occurred with stakeholders who either had a particular interest in the AWRC site or who may be affected by the permanent built works and/or landscaping. These included Aboriginal stakeholders, City of Penrith Council, aviation stakeholders and nearby landowners including Transport for NSW and the University of Sydney. Additional engagement with these stakeholders included:

- Aboriginal stakeholder engagement including a Walk on Country event and a stakeholder workshop with representatives from the project's advisory group (which was formed after seeking interest from any Aboriginal person living in Western Sydney with strong cultural connections or interest in the project area including Traditional Custodians, Local Aboriginal Land Councils and Registered Aboriginal Parties for the project).
- Emails inviting people to review the draft UDLP.
- Workshop with government agencies and City of Penrith Council.
- Follow up emails and phone calls with nearby landowners and businesses.

The conversation with interested and impacted stakeholders is ongoing and will extend beyond the plans described in the UDLP. These stakeholders will be invited to review the urban design, landscaping and riparian planting designs and, like the wider community, will be invited to participate in the master planning for the Green Space area later this year

What you have told us

There has been limited interest so far, particularly from the wider community, in the urban design within the AWRC operational area. This is to be expected given many of the decisions relating to buildings and structures have already been made by Sydney Water due to planning conditions and its own technical and operational requirements. There is some interest however in the operation of the AWRC including odour and traffic management and interfaces with adjacent properties.

Stakeholders from the Aboriginal community, as well as some government agencies and landowners nearby, have expressed an interest in learning more about landscaping designs and the proposed riparian planting along Wianamatta South Creek.

There is strong interest in the master planning process for opportunities within the Green Space. Aboriginal stakeholders have already emphasised the need to protect flora and fauna, restore the natural flow of water through the site, explore the possibility of improving land and water management across the area and not just within the AWRC site, consider some interpretation and education about Caring for Country and increase awareness of local Aboriginal language.

Table 10 Walk on Country and Stakeholder Workshop feedback

WALK ON COUNTRY AND STAKEHOLDER WOKRSHOP FEEDBACK		
Theme	Comments / Questions	Recommended Actions
Cultural Values Mapping	Will Sydney Water continue the Cultural Values Mapping work?	Advise on intention to continue/finalise Cultural Value Mapping work.
Aboriginal Heritage Investigations	• Why was the area in the green space salvaged? • Request for a map to identify areas that have been investigated/salvaged across the site. • Is there opportunity to put salvaged artefacts back on Country? • What was the salvage methodology, bulking or layers? • Requested to review a copy of the Heritage Report.	• Provide methodology for identification of salvage pits as well as for the salvage itself (i.e., bulking or layers). • Provide a map outlining the areas across the site that have been investigated/salvaged. • Investigate opportunity and process for returning the salvaged artefacts to Country. • Provide a copy (when completed) of the Heritage Report
Significant flora	• Noted a potential scar tree on the side of the access road as driving past during walk on Country. • Questioned the point of bunting the significant ecological communities (i.e. paperbark trees) for slashing if they are being removed for the construction of the AWRC centre. • Is there opportunity to relocate the paper bark trees on site, if they can't be retained? Potential relocation site at Salvage pit. • If they can't be relocated can the tree material be reused on site (i.e. habitat for fauna)	• Identify scar tree and investigate opportunity to protect scar tree on side of access road. • Investigate opportunities for relocation and/or reuse/seed collection of the paperbark trees that have been identified for removal (noting damp soil type requirements). • If relocation is possible, investigate if the paperbark trees could be relocated to the salvage pit along Kemps Creek to avoid disturbing more Country.
Water Management	• Questions and concerns regarding the impact of pumping water into the Nepean River. • Questions around the intentions for water reuse and recycling in the Aerotropolis, how will this be implemented?	• Bring a member of the Sydney Water team that is looking at the broader water management for the Aerotropolis to an upcoming workshop.
Connecting with neighbours	• Can the billabongs be returned to their natural state with the removal of the dam wall in the middle? • Can the dam at the top end of Kemps Creek be removed to allow natural water flow? • Opportunity to have connected walking/cycling paths in/out of the site to surrounding areas.	• Consult with neighbouring properties and understand potential downstream impacts and opportunities to return Kemps Creek and billabongs to natural water flows. • Consult with neighbouring properties to understand opportunities for walking/cycling paths and green space connectivity and continuity.
Caring for Country/ land management	• Opportunity for a cultural burn to support clearing of overgrowth and non-native plant species on the site.	• Investigate opportunity to undertake a cultural burn as part of the site clearing prior to construction.

WALK ON COUNTRY AND STAKEHOLDER WOKRSHOP FEEDBACK		
	• Questions around relocation of animals (e.g., red belly black snake) and provision of habitat during construction.	• Investigate and advise on approach for clearing/relocation of fauna prior to construction as well as provision of habitat on site for relocation.
Purpose of green space	• Questions regarding the purpose of the green space. • Noted opportunity for potential cultural space.	Dedicate a focus group of Traditional Custodians to discuss the purpose and potential use of the green space (i.e., for public use or reserved for cultural use) and what that could look like.
Dark Sky	Noted the site currently has good access to dark sky Country and it would be good to retain this.	• Revise DPE's Dark Sky Planning Guideline | Planning (nsw.gov.au) • Consider access to dark sky Country in lighting plan for the site and green space.
Language	Noted design team queries around use of language and pointed out that there is already the opportunity to use the word 'Wianamatta' instead of South Creek.	Investigate opportunity to update collateral and project documentation moving forward to refer to South Creek as 'Wianamatta'

Future Green Space Masterplan

Opportunities for upcoming engagement around the future Green Space will be flagged with relevant stakeholders to ensure a seamless transition from the development of the UDLP to the start of the master planning process for the Green Space.

Sydney Water, John Holland, Trility and Tract will engage with stakeholders as part of a master planning process to develop a concept for the future Green Space. The purpose of the engagement activities is mainly to 'consult'. We will seek feedback, consider it, address it and report back on how feedback was used during the decision-making process. There is the opportunity in this process for stakeholders to influence decision making but Sydney Water will make the final decision on the concept, which would then be included in a revised UDLP and subject to further financial review and planning approvals. Formal agreements may then be required with partner organisations to implement the concept.

Engagement activities will include:

- Meetings and workshops with Aboriginal stakeholders (ongoing)
- Liaison with representatives from NSW Department of Planning and Environment interested in Wianamatta South Creek (underway)
- Opportunity and constraint mapping workshops with a wider range of potentially interested or affected government stakeholders including Liverpool City Council, Greater Sydney Parklands, Western Parkland City Authority and other government agencies
- Ongoing community updates, individual meetings and community information sessions for nearby landowners and businesses.

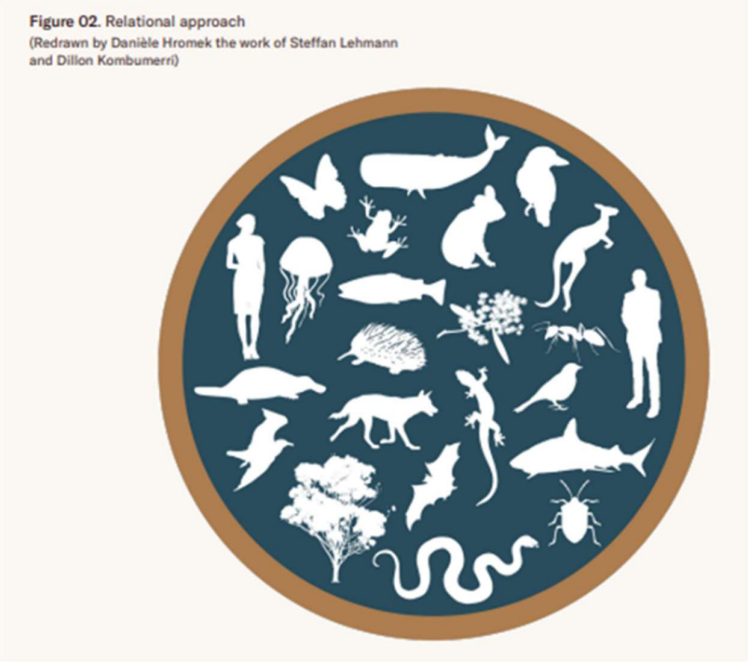

Figure 115 Approach to Country with rational approach

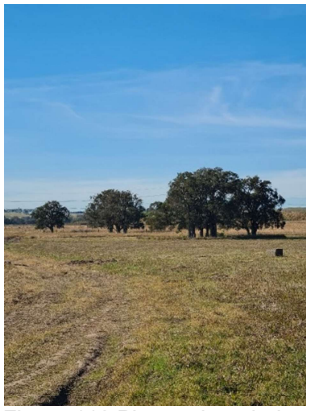

Figure 116 Photo taken during the Walk on Country (June 2023)

Figure 117 Site photo taken during the Walk on Country (June 2023)

15 Independent Review

15.1 Purpose and Objectives

Infrastructure Sustainability Council

This UDLP supports the requirements of *Pla-2 Urban and Landscape Design* in the *ISCA IS v2.1 DESIGN: CRITERIA FOR PLA-2 CREDIT* for the following criteria.

Level 1

***DL1.1 An urban and landscape design plan has been developed and design options implemented (this UDLP and Detailed Design Documentation*).**

The requirements for *DL.1.1 – An urban and landscape design plan has been developed and design options implemented* is achieved through the delivery of detailed design and documentation of the design elements in this UDLP. The detailed design process provides documentation that will be constantly refined throughout t the Project up until the point the design is 'Issued for Construction' stage. The design will then be implemented in construction.

***DL1.2 The maintenance arrangements for the project's urban and landscape design components have been reviewed. (Chapter 17*)**

Level 2

The requirements for Level 1 have been achieved.

DL2.1 An urban and landscape design statement has been prepared (this UDLP).

***DL2.2 The urban and landscape design plan and statement have been independently reviewed at key stages throughout the design* (this Chapter).**

Independent Review

An independent review has been undertaken of the ECI phase urban design package to provide independent advice to support placemaking objectives. This UDLP and project documentation will be reviewed at key stages to evaluate the implementation of the ULDP. The reviews will continue to be undertaken by an Independent Qualified Individual (IQI).

The purpose of the design reviews is to provide expert and impartial design advice to the project team against accepted urban and landscape design principles. Four independent reviews will occur at the following milestones.

Review 1 - ECI Phase documentation
Review 2 – Urban Design and Landscape Plan (this document)
Review 3 – 80% Detailed Design Documentation
Review 4 – 100% Detailed Design Documentation

Agreed, recommendations from each review will be incorporated into the subsequent stage documentation. Key recommendations from Review 1 have been incorporated into the development of the design and this UDLP. Documents reviewed include:

- Scoping Report Upper South Creek Advanced Water Recycling Centre (Sydney Water 2020)

- Upper South Creek Advanced Water Recycling Centre Urban Design Report (Aurecon Arup 2021)
- Upper South Creek Advanced Water Recycling Centre Final Submission *ECI Deliverables*:
  07-24 Architecture & Urban Design Brief,
  07-25 Site Master Plan,
  07-27 Landscape and Biodiversity Plan and
  07-28 Architectural Design and Drawings.

Table 11 Independent review recommendation and responses

INDEPENDENT REVIEW 1 – RECOMMENDATIONS AND RESPONSES		
Recommendations		Responses
Engagement		
1	Consider engaging with the surrounding residential and university groups for community/educational riparian corridor rehabilitation projects both within and to the external boundary of the site.	The engagement strategy for the Project identifies key stakeholders including State and Local Government agencies and community groups. Sydney Water's engagement process will continue for the duration of the Project and outcomes associated with the urban design of Project and opportunities for community /educational initiatives will be captured and potentially implemented into the ongoing maintenance, management, operation and development of the site. The engagement on the development of the Green Space Masterplan will incorporate opportunities around this recommendation.
Place		
1	Consider the incorporation of urban design principles of place through a review of the colours of the metal clad buildings within the treatment plant zone. This will encompass the opportunity to utilise light colours for roofs and wall cladding to minimise heat loading.	Chapter 11 identifies potential opportunities in the incorporation of lighter cladding colours and refining the response to Place. During the 80% Detailed Design Phase, consideration of these finishes will be undertaken.
2	Consider further opportunities for Connection to Country, through cultural practice, education, art and social enterprise.	Continuing engagement will Traditional Custodians and Registered Aboriginal Participants (RAP) will occur for the development of the Green Space Masterplan where opportunities for cultural practice, education, art and social enterprise will be further explored and incorporated where appropriate.
3	Consider hard landscape elements including furniture and pavement materiality as part of the wayfinding and signage elements and cultural and heritage identity outcomes for both stages of the project. Clearly identify the relationship of the Fleurs Antenna cross arrays and their relationship to the road layout design through interpretation on site as part of stage 1.	Refinement of material selections and elements will occur during the 80% Detailed Design Documentation Phase and identified during the preparation of the Green Space Masterplan. The UDLP identifies an on-ground treatment to mark the location of the crossing point of the Fleurs antennae cross arrays. Details of the treatment and interpretation will occur during the 80% Detailed Design Documentation stage.
Functionality		

INDEPENDENT REVIEW 1 – RECOMMENDATIONS AND RESPONSES		
1	Consider whether public amenities required as part of the Stage 1.	Visitors will be able to access the amenities in the Administration Centre. Visitor access will be controlled, and they will be accompanied by facility staff.
Biodiversity		
1	Consider environmental solutions like floating wetlands to reduce water evaporation from wetlands, waterways and to assist in filtration and limit algal blooms.	No permanent water bodies are proposed for Stage1 The bioretention and retention systems are designed to process stormwater during rainfall events and to ensure water quality and flows from the development of the site do not impact Wianamatta South Creek or Kemps Creek. The system is designed to filter and slow flows and does not permanently retain water. The billabongs are associated with the ephemeral nature of the flood plain and may at times hold water and at other times dry out. Floating wetland systems are not required for Stage 1 but can be considered for the future green space development where there are permanent water bodies that are part of the Kemps Creek system. During The 80% Detailed Design Documentation, plant species will be nominated for the bioretention and billabong precincts.
2	Incorporate plant species which aid soil health and removing contaminants from the topsoil and bioretention areas	During the 80% Detailed Design Documentation stage, plant species will be considered for their contribution to improving soil networks.
3	Maximise the planting opportunities (numbers, layering and mix of species to exploit biodiversity opportunities) with a focus on the continuing management and monitoring required around fire and aviation risk.	During the 80% Detailed Design Documentation stage, plant communities will be considered for their contribution to improving biodiversity outcomes. Detailed review of planting opportunities with consideration of the site's constraints.
4	Implement planting and habitat zones for key local fauna which do not contribute to aviation risk.	As per item 3 above.
5	Existing billabong within revegetation zone adjoining Wianamatta South Creek. Consider removing the artificial bund to reconnect the two billabongs into one connected system to improve environmental outcomes.	80% Detailed Design Documentation will incorporate the regrading of the bund to reconnect the two billabongs as one system.
6	Reduce hard surfaces within the treatment plant zone and replace with more permeable natural treatments to allow absorption of moisture to support plant growth, micro species and movement of micro fauna through connected soil networks	80% Detailed Design Documentation will incorporate these opportunities and document outcomes from a detailed review in conjunction with Sydney Water and the operations team.

16 Creating a Sustainable Place

16.1 Sustainable Infrastructure

Sustainable infrastructure can be defined as infrastructure that allows society to adapt and optimise to changing social, ecological and economic outcomes in the long term. The Infrastructure Sustainability Council (ISC) has developed an Ecological Sustainable Development (ESD) tool to drive and measure sustainability on infrastructure projects and assets. The tool aims to improve the productivity and liveability of industry and communities through sustainability in infrastructure. By obtaining an ISC rating, the construction and operational impacts of the AWRC with respect to sustainability will be minimised.

Approach to achieving the ISC Rating

Restoration of the site with a diverse environment that will become more inclusive and ecological will help enrich wildlife and biodiversity while improving water quality and soil degradation.

An improved soil biodiversity promotes healthy microfauna biodiversity. The trees will sequester carbon and assist the soil in capturing and storing carbon as we face Climate Change.

Restoring and sustaining natural systems in and around the AWRC

Our urban design vision for the AWRC is directly linked to achieving the circular economy principle of regenerating natural systems. In connecting to Country and taking a landscape-led approach to site development, beneficial natural system outcomes include:

- Retaining water in the landscape through soil amelioration, contour planting and water sensitive urban design initiatives
- Enabling regeneration of the Cumberland Plain Woodland communities throughout the site
- Restoring the riparian ecological landscape and preventing erosion by stabilising creek embankments
- Providing biodiversity by establishing continuous landscaped corridors that support diverse species.

For the AWRC to reach its full potential, we must ensure it achieves the environmental, social and economic values outlined in Table 12. The table is based on the Infrastructure Sustainability Council's (ISC) Ecological Sustainable Development (ESD) tool to drive and measure sustainability on infrastructure projects and assets.

Table 12 Environmental, social and economic values

ASPECTS	VALUES
Environmental	• Retaining water in the landscape to create green vibrant places that mitigate urban heat to meet Western Parkland City's objectives. • Integrated water sensitive urban design and natural processes, including accommodating overland drainage flow paths within constructed wetlands and maximising permeable surfaces. • A landscape that is appropriate, contextual, considers climate and reinforces biodiversity with the introduction of edible and medicinal Indigenous plants. • Connection to wider landscape and networks beyond the AWRC • Architecture that is sustainable and fits within its environment. • Considers carbon solutions
Social	• Environment that promotes socialisation through active and passive experiences

ASPECTS	VALUES
	• Connectivity throughout the site and with the broader neighbourhood • Playful and educational spaces for interaction that are adaptable, flexible and provide variety. • Sensitively designed place with beautiful detail • Integrated heritage interpretation that is contextual • Accessible, safe place for all. • Leave a lasting legacy, beyond the purpose of the Project (Noting this is an objective of ISC v2.1 too – LEG-1)
Economic	• Optimised recovery of wastewater to offset potable supplies. • Design layout for project staging to allow flexibility and resilience with consideration for future expansion and adaptability. • Resource recovery by maximising energy recovery from process and beneficially reusing biosolids • Accessible to the broader community • Robust materials with long life cycles • Initial capital costs and ongoing maintenance must be sustainable • Potential partnerships with local businesses, training and vocational and industry groups

Figure 118 USC AWRC site looking south

17 Management, Maintenance and Reviews

17.1 Operations and Maintenance - managing the landscape

Aligning with Urban Design Objectives and Principles

Connecting to Country, Culture and People Objectives and aligning with urban design principles around Placemaking, Leading edge environmental design responsiveness and Urban Renewal and Liveability identified in Section 3 will be reinforced with on-going management, maintenance and reviews.

A Landscape Management Plan (LMP) has been developed as part of the ongoing landscape monitoring and maintenance activities for the long-term care of the AWRC site and is included in Appendix B of this plan.

General management principles will focus on the development of the specific landscape character types identified in the UDLP and landscape management activities which support the goals and objectives of the UDLP. This will include the management of the entire site and the green space to be masterplanned.

The Vegetation Management Plan for the Wianamatta South Creek guides the detailed implementation of creek restoration and billabong zones, as per the Guidelines for Vegetation Management Plans on Waterfront Land (NSW Office of Water, DPI 2022) and the Draft Western Sydney Aerotropolis Riparian Revegetation Strategy in the Western Sydney Aerotropolis (Initial Precincts) Riparian Corridors Assessment (Sydney Water 2021).

The tree planting provisions in the Western Sydney Aerotropolis Development Control Plan – Phase 2 has been considered.

O1. Utilise stormwater for passive irrigation of street trees to promote healthy trees, optimise canopy cover and contribute to streetscape and amenity.

- Water Sensitive Urban Design (WSUD) has been included in the creation of drainage swales, bioretention and detention basins.

O2. Facilitate canopy street tree planting that reaches a mature height that is commensurate with the width of the street and the height of development fronting that street, to enhance the amenity and identity of the street.

- Due to wildlife hazards and bushfire risk, tree planting has been restricted within the asset protection zone. Outside of this zone, canopies in groups of three to five are proposed.

O3. In preparation for planting the site is to be de-compacted to ensure that a growing environment capable of supporting the sustainable growth of a tree is provided.

- De-compaction of the soil for tree planting is not recommended based on soil testing, as it will release excessive amounts of manganese causing water logging that is detrimental to tree survival.
- Our methodology will follow the advice in the Soil Re-Use Assessment (SESL 2023).

Overall site management is required for fire and aviation risk and to prepare for the development of green space grassland landscape.

Sydney Water retains ownership of the green space and will establish after the preparation of the future Green Space Masterplan if any assets are to be transferred to the relevant authority. The Green Space will

be managed and maintained by Sydney Water whilst the Operations side will be managed and maintained by the operator Trility for the duration of their contract.

Vegetation Management Plan

The Vegetation Management Plan (VMP) includes the incorporation of the comments and actions identified in the Net Ecological Gain paper to be prepared by Biosis (Ecologist) and meets the requirements of the MCoA E64(g). Figure 119 shows the management zones along the Wianamatta South Creek included in this Plan.

Preliminary works

The Vegetation Management Plan (VMP) details how the restoration and rehabilitation will be carried out. During the Preliminary works stage (Stage 1), construction management actions will be undertaken to ensure the buffering and retention of existing native vegetation from construction impacts. These include fencing to prevent sediment from running into the VMP site, inspection of plant and equipment before entering the site, and certifying any soil, plants and other materials are free of weeds and pathogens before entering the site.

Weed management

Prior to planting, primary weed control for each vegetation management zone will consist of appropriate eradication methods for the specific weed species found on site. Secondary weed control will occur after planting, throughout the establishment and maintenance periods, including follow-up treatments of all weed seedling growth, and overlooked weeds after initial weed treatment.

Planting and installation

Tube stock plants and seed embedded jute mats will be installed in each vegetation management zone to restore and rehabilitate the native ecology. A variety of trees, shrubs, forbs, grasses, and groundcovers are specified to meet biodiversity requirements. At the time of planting, a native slow-release fertiliser is to be applied to each plant.

Water regime

After planting and installing the seed embedded jute mats across the management zones, the proposed watering program specifies watering to occur once a day from weeks 1-4, once a fortnight from months 2-4 and once a month from months 5-6. The necessity for watering during the above program will be dependent upon rainfall. The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after period of 4 to 6 months the planting will be sufficiently established such that supplementary watering will no longer be required.

Monitoring and maintenance

Planting areas are to be monitored during the establishment and maintenance period to ensure that climatic conditions are not negatively affecting the newly planted tube stock and sprouting seeds. If climate or environmental conditions are affecting the plants, a watering program may be reinstated pending the approval by the environmental manager.

Monitoring will be undertaken by photo monitoring and vegetation surveys. Monitoring will be implemented before works commencing to establish a benchmark for performance, and to occur every six months or as directed by the contractor, until the completion of the project. Each six-month survey will be accompanied by brief correspondence with the Bush Regeneration contractor and the proponent/ project manager regarding the progress of the vegetation management works and highlight any areas of concern or merit.

Landscape Management Principles for AWRC

The following landscape management principles are to be incorporated into the Landscape Management Plan for monitoring and reporting:

- Incorporate actions and outcomes identified by Biosis and captured in the Vegetation Management Plan to ensure an adaptive regenerative process is applied and monitored.
- Minimise environmental impacts that may result from landscape management activities and utilise environmentally sustainable practices.
- Enhance and promote the Cumberland Plain character of the site.
- For new and replacement plantings, use of endemic plant species.
- Provide a safe environment, minimising potential risks to people, buildings, and property.
- Continue to incorporate water sensitive urban design (WSUD) techniques to manage stormwater, slow runoff, recharge groundwater, store for re-use and to passively irrigate landscape areas.
- Apply best practice bush regeneration in revegetated areas and best practice landscape maintenance in the Treatment Plant zone.
- Provide a high-quality path network that provides for safe, equitable movement.
- Ensure that all new works comply with the requirements of AS 1428 Access and Mobility Design.
- Target noxious weeds and feral animals using integrated pest management approaches.
- Provide opportunities for Aboriginal, environmental, and informal learning and study in the landscape.
- Maintain high quality outdoor spaces and public interfaces.
- Manage bushfire risk in accordance with recognised guidelines.
- Manage wildlife hazard risks in accordance with the Wildlife Management Plan.
- Provide opportunities for greater community involvement.
- Appropriately fund, plan and manage landscape maintenance to provide a measurable improvement of the AWRC landscape appearance, safety and amenity.
- Maintenance and monitoring process will be documented and planned.

Continuous improvement and change management will be incorporated into the Landscape Management Plan to achieve the design outcomes of the UDLP.

17.2 Review and Evaluation

Regular intervals for review and evaluation of UDLP implementation by an independent suitably qualified professional from the proponent (client) organisation or a third party will be specified within the LMP.

Independent Review - Quality Inspections

Independent review and reporting will occur to monitor and manage the landscape at the following times: three (3) inspections during construction, one (1) inspection at practical completion and one (1) inspection at final completion.

After each inspection, detailed reports and photographic evidence outlining aspects of the project that require attention due to non-conformance and rectification actions to meet performance specification and documentation outcomes will be issued. Each follow up inspection will monitor that identified issues have been rectified.

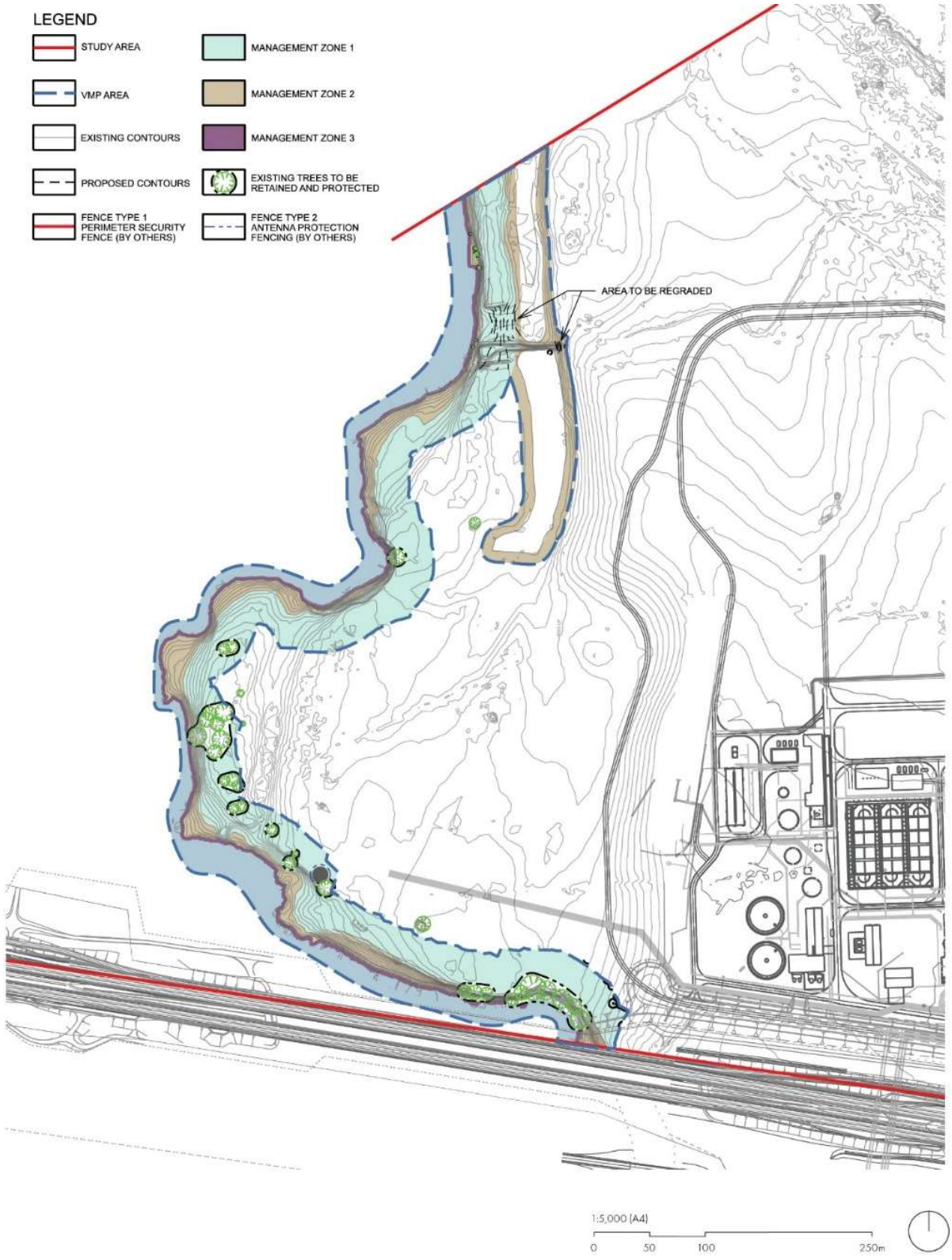

Figure 119 Vegetation Management Zones for Wianamatta South Creek

18 Appendices

Appendix A Vegetation Management Plan

Appendix B Landscape Management Plan

Appendix A Vegetation Management Plan

VEGETATION MANAGEMENT PLAN

Tract

SYDNEY WATER UPPER SOUTH CREEK ADVANCED WATER RECYCLING CENTRE

Prepared for John Holland

Tract
Gamaragal Country
Level 8, 80 Mound Street, North Sydney
NSW 2060
(02) 9954 3733
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4 October 2024

Quality Assurance

VEGETATION MANAGEMENT PLAN
SYDNEY WATER UPPER SOUTH CREEK ADVANCED WATER RECYCLING CENTRE

Project Number
AWRC-TRA-PLN-DES-0002

Revisions

Issue	Date	Description	Prepared By	Reviewed By	Project Principal
01	19/06/2023	Draft 50% Detailed Design for review	Adam Jeffery	Matthew Easton	Adam Jeffery
02	20/06/2023	Second Draft 50% Detailed Design for review	Adam Jeffery	Matthew Easton	Adam Jeffery
03	19/07/2023	Draft for review	Adam Jeffery	Julie Lee	Adam Jeffery
04	11/12/2023	Issue for JHG review	Jillian Davies	Matthew Easton	Julie Lee
05	18/03/2024	Final Issue	Jillian Davies	Matthew Easton	Julie Lee
06	09/07/2024	Final Issue	Eliza Fagan	Julie Lee	Julie Lee
07	18/09/2024	Revised following Sydney Water review	Alyce Harrington Mark Trethewy	Julie Lee	Julie Lee
08	04/10/2024	Revised following Sydney Water review and issue to DPHI	Alyce Harrington Mark Trethewy	Julie Lee	Julie Lee

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Glossary

Abbreviation	Description
CEEC	Critically Endangered Ecological Community
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environmental Protection and Biodiversity Act 1999*
PCT	Plant Community Type
TEC	Threatened Ecological Community
USC AWRC	Upper South Creek Advanced Water Recycling Centre
VMP	Vegetation Management Plan
VRZ	Vegetated Riparian Zone
WM Act	NSW *Water Management Act 2000*

1 Introduction

Tract Consultants Pty Ltd has prepared this Vegetation Management Plan (VMP) for John Holland Group on behalf of Sydney Water for the Upper South Creek Advanced Water Recycling Centre (USC AWRC). Sydney Water plans to build and operate new wastewater infrastructure to service the South West and Western Sydney Aerotropolis Growth Areas. Through treating wastewater, the USC AWRC will produce high-quality water suitable for a wide range of non-drinking uses in homes, various industrial services, businesses, agriculture, and for public open spaces. This VMP can be read in conjunction with the Landscape Management Plan (LMP) document.

1.1 Background

This Vegetation Management Plan (VMP) has been prepared by Tract Consultants for John Holland Group (JHG) on behalf of Sydney Water (SW) for the Upper South Creek Advanced Water Recycling Centre (AWRC) on Dharug Country. The AWRC is located at the confluence of the Wianamatta South Creek and Kemps Creek and is within an open space and environmental corridor. It is directly below Western Sydney Airport's flight path and will be bordered to the south by the M12 Motorway which is currently under construction by another contractor. Refer Figure 1 Local Context Plan, Figure 2 Stage 1 Plan, and Figure 3 Stage 1 Render.

Sydney Water will operate the wastewater infrastructure to service the southwest and Western Sydney Aerotropolis Growth areas. Through treating wastewater, the AWRC will produce high quality water suitable for a wide range of non-drinking uses in homes, various industrial services, businesses, agriculture, and public open spaces.

Figure 1 Local Context Plan (Tract)

Figure 2 Stage 1 Plan

Figure 3 Stage 1 Render

1.2 Purpose and Scope

The AWRC has been planned to be implemented in stages to grow according to demand. Stage 1 will be completed by 2026 and (of the SSI-8609189 approval scope relevant to the LMP), includes the following:

- Construction and operation of a sewage treatment plant at Kemps Creek sized to treat an average dry weather flow of 35ML/day during Stage 1
- Construction and operation of the overland flow swale from the plant to Wianamatta South Creek
- The vegetation riparian zone (VRZ) immediately adjacent to Wianamatta South Creek, to the extent of the northern and southern boundaries of the AWRC site.

The purpose of the VMP is to provide a description of the management activities to be undertaken for the VRZ immediately adjacent to Wianamatta South Creek, to the extent of the northern and southern boundaries of the AWRC site.

The VMP will be implemented following construction of Stage 1 of the AWRC. The ongoing management of the landscape is fundamental in creating and maintaining a safe environment within the AWRC site constraints and establishing a biodiverse environment supporting networked systems using endemic native species.

The VMP identifies post construction activities that ensure design intent and compliance with relevant approvals has been achieved. This VMP documents a standardised approach to the maintenance of landscape plantings and re-vegetation works, both in technique and frequency.

Stage 2 is proposed to be completed by 2035 with the space required for the potential future expansion allowed for within the AWRC Operational site. Outside of the AWRC Operational site and VRZ, is 38 hectares of green space and a potential Circular Economy Zone. Figure 4a provides an indicative representation of the stage development of the AWRC site.

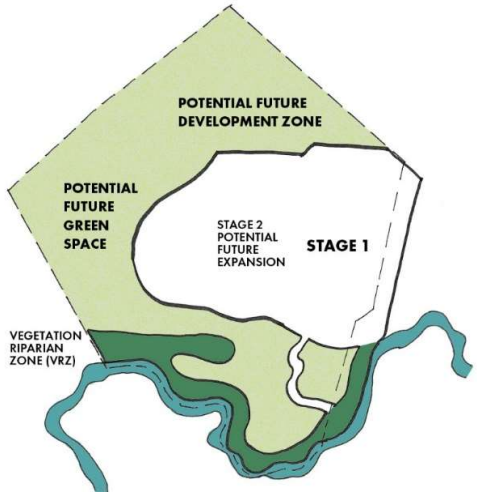


Figure 4 Staged Development of AWRC site

1.2.1 Where this Plan Applies

For clarity and to assist with implementation of the VMP, three distinct landscape zones have been established as detailed below and are presented in Figure 5Figure 4**Error! Reference source not found.**.

Zone 1: Operations Zone

The treatment plant zone, access road, fire trails and overland flow swale. Refer to Appendix B of the UDLP, Landscape Management Plan (LMP).

Zone 2: Wianamatta South Creek Zone

The restored areas adjoining Wianamatta South Creek and billabongs, documented in this VMP (Appendix A of the UDLP).

Zone 3: Potential Future Greenspace

Future master planning of the Greenspace and the Circular Economy Zone is proposed, and the landscape management of these areas will need to be reevaluated should any development occur.

This VMP applies to Zone 2 and is reflected in Figure 5 below. Use of this zoning in this document is consistent with the LMP to assist with the identification of and reference to zones to understand relevant landscape management requirements, and maintenance requirements.

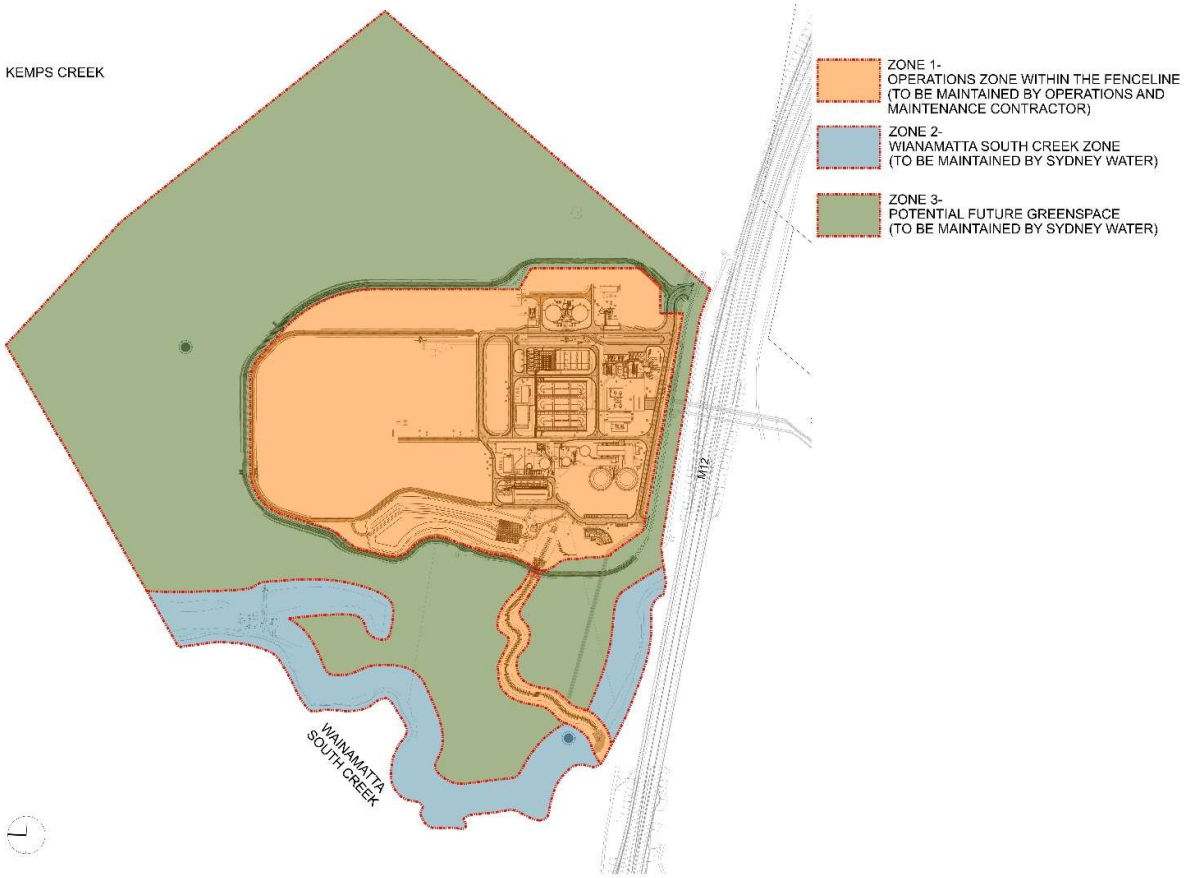


Figure 5 Landscape Management Zones

1.3 Key terms

The following terminology has been adopted for the preparation of this VMP:

- Study area: the extent of the land within the AWRC site boundary (Lot211 DP1272676), including the area of the site to be developed, specifically the construction of the Stage 1 works, including new roads, new infrastructure, buildings, ancillary development, and landscaping associated with the treatment plant. This area is outside the scope of this VMP and is visually presented in Figure 6.
- VMP area: the proportion of the site to be conserved and managed by this VMP; land adjacent to and along the Wianamatta South Creek corridor. Refer to Figure 6.
- Riparian corridor: a transition zone between the land (terrestrial environment) and the river or watercourse (aquatic environment). The riparian corridor consists of the:
    - channel comprises the bed and banks of the watercourse (to the highest bank).
    - Vegetated Riparian Zone (VRZ) adjoining the channel.
- Vegetated Riparian Zone (VRZ): vegetated buffer with a predetermined width based on the stream order and measured from the top of the highest bank of the watercourse.

1.3 Objectives

The overall objective of this VMP is to provide a management framework that will guide the rehabilitation, revegetation, and regeneration of the Cumberland Swamp Oak Riparian Forest vegetation within the Cumberland Plain Woodland along the Wianamatta South Creek corridor. To accomplish this objective, the following measures have been addressed within this VMP:

- Understanding the existing environment.
- Management of construction impacts.
- Identification of vegetation management zones.
- Implementation.
- Monitoring strategies and reporting.

1.3.1 Legislations, standards, guidelines and other references

The Minister of Planning gave the works consent under Section 5.19 of the Environmental Planning and Assessment Act 1979. The Conditions of Approval specific to the project and relevant to this VMP are listed below in Table 1, along with a reference to what stage and where each condition will be addressed within the relevant chapter of the VMP.

The conditions listed in Table 1 are a mixture of direct and indirect requirements the project will implement to achieve the required urban design and landscaping outcomes.

Table 1: Conditions of Approval relevant to this VMP

ID	Condition of Approval	Reference to the relevant Chapter of VMP
E23	Reuse of native vegetation and other habitat features Stage 1 of the CSSI must maximise the reuse of native vegetation and other habitat features that have been approved for removal. Where reuse by the CSSI is not possible, relevant council(s), NSW National Parks & Wildlife Service, Western Sydney Parklands Trust, Greater Sydney Local Land Services, local Landcare groups, DPI Fisheries and any additional relevant government agencies must be consulted before the removal of vegetation and other habitat to determine if: a. hollows, tree trunks (greater than 25-30 centimetres in diameter and 2-3 metres in length), mulch, bush rock and root balls salvaged from native vegetation impacted by the CSSI; and b. collected plant material, seeds and/or propagated plants from native vegetation impacted by the CSSI, could be used by others in habitat enhancement and rehabilitation activities, before pursuing other disposal options. If the native vegetation and other habitat features can be reused by others, the Proponent must advise them and facilitate access for salvage.	Section 4.1.6
E64 g)	Urban Design Landscape Plan (UDLP) The UDLP must document how the following matters have been considered in the design and landscaping of the project:	
	- Vegetation management that considers the principles of Guidelines for Vegetation Management Plans on Waterfront Land (NSW Office of Water, DPI 2012)	Section 2.2
	- Draft Western Sydney Aerotropolis Riparian Revegetation Strategy.	Section 2.3
	- Riparian Revegetation Strategy in Section 4 of the Western Sydney Aerotropolis (Initial Precincts) Riparian Corridors Assessment by Sydney Water (December 2021)	Section 5.1
E65 e)	The UDLP must include descriptions and visualisations (as appropriate) of: Details of strategies to rehabilitate, regenerate or revegetate disturbed areas with local native species.	Section 5.1 and 5.2

1.4 Implementation

A suitably qualified and experienced bush regeneration contractor must implement this VMP and use best practice techniques. They should be members of the Australian Association of Bush Regenerators (AABR) or possess the required qualifications and experience for membership. In addition, team leaders should have a minimum Certificate III in Conservation & Land Management or equivalent.

1.4.1 Considerations of Climate Change in Rehabilitation

In southern Australia, climate projections suggest that hot days will become hotter and more frequent, rainfall will decrease, droughts will increase, harsher fire weather will occur, and extreme rainfall events will become more intense (CSIRO & BOM 2022).
Management actions detailed in this VMP have been designed to maximise the resilience of re-vegetated areas to climate change as much as possible:

- Using local seed banks to propagate plants that will be best adapted to local conditions.
- Using species and densities consistent with plant community types that have been removed.
- Specifying performance criteria that ensure the regenerated areas meet suitable benchmarks to restore the ecological integrity of the communities.
- Consideration of fauna habitat restoration to attract wildlife that will be integral in creating resilient ecosystem functioning.
- Compliance with the aims and objectives of the NSW Rural Fire Service's Planning for Bush Fire Protection (PBP) 2019 and Australian Standard 3959 (Sydney Water 2021b)
- Ensuring adequate watering occurs during the establishment phase based on the prevailing weather conditions.
- Continued watering through the maintenance phase to support the survival and successful establishment of young plants during times of limited resources and stress (Section 3.5).
- Weed control in both the establishment and maintenance phases to maximise survivorship of installed plants and minimise competition for resources from weeds.

2 Methodology

2.1 Literature review

To prepare this VMP, a literature review involved a variety of sources, including government fact sheets and websites. A desktop review of aerial photography and spatial datasets was also conducted for components relating to the VMP area. Species planting lists for revegetation were reviewed in conjunction with a review of field survey data. Key documents included:

- Upper South Creek Advanced Water Recycling Centre Biodiversity Development Assessment Report (Biosis, 2021).
- Controlled activities – Guidelines for vegetation management plans on waterfront land - Fact sheet (Department of Planning and Environment, 2022).
- Western Sydney Aerotropolis Development Control Plan 2022 (Department of Planning and Environment, 2022).
- Greater Sydney Regional Strategic Weed Management Plan 2017-2022 (NSW Greater Sydney Local Lands Service, 2019)
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – profile (NSW Office of Environment and Heritage 2023).
- Western Sydney Aerotropolis (Initial Precincts) – Riparian Corridors Assessment Final Report (Sydney Water, 2021).
- Soil Re-Use Assessment and Advice – Advanced Water Recycling Centre (AWRC) (SESL Australia, 2023).

2.2 Determination of stream order and Vegetated Riparian Zone Widths

The Wianamatta South Creek corridor is a floodplain with a network of perennial and intermittent flowing tributaries that collectively drain into the more extensive Hawkesbury-Nepean River system. The Wianamatta South Creek catchment has been classified according to the Strahler Stream Classification system recognised in the Water Management Act 2000 (WM Act 2000). This method sets riparian corridor widths and uses an 'order' to reflect the number of tributaries associated with each watercourse. The Wianamatta South Creek corridor is a sixth-order stream (which indicates that five other tributaries flow into it).

A Vegetation Riparian Zone (VRZ) should be established based on the watercourse order classified under the Strahler System of ordering watercourses. Therefore, the Wianamatta South Creek VRZ for this VMP has been determined as 40 metres wide and measured from the top of the highest bank of the watercourse.

2.3 Western Sydney Aerotropolis (Initial Precincts) Riparian Revegetation Strategy

The waterways of the Wianamatta South Creek catchment are highly vulnerable to the impacts of urbanisation, and agricultural land uses. The Riparian Revegetation Strategy (RRS) for the Western Sydney Aerotropolis Initial Precincts seeks to extend and strengthen the Aerotropolis green-blue grid and achieve landscape-scale integrated water and waterway outcomes, strategic native revegetation of VRZs of Wianamatta South Creek and its tributaries is required to protect and restore sensitive riparian areas.

In particular, the RRS aims to identify strategies for enhancing, protecting, and maintaining waterways, riparian corridors, and water-dependent ecosystems. It aims to stabilise waterways, enhance, and protect native riparian and floodplain ecology and create VRZs that support waterway health and social objectives.

Figure 6 Study area

3 Description of the environment

3.1 Location

The study area is six kilometres northeast of the Western Sydney (Nancy Bird Walton) Airport. The Wianamatta South Creek corridor forms the site's western boundary, while Kemps Creek is along the north-eastern border. These waterways include part of the Hawkesbury-Nepean catchment and are integral to Western Parkland City. The proposed M12 Motorway will run along the southern edge of the study area. The study area comprises a flat, cleared pastoral landscape with few remnant trees.

The proportion of the site to be conserved and managed by this VMP is the area of land adjacent to and along the Wianamatta South Creek corridor. Refer to Figure 5.

3.2 Existing environment

3.2.1 Bioregion

The study area occurs within the Sydney Basin IBRA bioregion and Cumberland IBRA subregion. The Sydney Basin Bioregion lies on the central east coast of NSW and covers an area of approximately 3,624,008 hectares. It occupies about 4.53% of NSW and is one of two bioregions within the state.

The Cumberland IBRA subregion covers a 275,693-hectare area containing the Cumberland Plain, a broad shale basin in Western Sydney.

3.2.2 NSW (Mitchell) Landscapes

The study area spans two Mitchell Landscapes from the Sydney Basin Bioregion, including the Cumberland Plain and Hawkesbury-Nepean Channels and Floodplains.

The Cumberland Plain Landscape comprises low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast on horizontal Triassic shales and lithic sandstones forming a down-warped block on the coastal side of the Lapstone monocline. Intruded by several volcanic vents and partly covered by tertiary river gravels and sands (Hawkesbury-Nepean Terrace Gravels landscape). It comprises quaternary alluvium along the main streams. The general elevation is 30 to 120 metres, local relief 50 metres, and sometimes affected by salt in tributary valley floors. Soil pedology is uniform with red to brown clays on volcanic hills, with red and brown texture-contrast soils on crests grading to yellow harsh texture-contrast soils in valleys.

The Hawkesbury-Nepean Channels and Floodplains typically comprise meandering channels and moderately vast floodplains of the Hawkesbury and Nepean rivers on Quaternary sand and gravel. Sand is dominant upstream of the Warragamba River junction, with a general elevation of 0 to 20m and local relief.

3.2.3 Soil

The AWRC is in the Wianamatta South Creek Alluvial soil landscape, characterised by floodplains, valley flats and drainage depressions (>5%) on the flat, incised channels of the Cumberland Plain with local relief of 10 metres. Soils consist of deeply layered sediments over bedrock comprising structured plastic clays or structured loams in or adjacent to drainage lines, red and yellow podzolic soils on terraces, usually in combination with patchy structured grey clays, leached clay, and yellow formerly saline soils. Soils exhibit low fertility, are strongly acidic, have hard-setting surfaces, poor drainage, and are susceptible to extreme erosion. Vegetation associated with this soil landscape consists of riparian forests and wetlands.

The Soil Re-Use Assessment and Advice provided by SESL Australia (see Appendix D) identifies alluvial topsoil resource was observed that extends beyond the depth of investigation alongside the South Creek area. This area should be managed in a manner that allows for this material to be exploited and re-used as topsoil, such as through revegetation with riparian species.

Topsoil is generally low in organic matter, with acidic pH conditions and high magnesium. Sodic conditions and dispersion are typically not observed in the topsoil. Nitrogen, phosphorus, and potassium are generally low and will require amendment. The overall limitations that will require amendment is the acidic pH, poor cation balance and low nutrients. Manganese (Mn) is also high in all samples, likely due to the regular flooding that is experienced in the area, manganese toxicity will likely be seen if not managed correctly.

Cumberland Plain woodland species are Mn tolerant and are suitable to this landscape which may become waterlogged from rainfall or flooding.

3.3 Vegetation communities

The USC AWRC Biodiversity Development Assessment Report (Biosis, 2021) identified three Plant Community Types (PCTs) in the study area, as summarised in Table 2 below.

These vegetation zones are presented in Figure 8. Clearing of some of these PCTs has occurred within the study area to enable commencement of construction within the plant operational zone, including:

- PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion – Thinned
- PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion - Scattered Trees
- PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion - Scattered Trees

Table 2: Summary of PCTs within the study area

PCT ID	PCT NAME	COMMON NAME	CONDITION	EPBC Act TEC	BC Act TEC
835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	**Cumberland River-flat Forest**	Thinned, scattered trees	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (CEEC)	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin, and South East Corner Bioregions (EEC)
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	**Cumberland Shale Plains Woodland**	Scattered trees	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CEEC)	Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)
1800	Swamp Oak open forest on river-flats of the Cumberland Plain and Hunter Valley	**Cumberland Swamp Oak Riparian Forest**	Thinned, scattered trees	Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (EEC)	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin, and South East Corner Bioregions (EEC)

PCT 835: Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

Patches of this community occur within the study area and comprise scattered trees in regions of clearing or grazing. Typically, this scattered condition contains a native canopy, absent mid-storey and low cover of native species within the understorey. However, thinned areas of this PCT also occur in areas subject to historical clearing and grazing, containing a native canopy and an underdeveloped native mid-storey and understorey.

This PCT occurs as an open Eucalypt Forest on alluvial flats of rivers, streams, and creeks with a canopy of Rough-barked Apple (*Angophora floribunda*), Broad-leaved Apple (*Angophora subvelutina*), Cabbage Gum (*Eucalyptus amplifolia*) or Forest Red Gum (*Eucalyptus tereticornis*). In addition, this community contains a mid-storey *Melaleuca* spp. and *Acacia* spp., with an understorey of Blackthorn (*Bursaria spinosa*) and abundant grasses and forbs.

PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

Patches of this community occur within the study area and comprise scattered trees in regions of clearing or grazing. Typically, this scattered condition contains a native canopy, absent mid-storey and low cover of native species within the understorey. However, thinned areas of this PCT also occur in areas subject to historical clearing and grazing, containing a native canopy and an underdeveloped native mid-storey and understorey.

This PCT occurs as an open grassy woodland on gently undulating plains with a canopy of Grey Box (*Eucalyptus moluccanna*) and Forest Red Gum (*Eucalyptus tereticornis*), with subdominant species such as Narrow-leaved Ironbark (*Eucalyptus crebra*) or Red Ironbark (*Eucalyptus sideroxylon*) and occasional Spotted Gum (*Corymbia maculata*) over an understorey containing a sparse cover of shrubs and abundant grasses and forbs.

PCT 1800 Swamp Oak open forest on river-flats of the Cumberland Plain and Hunter Valley

Patches of this community occur within the study area along the banks of the Wianamatta South Creek corridor, and this PCT will be established as part of this VMP. The PCT comprises scattered trees in a densely spaced canopy of Swamp Oak (*Casuarina glauca*), an absent mid-storey and an understorey dominated by exotic weed species and pastoral grasslands interspersed with scattered native grasses and forbs. Thinned areas of this PCT are a densely spaced canopy of Swamp Oak (*Casuarina glauca*) over an absent mid-storey of shrubs and a slightly disturbed understorey of native grasses and forbs.

This PCT occurs on the river-flats of the Cumberland Plain as a stand of Swamp Oak (*Casuarina glauca*) with occasional Rough-barked Apple (Angophora floribunda), Forest Red Gum (*Eucalyptus tereticornis*) and Grey Box (*Eucalyptus moluccanna*). The mid-storey typically includes White-feather Honey Myrtle (*Melaleuca decora*), Prickly-leaved Paperbark (*Melaleuca styphelioides*), Blackthorn (*Bursaria spinosa*), White Sally (*Acacia floribunda*), and Crimson Bottlebrush (*Callistemon citrinus*).

The understorey contains Spiny-headed Mat-rush (*Lomandra longifolia*), Cockspur Flower (*Plectranthus parviflorus*), Native Wandering Jew (*Commelina cyanea*), Wonga Wonga Vine (*Pandorea pandorana*), Headache Vine (*Clematis glycinoides*), Berry Saltbush (*Atriplex semibaccata*), Knotweed Goosefoot (*Einadia polygonoides*), Tussock Grass (*Poa labillardierei*), Weeping Grass (*Microlaena stipoides*) and Swamp Dock (*Rumex brownii*).

One PCT dominates the VMP area as listed below and is presented in Figure 7:

- PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley - Thinned
- PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley - Scattered Trees

Figure 7 Site photograph of an existing stand of Cumberland Swamp Oak Riparian Forest

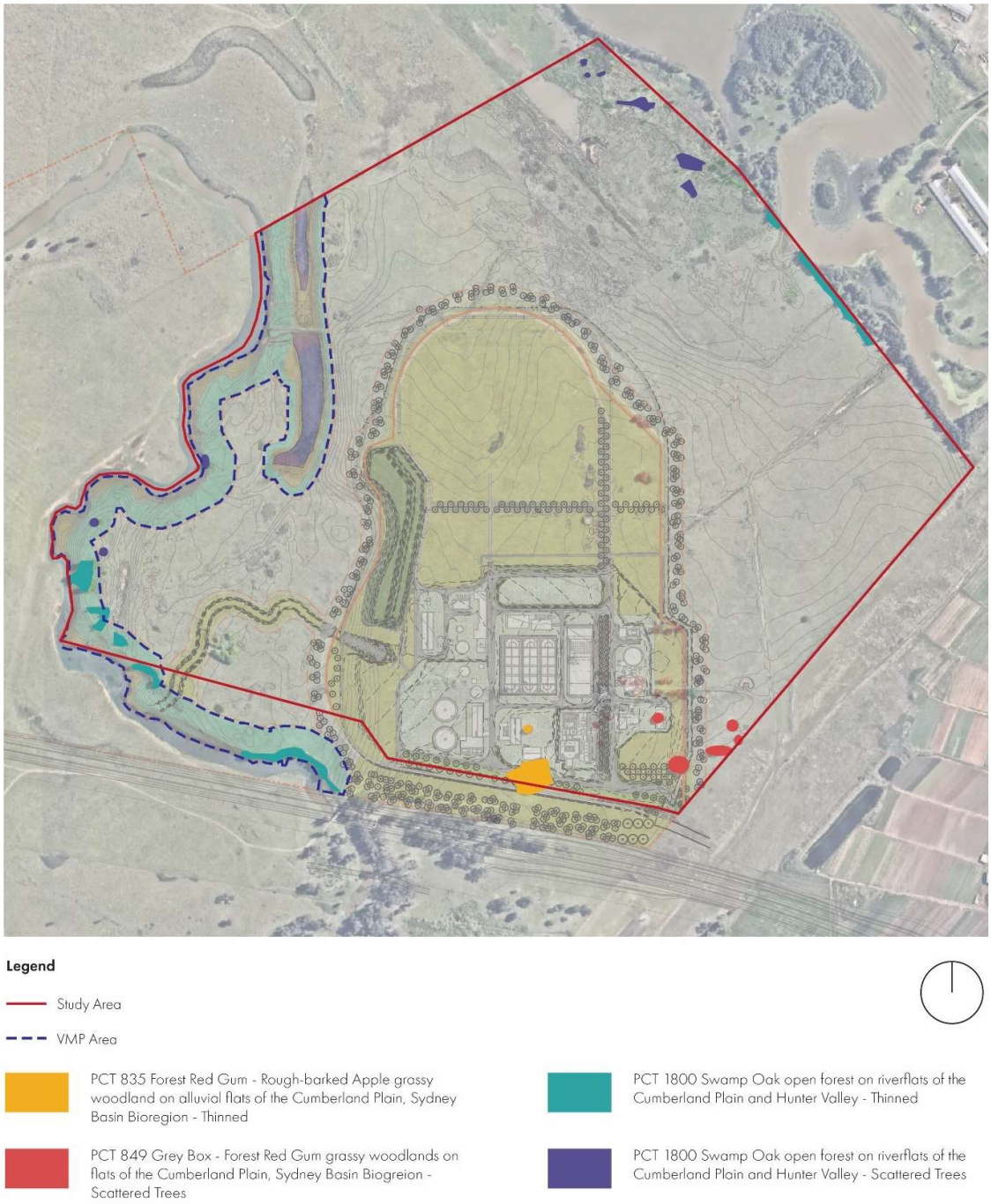


Figure 8 Vegetation communities within the VMP area and broader study area.

3.4 Weeds

The Biosecurity Act 2015 (BA Act) and regulations provide specific legal requirements for state-level priority weeds. Under the BA Act, all plants are regulated with a general biosecurity duty to prevent, eliminate, or minimise any biosecurity risk they may pose. In addition, any person who deals with any plant, who knows (or ought to know) any biosecurity risk, must ensure the risk is prevented, eliminated, or minimised so far as is reasonably practicable.

Specific legal requirements apply to State determined priorities under the Greater Sydney Regional Strategic Weed Management Plan 2017-2022, while regional preferences include outcomes to demonstrate compliance with the general biosecurity duty and strategical responses in the region to achieve relevant management objectives (Great Sydney Local Land Services 2017).

Initial weed mapping has been undertaken by AMBS Ecology and Heritage at the AWRC site, inclusive of the riparian corridor. The mapping undertaken thus far is to assist with the development of the landscape design and subcontract package for landscaping works and pending timing of the commencement of landscaping works, may need to be refreshed by a suitably qualified ecologist at a later time to ensure consistency with the requirements specified in the Weed and Pathogen Management Procedure. A copy of the weed mapping provided by AMBS Ecology and Heritage is provided in Appendix E.

All priority weeds listed in Table 3 below and those weeds identified as High Threat Weeds (HTW), Weeds of National Significance (WOFS) & Priority Weeds identified in the John Holland Weed Mapping Report (Appendix E) are to undergo initial primary treatment and clearance inspections as per the Weed and Pathogen Management Procedure within the Project Biodiversity CEMP Sub-Plan. All high and moderate priority weeds as defined in the Weed and Pathogen Management Procedure will be maintained to a maximum of 10% Percent Foliage Cover (PFC) during the installation, establishment and maintenance periods.

Alligator weed has been identified in the Billabongs within the Project boundary. However, due to the complex biotic environment of the billabongs located on the Project site; primary treatment won't be undertaken. As per Appendix J of the Project EIS (Table 55; Priority weeds within the impact assessment area) the Project is not required to eradicate Alligator Weed from the site. However, the Project is required to prevent any spread of weeds from the Project Boundary where feasible and mitigate the risk of new weeds being introduced to the site. To mitigate the further spread of weeds within the billabong, including Alligator weed, the Project will undertake localised planting on the banks and surrounding areas of the billabongs to prevent the spread or growth of priority weeds.

The control of weeds is required throughout all onsite activities. Wash-down of equipment and vehicles directly involved in vegetation clearing, i.e. mulchers, before and after use is necessary to minimise the introduction and spread of weed propagules. General vehicles which come in and out each day (LVs) do not need to be washed every time, unless they have observed excessive dirt, mud, weed/ seed build up. According to best management practices, all weeds must be treated before becoming an environmental threat. The *Weed and Pathogen Management Procedure* is provided within the Project Biodiversity CEMP Sub-Plan. The weed pre-clearance assessment methodology will be provided to the landscape subcontractor.

Table 3: Priority weeds and weeds of National Significance identified within this VMP

Botanical Name	**Common Name**
Alternanthera philoxeroides	Alligator Weed
Anredera cordifolia	Madeira Vine
Asparagus aethiopicus	Ground Asparagus
Asparagus asparagoides	Bridal Creeper
Cestrum parqui	Green Cestrum
Lantana camara	Lantana
Lycium ferocissimum	African Boxthorn
Nassella neesiana	Chilean Needle Grass

Botanical Name	Common Name
Olea europaea subsp. cuspidata	African Olive
Opuntia stricta	Common Pear
Rubus fruticosus	Blackberry
Salvinia molesta	Salvinia
Senecio madagascariensis	Fireweed

4 Construction and preliminary works

4.1 Management of construction impacts

Construction management action to be undertaken by the principal contractor John Holland (JHG) are provided below.

4.1.1 Edge effects

The management of edge effects will focus on buffering the existing native vegetation to be retained from construction impacts. This will include:

- Fencing off retained areas of native vegetation during construction to ensure no impacts from machinery.
- Sediment and erosion control.
- Weed control.
- Revegetation activities will focus on lining isolated vegetation stands with planting.

4.1.2 Temporary construction fencing

All native vegetation to be retained (existing Casuarina spp.) within the VMP area will require the installation of temporary fencing or flagging to ensure construction activities do not impact these conservation areas. Temporary fencing or flagging is to be used to mark vegetation management zones as directed by JHG.

4.1.3 Pest Control

A pest control program for the site should be implemented based on identification of pests during monitoring activities (Section 7). If rabbit warrens, foxes, and other pests are identified, fumigation will occur. This is to be undertaken in consultation with Local Land Services. The site is to be constantly monitored for evidence of pest activity. Monitoring will occur during the establishment and maintenance periods. Any damage by pests, primarily due to grazing young plants, will require rectification. Whilst no pest activity was observed on site during the various field inspections it is recommended that a provisional cost item of $10,000 is budgeted for pest control.

4.1.4 Erosion and sediment control

Work associated with the VMP will be managed in accordance with the Construction Environmental Management Plan (CEMP) that has been developed and implemented for the Upper South Creek project.
As part of the CEMP, a site-specific Erosion and Sediment Control Plan (ESCP) will be prepared and implemented before any ground-disturbing VMP works occur.

4.1.5 Soil management

To avoid the spread of soil-borne pathogens, appropriate hygiene procedures will be followed, including but not limited to the following:

- Ensure all clothing, hats, footwear, tools, equipment, machinery, and vehicles are free of soil, and organic matter before entering and exiting bushland.
- Ensure any soil, plants or other materials entering the site are free of weeds and pathogens.
- All works will be implemented in accordance the Project approved construction environmental management plans, with specific reference to the Biodiversity CEMP sub-plan, including Appendix B of the sub-plan Weed and Pathogen Management Procedure.

4.1.6 Watering program

Watering of the planting works will be undertaken to ensure that an adequate survival and establishment rate is achieved. Watering is to abide by any local authority water restrictions or guidelines.

Watering of all planting will occur at the time of the planting itself, to minimise shock on the tubestock in their new conditions. Ongoing watering of stock will be on an as required basis.

The frequency of watering to achieve plant establishment will depend on the prevailing climatic conditions at the time of planting and thereafter. Watering will generally be carried out in the cooler hours of the day (morning or afternoon) and will be frequent enough to prevent wilting of plants. Tubestock is to be watered prior to planting as well as immediately after planting installation.

During the establishment and maintenance phases the following watering program is recommended (dependent on weather) in Table 4.

Table 4: Watering Program

Phase	Implementation				Establishment	Maintenance	
Timing	Week 1	Week 2-4	Months 2-5	Months 5-6	Months 6-12	12-18 Months	18-36 Months
Frequency	Daily	Weekly	Fortnightly	Monthly	Monthly	Monthly	Monthly
Per m2 of VMZ	6 Litres	6 Litres	30 Litres	30 Litres	30 Litres	30 Litres	30 Litres
Note Watering **ONLY** to occur post 18 months if periods of prolonged dry and hot weather are experienced in excess of one (1) month.*							

The necessity for watering during the above program will be dependent upon rainfall. The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after period of 4 to 6 months the planting will be sufficiently established such that watering will no longer be required. Watering across the three zones will also be variable based on site conditions at each location. Planting closer to the water edge will require less watering. This will be implemented from a water cart/trailer with hose, no irrigation system will be installed.

Planting areas are to be monitored during the maintenance period to ensure that climatic conditions are not negatively affecting the newly planted tube stock. If climate or environmental conditions are affecting the tube stock a watering program may be reinstated pending the approval by the environmental manager.

4.1.7 Reuse of native vegetation and other habitat features

Habitat features such as tree hollows and logs have been salvaged from clearing the Operational Zone and stockpiled for future use. Habitat features are to be stored until landscape implementation. Storage has been undertaken within designated stockpile areas, with onsite contractors made aware that material is to be retained to prevent loss of stored habitat features before utilisation. Logs and root balls from several *Melaleuca nodosa* species were kept for habitat features, as well as *Eucalyptus parramattensis*, *Melaleuca armillaris*, *Eucalyptus tereticornis*, and *Eucalyptus punctata*.

Placing salvaged items within the subject site will increase the fauna habitat complexity as such items are used by various invertebrate and vertebrate species as microhabitat areas. Locations of salvaged tree hollows and logs are shown below in Figure 9. Habitat features will be relocated located within landscape areas as directed on site by the Environmental personnel. Additional images of stockpiled logs and root balls can be found in Appendix C.

Figure 9 Salvaged logs and root balls

Stored habitat features placed along the creek bank will be identified prior to rehabilitation works commencing and is to be completed by the project fluvial geomorphologist, to ensure placement of materials will not create localised downstream impacts to bank stability. The placement of logs and habitat features will be identified prior to installation of new plantings in coordination with the landscape contractor and project ecologist/fluvial geomorphologist. They may also be used to create fish habitat along stable and accessible sections of the creek where deemed possible.

4.1.8 Seed already collected from site

Seed collection in bushland areas within the AWRC site boundary has been undertaken by Muru Mitigar, specialising in growing endemic native plants from seeds collected in bushland areas. Two-thousand *Melaleuca decora* seeds collected by Muru Mitigar is proposed to be germinated, supplied and planted as part of the VMP. The collection, germination and on-site installation of seeds, salvaged logs and root balls meets the Minister's Conditions of Approval E23 to re-use native vegetation and other habitat features.

4.1.9 Local Provenance Species

A licensed bushland regeneration contractor or a landscaper can undertake this work. Seed collection visits should occur in each season across the study area to obtain a seed collection from as many native species as possible, as flowering and seed setting times vary with species, or until a time when adequate seeds have been collected. The seed may be collected from all strata, including grass and herb species, where possible. In addition, during clearing supervision works, the ecologist may collect any seed present on felled trees to be passed on to the bushland regeneration contractor or nursery staff.

Seeds collected will be germinated and grown in a nursery for later planting during bushland restoration works within the VMP area. If the requisite quantum of seeds cannot be collected on-site, then seeds may be collected in the first instance within ten kilometres of the site. If it can be shown that all reasonable steps have been taken to source from this radius unsuccessfully, then a larger area can be utilised provided:

- Seeds are sourced from the Cumberland IBRA subregion; and
- Seeds are from species listed in Tables 7, 12 and 14; or
- Seeds are from species known to occur within the Cumberland Swamp Oak Riparian Forest.
- Requirements:
    - Qualifications and experience of contractors.
    - Certification of seed and local provenance stock.

4.1.10 Vegetation Management Types

The VMP area will undergo two types of vegetation management to rehabilitate the Cumberland Swamp Oak Riparian Forest:

1. **Revegetation works** aim to actively manage weed control, manage causes of degradation, and reintroduce endemic plants.
2. **Regeneration works** aim to rehabilitate an area from a weed affected or otherwise degraded state to a healthier community of native plants and animals.

Specific revegetation and regeneration works that will be undertaken as part of this VMP is outlined in Section 5.

5 Vegetation management zones

5.1 Vegetation management zones

The VMP encompasses the area east of the Wianamatta South Creek corridor. Three vegetation management zones have been identified based upon the works required as indicated in Figure 10 and include the following:

- Management Zone 1: Revegetation of existing Cumberland Swamp Oak Riparian Forest
- Management Zone 2: Wianamatta South Creek Embankment Revegetation
- Management Zone 3: Wianamatta South Creek Edge Revegetation

The objectives of these management zones are to achieve a recordable net ecological gain through the Biodiversity Assessment Method and:

- Control and manage exotic weed species.
- Maximum 10% exotic species Percent Foliage Cover (PFC) to be achieved over the entire VMP area during the establishment and maintenance works.
- 80% survival rate of all plant material.
- Retain native, remnant elements of the degraded Cumberland Swamp Oak Riparian Forest where possible (existing trees to be retained and fenced are identified in the drawings to allow regeneration).
- Revegetate with a diverse array of native canopy trees, shrubs, and groundcovers of the Cumberland Swamp Oak Riparian Forest.
- Revegetation and regeneration work to generate a quantifiable net ecological gain at the post-development site when compared to the pre-development study area.

5.2 Revegetation and Regeneration Works

This section provides details of revegetation and regeneration specific to the Cumberland Swamp Oak Riparian Forest.

The aim of the revegetation and regeneration works and vegetation to be retained is to achieve the following performance-based outcomes:

- Controlled threats impacting the health and future regeneration potential of native vegetation communities.
- Increased species diversity and percentage cover of planted native vegetation.
- Improved resistance of native vegetation to future weed establishment and related threats.
- Indicators show planting success and regeneration responses and have assisted in prioritising bushland regeneration works during the implementation program.
- An estimated 305,843 plants are to be installed as part of the proposed VMP works. In the event of plant loss, a nominated replacement stock of 10% of the total plants installed (30,584) has been calculated and should be sourced on top of the totals presented in Tables 7, 13 and 16.

5.2.1 Amelioration

Primary and Secondary amelioration for all areas of the VMP will be confirmed by more detail testing by the landscape contractor prior to construction and maintenance, to the approval of JHG.

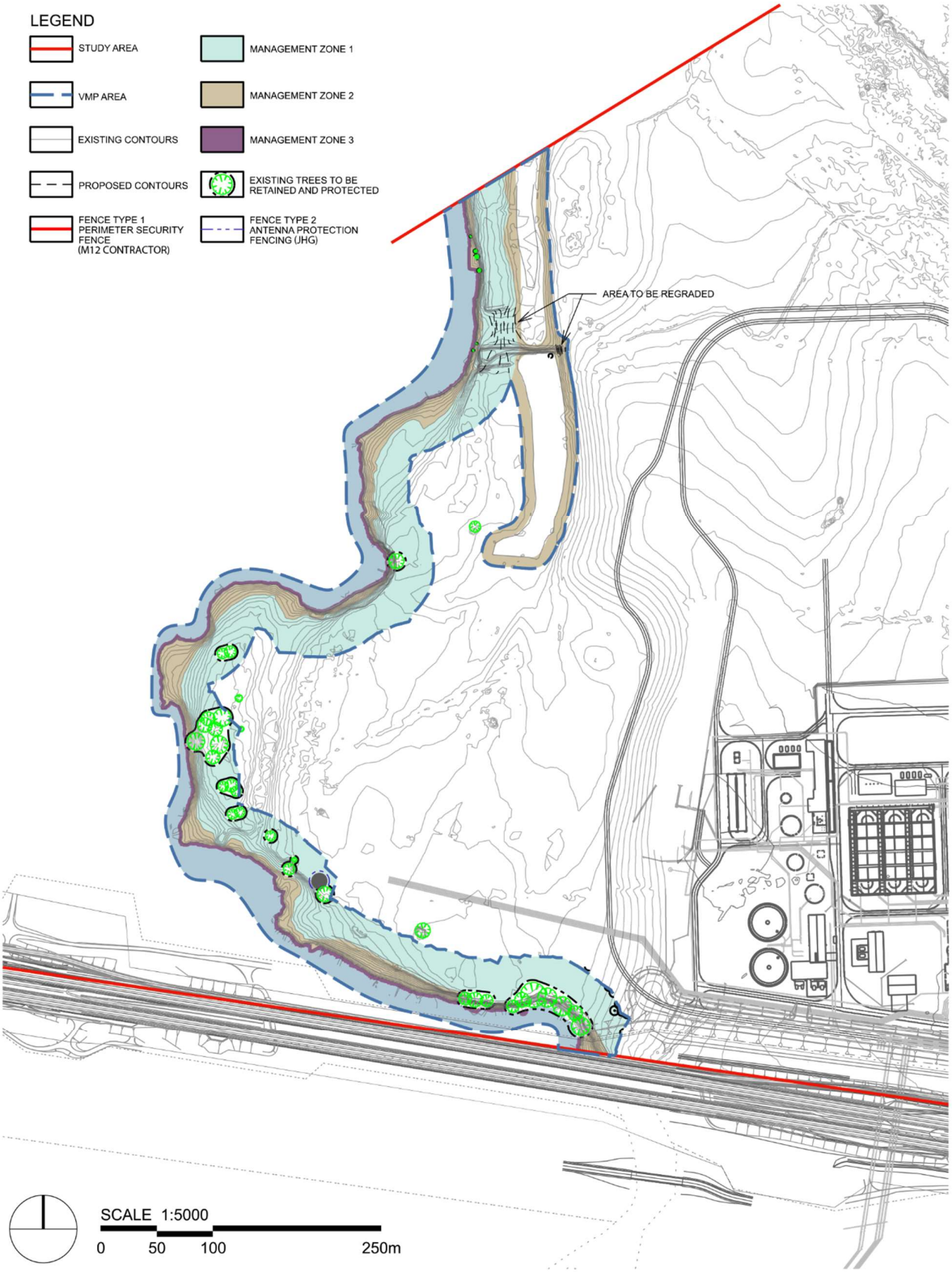


Figure 10 Vegetation Management Zones

5.2.2 Management Zone 1: Revegetation of existing Cumberland Swamp Oak Riparian Forest

Management Zone 1 encompasses the areas dominated by pastoral grasslands, interspersed with scattered Swamp Oak (*Casuarina glauca*), native grasses and forbs.

JHG has provided the methodology for weed removal, *Weed and Pathogen Management Procedure*, in the Project Biodiversity CEMP sub-plan. Additionally, weed pre-clearance assessments will need to be undertaken 1-3 months prior to the restoration works commencing. These pre-clearance reports will provide a more detailed and specific methodology for weed removal in each management zone. These assessments will be undertaken by the Project Ecologist and passed on to the landscape subcontractor.

This area will not undergo major earthworks. Cultivate existing topsoil to 200mm, see Tables 5 and 6 for Primary Amelioration Secondary Amelioration specifications below, more detailed testing by the landscape contractor to occur to determine if required. The biodiverse plant schedule for this management zone is listed in Table 7 below to meet the required ecological net gain. Hydro mulching may also be undertaken in this management zone as per the methodology proposed in section 5.2.4. below. The landscape contractor will advise on the best planting methodologies for this zone (i.e direct planting, hydro-mulching or a combination of both). Follow the watering regime provided below.

To align with the Aviation Safety Guidelines, the plant type selected for this site fosters microfauna biodiversity but will not cater to roosting large birds or attracting migratory birds. Tree species that produce berries have also been excluded from the planting schedule to further discourage larger bird flocks from residing in the area. This will reduce the risk of aviation bird strikes on site.

A typical example of the existing condition of Management Zone 1 is presented in Figure 11.

Primary Amelioration

For shrubs and smaller plantings, no subsoil treatment is required, and the top 200mm may be re-worked to improve soil conditions prior to planting. These areas do not require additional testing prior to re-working. Outlined in Table 5 below is the recommended primary amelioration for Management Zone 1 to be treated in-situ, subject to later and more detailed testing by the landscape contractor to determine if necessary.

Table 5: MZ1 Primary Amelioration Gypsum and Lime Rates

Landscape Treatment	Lime g/ m²	Gypsum g/ m²	Compost* %v/ v
Alluvial areas	100	200	20

All ameliorants are to be incorporated to a depth of 200mm.

*Compost must be compliant to AS4454 or equivalent.

Secondary Amelioration

Secondary amelioration involves the addition of fertilisers into the soil to improve the nutrient profile of the soils. SESL recommends that fertilisers are added shortly before topsoil is to be laid or just prior to planting to ensure the nutrients are utilised. See Table 6 below for fertiliser application rates.

Table 6: MZ1 Fertiliser Application Rates

Area	Fertiliser Addition
Alluvial	• For Non-P Sensitive Species, apply Nutricote Black (or similar CRF fertiliser) at 5 g per planting hole • For P Sensitive Species, apply Nutricote Pink (or similar CRF fertiliser) at 5 g per planting hole

Controlled release fertilisers have been recommended at a low rate for the alluvial /riparian areas and the billabong region to avoid nutrification within the surrounding creeks.

Pre-Planting

Do not vary plant locations from those shown on the Drawings (Appendix A) unless otherwise directed by John Holland and the Landscape Architect. If it appears necessary to vary the locations and spacing to avoid service lines, or to cover the area uniformly, or for similar reasons, apply for directions.

Do not plant in unsuitable weather conditions such as extremes of heat or cold, wind or rain.

Plant roots should be free flowing, not pot-bound and strangled. If roots are not loose, before plants are installed all pot sizes should have their roots pruned with an appropriate, clean, sharp instrument to eliminate any root confusion occurring at edge of pot zone. This is especially relevant for large mature plantings and a case-by-case situation for tubestock.

Before planting begins, thoroughly water the plants and the planting area. Keep the area and plants moist during planting.

Tubestock and Forestry-tube Planting

Excavate a hole for planting each plant large enough to provide not less than 100 mm all around the root system of the plant for viro-tube and forestry-tubes, backfill with soil mixture.

When the hole appears to be the correct size, and not before, remove the plant from the container with minimum disturbance to the root system and place in its final position and to match adjoining finish ground levels.

Mulch Spreading

Mulch spreading may be undertaken in Management Zones 1. Care should also be taken to ensure any mulch spreading does not suppress any hydro-mulch seeding that may be applied in this zone.

Watering

Watering of the planting works will be undertaken to ensure that an adequate survival and establishment rate is achieved. Watering is to abide by any local authority water restrictions or guidelines. Watering of all planting will occur at the time of the planting itself, to minimise shock on the tube stock in their new conditions. Ongoing watering of stock will be on an as required basis.

The frequency of watering to achieve plant establishment will depend on the prevailing climatic conditions at the time of planting and thereafter. Watering will generally be carried out in the cooler hours of the day (morning or afternoon) and will be frequent enough to prevent wilting of plants. Tube stock is to be watered prior to planting as well as immediately after planting installation.

During the establishment phase the watering program in Table 4 is recommended (dependent on weather).

The necessity for watering during the above program will be dependent upon rainfall. The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after period of 4 to 6 months the planting will be sufficiently established such that watering will no longer be required.

Planting areas are to be monitored during the maintenance period to ensure that climatic conditions are not negatively affecting the newly planted tube stock. If climate or environmental conditions are affecting the tube stock a watering program may be reinstated pending the approval by the environmental manager.

Figure 11 Typical example of the existing condition of Management Zone 1

Table 7: Management Zone 1 Species List

MANAGEMENT ZONE 1: Revegetation of existing Cumberland Swamp Oak Riparian Forest Local provenance species from the Cumberland Swamp Oak Riparian Forest				Total Area (m^2)	34430
100mm MULCH OVER 150mm CULTIVATED SUBGRADE WITH TREE, SHRUB AND GROUNDCOVERS PLANTING MIX:					
CODE	**BOTANIC NAME**	**COMMON NAME**	**SIZE**	**PERCENTAGE**	**QUANTITY**
TREES to be planted at 10m centres					
ANG flo	*Angophora floribunda*	Rough-barked Apple	Forestry tube	4%	138
ACA par	*Acacia parramattensis*	Sydney green wattle	Forestry tube	4%	138
ANG sub	*Angophora subvelutina*	Broad leaved Apple	Forestry tube	4%	138
CAS gla	*Casuarina glauca*	Swamp Oak	Forestry tube	4%	138
EUC amp	*Eucalyptus amplifolia*	Cabbage Gum	Forestry tube	4%	138
EUC eug	*Eucalyptus eugenioides*	Thin-leaved Stringybark	Forestry tube	4%	138
EUC mol	*Eucalyptus molucanna*	Grey Box	Forestry tube	4%	138
EUC ter	*Eucalyptus tereticornis*	Forest Red Gum	Forestry tube	4%	138
MEL dec	*Melaleuca decora*	White-feather Honey Myrtle	Grown from on-site seed (provided by JHG)	60%	2063
MEL lin	*Melaleuca linariifolia*	Snow in summer	Forestry tube	4%	138
MEL sty	*Melaleuca styphelioides*	Prickly-leaved Paperbark	Forestry tube	4%	138
				Total Trees	**3443**

SHRUBS to be planted at 5m centres					
ACA flo	*Acacia floribunda*	White Sally	Forestry tube	10%	689
ACA fal	*Acacia falcata*	Sickle Wattle	Forestry tube	10%	689
ACA imp	*Acacia implexa*	Hickory wattle	Forestry tube	10%	689
BRE obl	*Breynia oblongifolia*	Coffee bush	Forestry tube	10%	689
BUR spi	*Bursaria spinosa subsp spinosa*	Blackthorn	Forestry tube	10%	689
CAL cit	*Callistemon citrinus*	Crimson Bottlebrush	Forestry tube	10%	689
DIL sie	*Dillwynia sieberi*	Sieber's parrot-pea	Forestry tube	10%	689
DOD vis	*Dodonaea viscosa subsp. angustifolia*	Sticky Hop-bush	Forestry tube	10%	689
IND aus	*Indigofera australis*	Native Indigo	Forestry tube	10%	689
OZO dio	*Ozothamnus diosmifolius*	Dogwood	Forestry tube	10%	689
				Total Shrubs	**6890**

FORBS, HERBS, AND GROUNDCOVERS to be planted at 1m centres					
CEN asi	*Centella asiatica*	Indian Pennywort	Viro Tube	6.25%	2152
COM cya	*Commelina cyanea*	Scurvy weed	Viro Tube	6.25%	2152
DIC rep	*Dichondra repens*	Kidney weed	Viro Tube	6.25%	2152
DIA lon	*Dianella longifolia var. longifolia*	Blue Flax-Lily	Viro Tube	6.25%	2152
EUN has	*Einadia hastata*	Saloop	Viro Tube	6.25%	2152
EIN nut	*Einadia nutans subsp. nutans*	Climbing Saltbush	Viro Tube	6.25%	2152
EIN pol	*Einadia polygonoides*	Knotweed Goosefoot	Viro Tube	6.25%	2152
ASP con	*Asperula conferta*	Common Woodruff	Viro Tube	6.25%	2152
EIN tri	*Einadia trigonos subsp. trigonos*	Fishweed	Viro Tube	6.25%	2152
GER sol	*Geranium solanderi var. solanderi*	Native Geranium	Viro Tube	6.25%	2152
LOB pur	*Lobelia purpurascens*	White root	Viro Tube	6.25%	2152
LOM fil	*Lomandra filiformis subsp. filiformis*	Wattle mat-rush	Viro Tube	6.25%	2152
LOM lon	*Lomandra longfolia*	Spiny-headed Mat-rush	Viro Tube	6.25%	2152
LOM mul	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush	Viro Tube	6.25%	2152
PLE par	*Plectranthus parviflorus*	Cockspur	Viro Tube	6.25%	2152
SOL pri	*Solanum prinophyllum*	Forest Nightshade	Viro Tube	6.25%	2152
				Total Forbs, Herbs, and Groundcovers	**34430**
CLIMBERS AND SCRAMBLERS to be planted at 10m centres					
BIL sca	*Billardiera scandens*	Apple Berry	Viro Tube	20%	688
CLE ari	*Clematis aristata*	Old Man's Beard	Viro Tube	20%	688
CLE gly	*Clematis glycinoides var. glycinoides*	Headache Vine	Viro Tube	20%	688
GEI cym	*Geitonoplesium cymosum*	Scrambling Lily	Viro Tube	20%	688

PAN pan	*Pandorea pandorana*	Wonga Wonga Vine	Viro Tube	20%	688
				Total Climbers and Scramblers	**3440**
GRASSES to be planted at 4/ m²					
AUS ram	*Austrostipa ramosissima*	Stout Bamboo Grass	Viro Tube	6.25%	8608
BOT mac	*Bothriochloa macra*	Red-leg Grass	Viro Tube	6.25%	8608
CHL ven	*Chloris ventricosa*	Plump windmill grass	Viro Tube	6.25%	8608
CYM ref	*Cymbopogon refractus*	Barbed Wire Grass	Viro Tube	6.25%	8608
DIC mic	*Dichelachne micrantha*	Shorthair Plumegrass	Viro Tube	6.25%	8608
ECH cae	*Echinopogon caespitosus var. caespitosus*	Tufted Hedgehog Grass	Viro Tube	6.25%	8608
ECH ova	*Echinopogon ovatus*	Forest Hedgehog Grass	Viro Tube	6.25%	8608
ENT mar	*Entolasia marginata*	Bordered Panic	Viro Tube	6.25%	8608
IMP cyl	*Imperata cylindrica*	Bladey Grass	Viro Tube	6.25%	8608
MIC sti	*Microlaena stipoides var. stipoides*	Weeping Grass	Viro Tube	6.25%	8608
OPL aem	*Oplismenus aemulus*	Basket Grass	Viro Tube	6.25%	8608
PAS dis	*Paspalidium distans*		Viro Tube	6.25%	8608
POA lab	*Poa labillardieriei var. labillardiere*	Tussock	Viro Tube	6.25%	8608
RYT cae	*Rytidosperma caespitosum*	Ringed Wallaby Grass	Viro Tube	6.25%	8608
SPO elo	*Sporobolus elongatus*	Slender Rat's Tail Grass	Viro Tube	6.25%	8608
THE tri	*Themeda triandra*	Kangaroo Grass	Viro Tube	6.25%	8608
				Total Grasses	**137720**

In the event of plant loss, a nominated replacement stock of 10% of the total plants installed has been calculated and should be sourced on top of the totals presented in Table 7 above.

5.2.3 Management Zone 2: Wianamatta South Creek Embankment Revegetation

Management Zone 2 includes riparian vegetation on the embankments of the Wianamatta South Creek below the 5-year flood zone and is adjacent to the existing ephemeral wetlands. The existing vegetation in this zone is in extremely poor condition with the creek banks heavily degraded and eroded.

The methodology for weed removal is in the Project Biodiversity CEMP sub-plan weed and pathogen management procedure. Additionally, weed pre-clearance assessments will need to be undertaken 1-3 months prior to the restoration works commencing. These pre-clearance reports will provide a more detailed and specific methodology for weed removal in each management zone. These assessments will be undertaken by the Project Ecologist and passed on to the landscape subcontractor.

To align with the Aviation Safety Guidelines, the plant type selected for this site fosters microfauna biodiversity but will not cater to roosting large birds or attracting migratory birds. Tree species that produce berries have also been excluded from the planting schedule to further discourage larger bird flocks from residing in the area. This will reduce the risk of aviation bird strikes on site.

Retain and protect existing *Casuarina spp.* Stabilise soil at the toe of the creek bank to prevent it from undermining and collapsing in on itself. Bank stabilisation can be achieved through re-planting of native species and application of jute mesh were practical. Log jams and root balls may also be used to create fish habitat along stable and accessible sections of the creek where deemed possible. Cultivate existing ground to 200mm, see Tables 8 and 9 for Primary and Secondary Amelioration specifications below, more detailed testing by the landscape contractor to occur to determine if required. Two planting methodologies are provided for this management zone: seeding (hydro-mulch) or direct planting with jute matting, specifications provided below. The subcontractor is to provide pricing for each method. The biodiverse planting palette, including trees, outlined in Table 12 for this management zone is specified to meet the required ecological net gain. Follow the watering regime provided below.

A typical example of the existing condition of Management Zone 1 is presented in Figure 12.

Restoration Actions & Regenerative Works

- Retain and protect existing *Casuarina spp*, refer to Figure 5.
- Stabilise soil at the toe of the creek bank through re-planting of native species and application of jute mesh where practical.
- Application of ameliorants, to be confirmed after testing.
- Install either of the following jute products where required on heavily eroded sections of the Management Zone:
    - An open weave jute mesh matting product (470 grams/square metre (gsm))
    - A 620 gsm slitted jute matting product.
    - Installation method to be confirmed with JHG prior to proceeding.
- Soil stabilisation with coir logs as specified (steep sections or surface water drainage lines) to arrest any potential surface erosion and instability post weed control activities.

Primary Amelioration

For shrubs and smaller plantings, no subsoil treatment is required, and the top 200mm may be re-worked to improve soil conditions prior to planting. These areas do not require additional testing prior to re-working. Outlined in Table 8 below is the recommended amelioration for Management Zone 2 to be treated in-situ, subject to later and more detailed testing by the landscape contractor to determine if necessary.

Table: 8 MZ2 Primary Amelioration Recommended Gypsum and Lime Rates

Landscape Treatment	Lime g/ m^2	Gypsum g/ m^2	Compost* %v/ v
Alluvial areas	**100**	**200**	**20**
Billabong areas	**240**	**300**	**NIL**

All ameliorants are to be incorporated to a depth of 200mm.

*Compost must be compliant to AS4454 or equivalent.

Secondary Amelioration

Secondary amelioration involves the addition of fertilisers into the soil to improve the nutrient profile of the soils. SESL recommends that fertilisers are added shortly before topsoil is to be laid or just prior to planting to ensure the nutrients are utilised.

Table 9: MZ2 Fertiliser Application Rates

Area	Fertiliser Addition
Alluvial and Billabong areas	• For Non-P Sensitive Species, apply Nutricote Black (or similar CRF fertiliser) at 5 g per planting hole

Controlled release fertilisers have been recommended at a low rate for the alluvial /riparian areas and the billabong region in order to avoid nutrification within the surrounding creeks.

Forestry-tube Planting (Trees)

Cut through the jute mat and excavate a hole for planting each plant large enough to provide not less than 100 mm all around the root system of the plant, backfill with soil mixture.

When the hole appears to be the correct size, and not before, remove the plant from the container with minimum disturbance to the root system and place in its final position and to match adjoining finish ground levels.

PLANTING METHODOLOGIES

Two methodologies for implementation have been identified and are to be priced separately.

Planting Methodology #1: Seeding

Hydro-mulching

The Contractor will ensure hydro-mulching shall be a slurry of water, organic mulch, seed, fertiliser, soil conditioners and binders homogeneously mixed in a purpose-built, truck-mounted tank.

The slurry shall be sprayed onto the site from the truck via a directional monitor and shall be pumped through extension hoses as necessary. The slurry shall bond to the soil surface providing an optimum medium for germination and even distribution of seed and fertilizer.

Hydro-mulching materials and seeds are to be sourced from an approved and recognized hydroseeding provider, nominally Spray Grass Australia (ph: 1300 754 102) or approved alternative.

The Contractor shall undertake the following operations with the following equipment and materials:

Hydro-mulch Equipment

Hydraulic equipment used for the application of the slurry of prepared wood pulp shall be of the "Finn Super Hydro-seeder" type, or equivalent. This equipment shall have a built-in agitation system and operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing not less than 16 kilos of fibre mulch, plus a combined total of 3.5 kilos fertiliser solids for each 400 litres of water. The slurry distribution lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic spray nozzles which will provide a continuous non-fluctuating discharge. The slurry tank shall have a minimum capacity of 6,825 litres and shall be mounted on a travelling unit, either self-propelled or drawn by a separate unit, which will place the slurry tank and spray nozzles within sufficient proximity to the areas being treated.

Materials

Provide Cellulose fibre mulch containing no germination- or growth-inhibiting factors. Ensure a constant texture which disperses evenly and remains suspended in agitated water. Provide with a temporary green dye and the percentage property analyses detailed in Table 10.

Table 10: MZ2 Hydro-mulch Properties

Property	Percentage/ Description
Moisture content	+/- 3 o.d. basis
Organic matter	99.2 +/- 0.8
Ash content	0.8 +/- 0.2
pH	4.8 +/- 0.5
Water-holding capacity	1150 minimum (gms of water per 100 gms of fibre)
Soil binder	Terra Control applied at 200 kg/ ha or approved equal
Fertiliser	Per recommendations in Table 9
Seed	As nominated in plant schedule in Table 11

Native seeds

Confirm with JHG's landscape contractor quantity of seeds to be used in hydromulch based on available native seed mix proposed at tender.

Slurry Preparation

Prepare the slurry at the project site by first adding water to the tank when the engine is at half-throttle. When the water level has reached the height of the agitator shaft, provide full recirculation, then add seed, fertiliser and soil binder into the mulch when the tank is 2/3 to 3/4 full. Commence spraying immediately when tank is full.

Application rates as follows:

Table 11: Slurry Application Rates

Property	Rate
Fibre	1500 kg/ ha
Binder	100 kg/ ha
Fertiliser	150 kg/ ha
Seed	100 – 400 kg/ ha – to be refined based on seed mix selected by Project

Application

Hydro-mulching shall not commence until all trees which occur have been planted. Apply sufficient water (to be defined by Landscape Subcontractor) to hydro-mulching areas to moisten upper layers of soil prior to application of slurry. Do not allow the surface to become overly saturated, or excessively dry prior to seeding. Verify that residual moisture lies within 25mm of the soil surface. Do not hydro-mulch during heavy rainfall events.

Apply the slurry spray with a visually uniform coat, using the green colour of the mulch as a guide.

Apply in a downward drilling motion with a fan stream nozzle, so that the slurry will penetrate the surface and by so doing mixing the slurry components into the soil allowing the fibres to build on each other until a good coat is achieved and the material is spread at equal rates.

Do not leave the hydro-mulch slurry in tank for more than 2 hours. Add 50% more of the originally specified seed mix to any slurry mix which has not been applied within the 2 hours after mixing. Add 75% more of the original seed mix to any slurry mixture which has not been applied 8 hours after mixing. Remove and dispose of offsite all mixture over 8 hours old.

Prevent overspray of slurry onto hardscape areas such as fences. Any overspray of mulch material on plants or tree stakes shall be immediately cleaned off by the Contractor.

The seedbed shall be watered as necessary after sowing to keep it moist until germination, and to produce a satisfactory sward.

The Contractor shall protect the newly sown areas against trespass and traffic until the grass is well established.

The Contractor shall allow for raking over and reseeding all areas where the grass seed fails to germinate within four to eight (4-8) weeks from the date of original seeding.

Irrespective of the time of year of sowing, all plants shall be maintained until a healthy, dense sward is achieved over the entire area.

Planting Methodology #2: Direct Planting

Either of the following jute products to be installed across steep and eroded areas of the management zone, confirm with JHG before proceeding.

- An open weave jute mesh matting product (470 grams/square metre (gsm))
- A 620 gsm slitted jute matting product.

Coir Logs

Product: EcoLog™ Coir log 300mm x 3.0m Product codes: 30-Coir COIRL3 or equal approved coir logs (coconut fibre logs).

38 x 38 x 900mm stakes. Use longer stakes in soft ground. Staking at minimum 800mm centers and 1500mm from coir log ends.

Mulch Spreading

Mulch spreading may be undertaken in Management Zones 2. Care should also be taken to ensure any mulch spreading does not suppress any hydro-mulch seeding that may be applied in this zone.

Pre-Planting

Do not vary plant locations from those shown on the Drawings (Appendix A) unless otherwise directed. If it appears necessary to vary the locations and spacing to avoid service lines, or to cover the area uniformly, or for similar reasons, apply for directions.

Do not plant in unsuitable weather conditions such as extremes of heat or cold, wind or rain.

Before plants are installed all pot sizes shall have their roots pruned with an appropriate, clean, sharp instrument to eliminate any root confusion occurring at edge of pot zone.

Before planting begins, thoroughly water the plants and the planting area. Keep the area and plants moist during planting.

Forestry-tube Planting

Cut through the jute mat and excavate a hole for planting each plant large enough to provide not less than 100 mm all around the root system of the plant, backfill with soil mixture.

When the hole appears to be the correct size, and not before, remove the plant from the container with minimum disturbance to the root system and place in its final position and to match adjoining finish ground levels.

Watering

Watering of the planting works will be undertaken to ensure that an adequate survival and establishment rate is achieved. Watering is to abide by any local authority water restrictions or guidelines. Watering of all planting will occur at the time of the planting itself, to minimise shock on the tube stock in their new conditions. Ongoing watering of stock will be on an as required basis.

The frequency of watering to achieve plant establishment will depend on the prevailing climatic conditions at the time of planting and thereafter. Watering will generally be carried out in the cooler hours of the day (morning or afternoon) and will be frequent enough to prevent wilting of plants. Tube stock is to be watered prior to planting as well as immediately after planting installation.

During the establishment phase the watering program in Table 4 is recommended (dependent on weather).

The necessity for watering during the above program will be dependent upon rainfall. The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after period of 4 to 6 months the planting will be sufficiently established such that watering will no longer be required.

Planting areas are to be monitored during the maintenance period, see Section 7.2, to ensure that climatic conditions are not negatively affecting the newly planted tube stock. If climate or environmental conditions are affecting the tube stock a watering program may be reinstated pending the approval by the construction/commissioning manager.

Table 12: Management Zone 2 Species List

MANAGEMENT ZONE 2: Wianamatta South Creek Embankment Vegetation Local provenance degraded Cumberland Swamp Oak Riparian Forest species				**Total Area (m²)**	**18400**
TREE PLANTING AND HYDROMULCH:					
CODE	**BOTANIC NAME**	**COMMON NAME**	**SIZE**	**PERCENTAGE**	**QUANTITY**
TREES to be planted at 10m centres					
ACA flo	*Acacia floribunda*	White Sally	Forestry tube	25%	460
ACA par	*Acacia parramattensis*	Sydney Green Wattle	Forestry tube	25%	460
CAS gla	*Casuarina glauca*	Swamp Oak	Forestry tube	25%	460
MEL lin	*Melaleuca linariifolia*	Flax-leaved Paperbark	Forestry tube	25%	460
				Total Trees	**1840**
HYDROMULCH:					
CODE	**BOTANIC NAME**	**COMMON NAME**	**MINIMUM APPLICATION RATE (kg/ ha)**	**QUANTITY (kg)**	
COVER CROP					
ECH esc	*Echinochlora esculenta*	Japanese Millet @ 20kg/ha (warmer months)	20	36.8	
SEC cer	*Secale cereale*	Rye Corn @ 25kg/ha (cooler months)	25	46	
SHRUBS to be planted at 5m centres if forestry tubes or seed if hydromulched					
CODE	**BOTANIC NAME**	**COMMON NAME**	**SIZE**	**PERCENTAGE**	**QUANTITY**
ACA fal	*Acacia falcata*	Sickle Wattle	Forestry tube/ seeds	12.5%	460 tubes
ACA imp	*Acacia implexa*	Hickory Wattle	Forestry tube/ seeds	12.5%	460 tubes
BRE obl	*Breynia oblongifolia*	Coffee Bush	Forestry tube/ seeds	12.5%	460 tubes
BUR spi	*Bursaria spinosa subsp. spinosa*	Blackthorn	Forestry tube/ seeds	12.5%	460 tubes
DIL sie	*Dillwynia sieberi*	Sieber's parrot-pea	Forestry tube/ seeds	12.5%	460 tubes
DOD vis	*Dodonaea viscosa subsp. angustifolia*	Sticky Hop-bush	Forestry tube/ seeds	12.5%	460 tubes
IND aus	*Indigofera australis*	Native Indigo	Forestry tube/ seeds	12.5%	460 tubes
OZO dio	*Ozothamnus diosmifolius*	Dogwood	Forestry tube/ seeds	12.5%	460 tubes
				Total Shrubs	**3680 tubes**

FORBS, HERBS, AND GROUNDCOVERS to be planted at 1m centres if viro tubes or seed if hydromulched					
ASP con	*Asperula conferta*	Common Woodruff	Viro Tube/ seeds	**6.25%**	1150 tubes
CEN asi	*Centella asiatica*	Indian Pennywort	Viro Tube/ seeds	**6.25%**	1150 tubes
COM cya	*Commelina cyanea*	Scurvy weed	Viro Tube/ seeds	**6.25%**	1150 tubes
DIC rep	*Dichondra repens*	Kidney weed	Viro Tube/ seeds	**6.25%**	1150 tubes
DIA lon	*Dianella longifolia var. longifolia*	Blue Flax-Lily	Viro Tube/ seeds	**6.25%**	1150 tubes
EUN has	*Einadia hastata*	Saloop	Viro Tube/ seeds	**6.25%**	1150 tubes
EIN nut	*Einadia nutans subsp. nutans*	Climbing Saltbush	Viro Tube/ seeds	**6.25%**	1150 tubes
EIN pol	*Einadia polygonoides*	Knotweed Goosefoot	Viro Tube/ seeds	**6.25%**	1150 tubes
EIN tri	*Einadia trigonos subsp. trigonos*	Fishweed	Viro Tube/ seeds	**6.25%**	1150 tubes
GER sol	*Geranium solanderi var. solanderi*	Native Geranium	Viro Tube/ seeds	**6.25%**	1150 tubes
LOB pur	*Lobelia purpurascens*	White root	Viro Tube/ seeds	**6.25%**	1150 tubes
LOM fil	*Lomandra filiformis subsp. filiformis*	Wattle mat-rush	Viro Tube/ seeds	**6.25%**	1150 tubes
LOM lon	*Lomandra longfolia*	Spiny-headed Mat-rush	Viro Tube/ seeds	**6.25%**	1150 tubes
LOM mul	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush	Viro Tube/ seeds	**6.25%**	1150 tubes
PLE par	*Plectranthus parviflorus*	Cockspur	Viro Tube/ seeds	**6.25%**	1150 tubes
SOL pri	*Solanum prinophyllum*	Forest Nightshade	Viro Tube/ seeds	**6.25%**	1150 tubes
				Total Forbs, Herbs, and Groundcovers	**18400 tubes**
CLIMBERS AND SCRAMBLERS to be planted at 10m centres					
BIL sca	*Billardiera scandens*	Apple Berry	Viro Tube / seeds	20%	368 tubes
CLE ari	*Clematis aristata*	Old Man's Beard	Viro Tube/ seeds	20%	368 tubes
CLE gly	*Clematis glycinoides var. glycinoides*	Headache Vine	Viro Tube/ seeds	20%	368 tubes
GEI cym	*Geitonoplesium cymosum*	Scrambling Lily	Viro Tube/ seeds	20%	368 tubes
PAN pan	*Pandorea pandorana*	Wonga Wonga Vine	Viro Tube/ seeds	20%	368 tubes
				Total Climbers and Scramblers	**1840 tubes**

GRASSES to be planted at 4/m^2					
AUS ram	*Austrostipa ramosissima*	Stout Bamboo Grass	Viro Tube/ seeds	6.25%	4600 tubes
BOT mac	*Bothriochloa macra*	Red-leg Grass	Viro Tube/ seeds	6.25%	4600 tubes
CHL ven	*Chloris ventricosa*	Plump windmill grass	Viro Tube/ seeds	6.25%	4600 tubes
CYM ref	*Cymbopogon refractus*	Barbed Wire Grass	Viro Tube/ seeds	6.25%	4600 tubes
DIC mic	*Dichelachne micrantha*	Shorthair Plumegrass	Viro Tube/ seeds	6.25%	4600 tubes
ECH cae	*Echinopogon caespitosus var. caespitosus*	Tufted Hedgehog Grass	Viro Tube/ seeds	6.25%	4600 tubes
ECH ova	*Echinopogon ovatus*	Forest Hedgehog Grass	Viro Tube/ seeds	6.25%	4600 tubes
ENT mar	*Entolasia marginata*	Bordered Panic	Viro Tube/ seeds	6.25%	4600 tubes
IMP cyl	*Imperata cylindrica*	Bladey Grass	Viro Tube/ seeds	6.25%	4600 tubes
MIC sti	*Microlaena stipoides var. stipoides*	Weeping Grass	Viro Tube/ seeds	6.25%	4600 tubes
OPL aem	*Oplismenus aemulus*	Basket Grass	Viro Tube/ seeds	6.25%	4600 tubes
PAS dis	*Paspalidium distans*		Viro Tube/ seeds	6.25%	4600 tubes
POA lab	*Poa labillardieriei var. labillardiere*	Tussock	Viro Tube/ seeds	6.25%	4600 tubes
RYT cae	*Rytidosperma caespitosum*	Ringed Wallaby Grass	Viro Tube/ seeds	6.25%	4600 tubes
SPO elo	*Sporobolus elongatus*	Slender Rat's Tail Grass	Viro Tube/ seeds	6.25%	4600 tubes
THE tri	*Themeda triandra*	Kangaroo Grass	Viro Tube/ seeds	6.25%	4600 tubes
				Total Grasses	**73600 tubes**

In the event of plant loss, a nominated replacement stock of 10% of the total plants installed has been calculated and should be sourced on top of the totals presented in Table 12 above.

Figure 12 Typical example of the existing condition of Management Zone 2

5.2.4 Management Zone 3: Wianamatta South Creek Edge Revegetation

Management Zone 3 encompasses the Wianamatta South Creek edge embankment at a consistent width of 4m from the water's edge and includes riparian vegetation. This area is below the 5-year flood zone and is subject to frequent inundation. The existing vegetation and embankment conditions are extremely poor and heavily eroded where steep slopes occur. For work proposed to occur within or near to a waterway, the project will minimise the duration of these works and where practical, conduct the works during periods of low flow and retain any existing native species including trees, shrubs and grasses, located along the edge of the creek bank.

JHG has provided the methodology for weed removal, *Weed and Pathogen Management Procedure*, in the Project Biodiversity CEMP sub-plan. Additionally, weed pre-clearance assessments will need to be undertaken 1-3 months prior to the restoration works commencing. These pre-clearance reports will provide a more detailed and specific methodology for weed removal in each management zone. These assessments will be undertaken by the Project Ecologist and passed on to the landscape subcontractor.

Stabilise soil at the toe of the creek bank through re-planting of native species and application of jute mesh where practical. Cultivate existing ground to 200mm, see Table 13 for Primary Amelioration specifications below, more detailed testing by the landscape contractor to occur to determine if required. Plant native tubestock into jute. The biodiverse planting schedule outlined in Table 14 for this management zone is specified to meet the required ecological net gain.

To align with the Aviation Safety Guidelines, the plant type selected for this site fosters microfauna biodiversity but will not cater to roosting large birds or attracting migratory birds. Only grasses are to be planted in this zone, reducing the risk of any larger flocks of birds roosting in the area. This will reduce the risk of aviation bird strikes on site.

A typical example of the existing condition of Management Zone 3 is presented in Figure 13.

Restoration Actions & Regenerative Works

- Stabilise soil at the toe of the creek bank through re-planting of native species and application of jute mesh where practical.
    - Log jams and root balls may also be used to create fish habitat along stable and accessible sections of the creek where deemed possible.
- Application of ameliorants
- Install either of the following jute products over the entirety of the Management Zone:
    - An open weave jute mesh matting product (470 grams/square metre (gsm))
    - A 620 gsm slitted jute matting product.
    - Installation method to be confirmed by JHG prior to proceeding.
- Soil stabilisation with coir logs as specified (toe of bank) to arrest any potential surface erosion and instability post weed control activities. See landscape documentation in Appendix A.

Primary Amelioration

For shrubs and smaller plantings, no subsoil treatment is required, and the top 200mm may be re-worked to improve soil conditions prior to planting. These areas do not require additional testing prior to re-working. Outlined in Table 13 below is the recommended amelioration for Management Zone 3 to be treated in-situ. More detailed testing by the landscape contractor to occur to determine if required.

Table 13: MZ3 Primary Amelioration Gypsum and Lime Rates

Landscape Treatment	Lime g/ m^2	Gypsum g/ m^2	Compost* %v/ v
Alluvial areas	**100**	**200**	**20**

All ameliorants are to be incorporated to a depth of 200mm.

*Compost must be compliant to AS4454 or equivalent.

Viro-tube Planting

Cut through jute mat and excavate a hole for planting each plant large enough to provide not less than 100 mm all around the root system of the plant for viro-tube, backfill with soil mixture.

When the hole appears to be the correct size, and not before, remove the plant from the container with minimum disturbance to the root system and place in its final position and to match adjoining finish ground levels.

Pre-Planting

Do not vary plant locations from those shown on the Drawings (Appendix A) unless otherwise directed. If it appears necessary to vary the locations and spacing to avoid service lines, or to cover the area uniformly, or for similar reasons, apply for directions.

Do not plant in unsuitable weather conditions such as extremes of heat or cold, wind or rain.

Before plants are installed all pot sizes shall have their roots pruned with an appropriate, clean, sharp instrument to eliminate any root confusion occurring at edge of pot zone.

Before planting begins, thoroughly water the plants and the planting area. Keep the area and plants moist during planting.

Mulch Spreading

Mulch spreading will not be undertaken in Management Zone 3 due to its proximity to the creek and the potential for localised flooding within the area following a significant rain event.

Watering

Watering of the planting works will be undertaken to ensure that an adequate survival and establishment rate is achieved. Watering is to abide by any local authority water restrictions or guidelines. Watering of all planting will occur at the time of the planting itself, to minimise shock on the tube stock in their new conditions. Ongoing watering of stock will be on an as required basis.

The frequency of watering to achieve plant establishment will depend on the prevailing climatic conditions at the time of planting and thereafter. Watering will generally be carried out in the cooler hours of the day (morning or afternoon) and will be frequent enough to prevent wilting of plants. Tube stock is to be watered prior to planting as well as immediately after planting installation.

During the establishment phase the watering program in Table 4 is recommended (dependent on weather).

The necessity for watering during the above program will be dependent upon rainfall. The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after period of 4 to 6 months the planting will be sufficiently established such that watering will no longer be required.

Planting areas are to be monitored during the maintenance period to ensure that climatic conditions are not negatively affecting the newly planted tube stock. If climate or environmental conditions are affecting the tube stock a watering program may be reinstated pending the approval by the environmental manager.

Table 14: Management Zone 3 Species List

MANAGEMENT ZONE 3: Wianamatta South Creek Edge Revegetation Local provenance degraded Cumberland Swamp Oak Riparian Forest			**Total Area (m²)**		**4142**
CODE	**BOTANIC NAME**	**COMMON NAME**	**SIZE**	**PERCENTAGE**	**QUANTITY**
GRASSES, SEDGES AND RUSHES					
ALT den	*Alternanthera denticulata*	Lessor Joy Weed	Viro Tube	12.5%	1381
BAU art	*Baumea articulata*	Jointed Twig Rush	Viro Tube	12.5%	1381
BOL cal	*Bolboschoenus caldwellii*		Viro Tube	12.5%	1381
CAR app	*Carex appressa*	Tall Sedge	Viro Tube	12.5%	1381
CYP pol	*Cyperus polystachyos*		Viro Tube	12.5%	1381
ELE acu	*Eleocharis acuta*		Viro Tube	12.5%	1381
JUN usi	*Juncus usitatus*	Common Rush	Viro Tube	12.5%	1381
LOM lon	*Lomandra longfolia*	Spiny-headed Mat-rush	Viro Tube	12.5%	1381
PER dec	*Persicaria decipiens*	Slender Knotweed	Viro Tube	12.5%	1381
PER hyd	*Persicaria hydropiper*	Water Pepper	Viro Tube	12.5%	1381
PAS dis	*Paspalum distichum*	Water Couch	Viro Tube	12.5%	1381
PHR aus	*Phragmites australis*	Common Reed	Viro Tube	12.5%	1381
				Total	**16572**

In the event of plant loss, a nominated replacement stock of 10% of the total plants installed has been calculated and should be sourced on top of the totals presented in Table 14 above.

Figure 13 Typical example of the existing condition of Management Zone 3

6 Implementation Schedule

An indicative schedule of works for the implementation, establishment and maintenance periods, and initial two-year maintenance has been provided in Table 15. Implementation phase is defined as complete when all plant material has been installed. The Establishment period of 6 to 12 months from the end of the Implementation phase is subject to change depending on the selection of planting methodology. The Maintenance phase is 2 years from the completion of the Establishment phase. JHG will be responsible for landscaping maintenance until contract completion is achieved.

Table 15: Implementation schedule

Management actions	Year 1				Year 2				Year 3			
	Implementation		Establishment		Maintenance				Maintenance			
	1	2	3	4	1	2	3	4	1	2	3	4
Preliminary Works												
Install construction fencing and sediment fencing	■											
Rubbish/ debris removal	■	■	■	■	■	■	■	■	■	■	■	■
Install signage	■											
Install salvaged logs and habitat		■										
Seed collection	■											
Propagation	■	■										
Soil treatment	■											
Grading works		■										
Weed pre-clearance assessment	■											
Management Zone 1												
Weed control	■	■	■	■	■	■	■	■	■	■	■	■
Pest management	■	■	■	■	■	■	■	■	■	■	■	■
Soil amelioration	■	■										
Tubestock supply and install	■	■										
Install mulch	■	■										
Fertilising	■	■	■	■	■	■	■	■	■	■	■	■
Watering	■	■	■	■	■	■	■	■				
Replacement planting		■	■	■	■	■	■	■	■	■	■	■
Maintain fencing and signage	■	■	■	■	■	■	■	■	■	■	■	■
Management Zone 2												
Weed control	■	■	■	■	■	■	■	■	■	■	■	■
Pest management	■	■	■	■	■	■	■	■	■	■	■	■
Retain *Casuarina spp.*	■	■										
Soil amelioration	■	■										
Install jute	■	■										
Stabilise soil	■	■										
Tree supply + install	■	■										
Hydro-mulch (Option 1)	■	■										
Tubestock supply and install (Option 2)	■	■										
Fertilising	■	■	■	■	■	■	■	■	■	■	■	■
Watering	■	■	■	■	■	■	■	■				
Replacement planting		■	■	■	■	■	■	■	■	■	■	■
Maintain fencing and signage	■	■	■	■	■	■	■	■	■	■	■	■
Management Zone 3												
Weed control	■	■	■	■	■	■	■	■	■	■	■	■
Pest management	■	■	■	■	■	■	■	■	■	■	■	■
Regrade creek bank	■											
Soil amelioration	■	■										
Soil stabilisation	■	■										
Tubestock supply and install	■	■										
Fertilising	■	■	■	■	■	■	■	■	■	■	■	■
Watering	■	■	■	■	■	■	■	■				
Replacement planting		■	■	■	■	■	■	■	■	■	■	■
Maintain fencing and signage	■	■	■	■	■	■	■	■	■	■	■	■
Monitoring												
Monthly Inspections + Reporting	■	■	■	■	■	■	■	■	■	■	■	■

6.1 Adaptive management

As this is a long-term project implemented over several years, an adaptive management approach will enable the contractor to learn from and respond to successful and unsuccessful techniques used on the site and inform future priorities and work plans. In its simplest form, this may include substituting species identified in the planting tables or undertaking advanced direct seeding techniques instead of manual planting techniques for revegetation. A record will be kept of such changes through a monitoring and reporting scheme as outlined in Section 7. 1.

The success of the works will be determined by meeting the performance criteria identified in Section 7.3 and 7.4 and Table 16. Contractors can implement different techniques to those specified here providing that performance criteria are met. However, any major departures from the VMP or proposed changes to performance criteria must be approved in writing by JHG.

7 Maintenance, Monitoring and Reporting

7.1 Maintenance

The VMP site will require ongoing maintenance to control weed regrowth from the existing seed bank within the soil. Maintenance work is to be undertaken at the direction of a qualified bush regeneration contractor(s) or landscaper(s) to meet the performance criteria in Section 7.4 and Table 16.

Maintenance will be undertaken as required in the peak growing seasons (spring and summer) and monthly in cooler periods (autumn and winter). Maintenance will be undertaken for 2 years after completion of the establishment works. Establishment completion refers to the completion of those parameters defined in the performance criteria detailed within Section 7.4 i.e. soil preparation, initial weed control and planting establishment to 80% survival rate.

The maintenance period will commence upon the completion of the establishment period, installed in compliance with this plan. JHG will be responsible for landscaping maintenance until contract completion is achieved. Throughout the maintenance period the Contractor shall continue to carry out recurrent works of a maintenance nature as specified in this VMP, including but not limited to watering, mowing, weeding, fertilising, pest and disease control, plant replacement and facilitating required monitoring inspections. To abide by Aviation Guidelines, the site will be monitored in accordance with the Projects Wildlife Hazard Management Plan.

Completion of the maintenance period is dependent on achieving the required objectives for the site. If the objectives identified in Section 5.1 or the performance criteria outlined in Section 7.4 are not met, the maintenance period may be extended until they have been met. Therefore, maintenance must continue until Sydney Water formally accepts that the objectives and performance criteria have been met and the maintenance period has concluded. Maintenance programs need to closely monitor pest activity as outlined in Section 4.1.3.

The southern portion of the creek restoration area, which is part of the scope of this VMP, is owned by the University of Sydney (Lot 212//DP1272676). The Project will restore and maintain this area in accordance with Drawings referenced in Appendix A and Section 5 of this plan. Maintenance activities will be carried out within the University of Sydney's land as per the Sydney Water area. However, it is important to note that the design and management requirements outlined in this plan for the University's area may be subject to change following further detailed conversations and agreement.

Maintenance shall include the below listed items for JHG in establishment and Sydney Water & John Holland during the maintenance period as a minimum requirement.

7.1.1 Inspections Notice

Give notice so that inspection may be made of the following:

- Formal monthly inspection of site conditions undertaken by JHG, Sydney Water or their respective landscape contractor.

7.1.2 Plant Establishment Reports

The Contractor shall provide to the client (JHG for Pre-contract completion/Sydney Water for Post-contract completion) written plant establishment reports by the last Friday of each month, outlining what dates the site was inspected and what works were undertaken as follows:

- extent of watering
- extent of fertilising
- extent of extent of replacement
- extent of herbicide or insecticide spraying
- extent of weeding
- extent of rubbish removal
- extent of lawn mowing
- A description of any problems encountered in implementing the works outlined in this VMP and how they were overcome.

A photographic record shall be taken and submitted with each monthly report illustrating the state of the VMP area and maintenance items.

Maintenance payments will be made only on receipt of plant establishment reports.

7.1.3 Watering

Trees in grass and mass planted areas shall be watered regularly with an evenly deep penetrating application to ensure continuous healthy growth. All other plants will be watered according to the watering program provided in Table 4. The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after period of 4 to 6 months the planting will be sufficiently established such that watering will no longer be required.

7.1.4 Weeding and Rubbish Removal

During the contract period remove regular rubbish and weed growth that occurs throughout all contract areas. This shall be executed regularly so that at intervals, the contract area may be observed in a completely clean and tidy condition. Provide ten (10) days' notice to JHG or Sydney Water of the application of any herbicide or fungicide.

7.1.5 Replacements

Plant success will be recorded as either ALIVE or FAILED (including missing and deceased) and the dead-alive ratio must stay above an 80% success rate as per Table 17. During the implementation, establishment, and maintenance phases replace plants within 7 days, which die or fail to establish, have been eaten by pests or are damaged or stolen, with plants of same size and quality unless otherwise directed. Plants that perish and are replaced by the landscape contractor must undergo an additional 12 weeks of establishment to prevent repeat die-off.

7.1.6 Graffiti and Vandalism Repairs

Notify client (JHG or Sydney Water) as soon as possible following graffiti or vandalism attacks on site. All vandalism and graffiti attacks are to be reported to the client (JHG or Sydney

Water) for recommended action to be taken. Notwithstanding the above, the landscape sub-contractor is to ensure that the site is left in a neat, tidy and safe state.

7.1.7 Spraying

Report any incidence of pest or disease attack on plants to the client (JHG or Sydney Water). Insecticide and fungicide spraying, if considered necessary and approved by the client (JHG or Sydney Water), shall be carried out in accordance with the manufacturer's instructions.

7.1.8 Completion

Notwithstanding anything to the contrary in the Contract, the client (JHG or Sydney Water) may instruct the landscape sub-contractor to perform urgent maintenance works. Should the landscape sub-contractor fail to carry out these works within seven (7) days of such a notice, the client (JHG or Sydney Water) reserves the right to employ others to carry out such works and charge costs of these works to the landscape sub-contractor.

7.2 Monitoring to Determine Ecological Gain

Monitoring and reporting are to be undertaken by a suitably qualified restoration ecologist. Reports are to be reviewed by the client (JHG or Sydney Water).

Monitoring will be undertaken by photo monitoring and vegetation surveys, as outlined in sections 7.2.1 below. Monitoring will be implemented before works commence to establish a benchmark for performance, and to occur post completion of the establishment phase at 6 and 12 month intervals or as directed by the JHG representative, as outlined in Section 7.3. Baseline data will be gathered using the Biodiversity Assessment Method (BAM 2020) via the establishment of a minimum of two floristic plots in Management Zones 1 & 2, and a minimum of 1 floristic plot in Management Zone 3. The vegetation integrity (VI) scores will be then calculated with scope provide evidence of an increase in VI and then represented as a percentage to document an ecological net gain.

Each survey should be accompanied by brief correspondence with JHG regarding the progress of the vegetation management works and highlight any areas of concern or merit. Monitoring results will be included in the progress report.

7.2.1 Photo monitoring

The restoration zones will be monitored in terms of vegetation condition and the achievement of performance criteria. Monitoring activities are to include:

- Placement of star pickets approximately ten metres apart to record the location (eastings and northings) of the first star picket with a GPS and the bearing to the second star picket.
- Taking a digital photo from the first star picket looking towards the second star picket, showing the entire length of the first star picket.
- Visual documentation of the VMP's progress will be undertaken during the application of the methodology (BAM) by the suitably Project qualified ecologist.
- Compile initial and on-going weed density maps.
- Assessment of weed control should be based on advice provided in the pre-clearance assessment and the weed management procedure.
- Identification and assessment of any natural regeneration of native plant species.

- Assessment of the success rate of plantings via the planting survivorship method which involves measuring plant survival at regular intervals following revegetation to monitor the success of planted/ salvaged seedlings.
- The planting survivorship method includes:
    - Collecting the following over a minimum of two established metre transect per management zone:
        - Planting success recorded as either ALIVE or FAILED (failed includes missing and deceased).
        - Signs of predation or disturbance (plant damaged, presence of scat, tree guard damaged or removed, etc.,)
        - General comments: correctly planted, sufficient watering undertaken, plant health and vigour (observed nutrient deficiencies).
- Label each digital image with a unique reference number indicating where the photo was taken (i.e., the photo monitoring point) and the date it was taken (e.g., 01_200330 for a photo taken at the first photo monitoring point on the 30th of March 2024).

7.3 Urban and Landscape Implementation Evaluation Reports

To ensure the successful establishment and ongoing maintenance of planting, other landscape, and public realm features detailed within Phase 1 of the Urban Design Landscape Plan (UDLP), urban and landscape implementation reviews and evaluations will be undertaken. These reviews and evaluations will follow an inspection schedule defined by the Project's independent suitably qualified professional (ISQP), who should have relevant qualifications in urban design or landscape architecture and a minimum of 7 years' experience as an urban and landscape design practitioner.

The inspection schedule is as follows:

- On-site inspection will be required for a relevant installation milestone.
- On-site inspection will be conducted once all landscaping, as detailed within the Vegetation Management Plan and Landscape Management Plan, has been installed (planted).
- A relevant installation milestone can be evidenced through means other than on-site inspection, such as images collected or installation schedules.
- A relevant installation milestone can also be evidenced through means other than on-site inspection.
- Another relevant installation milestone will require on-site inspection.

The ISQP will then prepare Urban and Landscape Implementation Evaluation reports, which will detail the findings, recommendations, identified major or recurring non-compliances, and remedial actions for the Project Sustainability, Environment & Construction Managers. These reports will have a scope that assesses the options proposed and detailed in the urban and landscape design plan and statements, ensuring that plantings and other landscape design features are implemented and maintained correctly. The Project Sustainability, Environment & Construction Managers will take action to implement corrective measures based on the ISQP findings to achieve implementation and address any issues. The ISQP reports are crucial in maintaining the successful implementation of the UDLP and ensuring that the design measures are implemented in the final asset of the project.

7.4 Performance criteria

VMP Performance criteria are detailed below within Table 16. The author of this VMP, or an equally qualified landscape contractor as outlined in Section 1.4 must prepare a statement/ report certifying compliance with the performance criteria (Table 16) at the end of the establishment period for submission and acceptance by a relevant Sydney Water Corporation representative. The report will include the below listed items.

Failure to achieve the stated performance criteria may require the establishment period to be extended and relevant actions proposed and agreed between all relevant parties. Therefore, the establishment phase must continue until the performance criteria are achieved and evidenced to Sydney Water for formal acceptance, concluding the establishment phase and commencing the maintenance phase.

If monitoring indicates that the VMP tasks are not achieving the performance criteria, the management actions (Table 17) and program will be revised. The client (JHG or Sydney Water) and the bush regeneration or landscape contractor can adapt the criteria and actions as required in response to the success of rehabilitation works.

Reports will include, at a minimum, the following:

- Time and period the report relates to.
- Photo monitoring results to date.
- A description of any problems encountered in implementing the works outlined in this VMP and how they were overcome.
- Any observations made, including new plant species recorded (native and weed species), comments on regeneration rates and any problems that impact the implementation of the VMP.
- The status of achievement towards the Vegetation Performance Criteria in Table 16.
- Achievement of performance criteria will be updated in each subsequent report as milestones are achieved.

Monitoring works will also provide the following certifications to the proponent/project manager, and then on to the client:

- Certification that the planting stock (including initial and replacement plantings) is at the required densities.
- Certification of commencement of maintenance period, i.e. all primary secondary and revegetation works have been completed to acceptable standards
- Final certification that the targets of the vegetation management works have been achieved.

These reports are to be provided to the organisation that requested the report. The performance criteria are detailed below within Table 16 and the management actions within Table 17.

Table 16: Vegetation Performance Criteria

Performance Action	Management Zone	Responsibility	Performance Criteria	Timing (Phase)
Weed control	All vegetation management zones	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Sydney Water – Maintenance post contract completion.	All weeds within the area of the Vegetation Management Plan (VMP), which details riparian restoration works must be maintained to less than or equal to 10% Percent Foliage Cover (PFC) across the entire footprint. Weeds for the purpose of this requirement are defined within: • Section 3.4 Weeds, Vegetation Management Plan (Revision 7) • John Holland Upper South Creek AWRC – Weed Mapping report (AMBS: 24447) dated 10/09/2024, all weeds identified as High Threat Weeds (HTW), Weeds of National Significance (WOFS) & Priority Weeds.	From the commencement of vegetation management plan works: • Implementation • Establishment • Maintenance
Revegetation/ Plant Maintenance	All vegetation management zones	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Sydney Water – Maintenance post contract completion.	A minimum 80% survival rate of individual plant species must be achieved. The survival rate should be calculated based on the species percentage (%) coverage rate per square meter (m2) reference to the coverage	From the commencement of vegetation management plan works: • Implementation • Establishment • Maintenance

Performance Action	Management Zone	Responsibility	Performance Criteria	Timing (Phase)
			nominated in the design, landscape specification, vegetation and landscape management plans for the respective management zone or area of the riparian corridor. The measurement of plant survival rates will be undertaken by the landscape contractor at the following prescribed milestones: ▪ Establishment completion ▪ Maintenance completion ▪ Handover from John Holland to another party (if required) These milestones serve as checkpoints to assess and monitor the survival rates of the planted species. The landscape contractor will be responsible for conducting the measurements and ensuring that the minimum survival rate of 80% is achieved for each individual plant species based on the specified coverage rate per square meter. The Subcontractor shall maintain the plants at the required survival	

Performance Action	Management Zone	Responsibility	Performance Criteria	Timing (Phase)
			rates for the duration of the Subcontractor's maintenance period. The Subcontractor shall replace and reestablish any species to the minimum survival rates during both establishment and maintenance period.	

Table 17: Vegetation Management Actions

Management Action (MA#)	Management Zone	Responsibility	Task/ Performance Criteria	Timing (Phase)
MA1 - Weed control	All vegetation management zones	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Sydney Water – Maintenance post contract completion.	Primary and secondary weed control works are to include the following actions: • All priority, environmental, vine and woody weeds are to undergo initial primary treatment in accordance with the Project Biodiversity CEMP sub-plan weed and pathogen management procedure and the requirements detailed within section 3.4 of this plan. • Commencement of installation works will occur once mature exotic species have been reduced in accordance with the Project Biodiversity CEMP sub-plan weed and pathogen management procedure.	From the commencement of vegetation management plan works: • Implementation • Establishment • Maintenance
MA2 - Jute matting, coir log and mulch installation	All vegetation management zones	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Sydney Water – Maintenance post contract completion.	Following primary weed control and vegetation removal, the following activities are to be implemented in required, appropriate areas: • Placement of a jute soil stabilisation fabric in required areas of all MZs to eliminate any potential surface erosion and instability (primarily in riparian interface areas and basin) • Installation of mulch (to a minimum depth of 100mm) (MZ1/MZ2 only). • Establishment of coir logs in areas of high erosion potential to eliminate surface erosion and instability.	As required immediately following vegetation removal (initial weed treatment and exotic vegetation removal).

Management Action (MA#)	Management Zone	Responsibility	Task/ Performance Criteria	Timing (Phase)
MA3 - Revegetation	All vegetation management zones	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Sydney Water – Maintenance post contract completion.	Following the preliminary works (weed control, mulch/jute installation), revegetation is to be undertaken to ensure sufficient vegetation cover exists to prevent soil erosion and to assist in the rehabilitation of the threatened ecological community. • Where possible, installed plants are to be propagated from locally sourced seed stock collected within a 10-kilometre radius of the study area and selected from the list for contained in the document.	Following the preliminary works (weed control, mulch/jute installation).
MA4 - Planting maintenance	All vegetation management zones	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Sydney Water – Maintenance post contract completion.	Installed plantings are to be maintained with key elements of water (Table 4), prevention of predation and suppression of smothering weeds required to establish plants. Replacement planting is to be carried out throughout the maintenance period to sustain the 80% individual species survival rate (Table 16) at the completion of the maintenance period. Losses of greater than 20% of originally installed plantings may have the maintenance period extended until survival rates have been achieved.	Establishment – Commence immediately post plant installation. Maintenance – Post establishment until completion.
Maintenance	All vegetation management zones	JHG (Principal Contractor) - Implementation, Establishment and Maintenance	All mature priority weeds are to be appropriately managed prior to commencement of maintenance period.	Maintenance period will run for a 24-month term following successful completion of establishment.

Management Action (MA#)	Management Zone	Responsibility	Task/ Performance Criteria	Timing (Phase)
		until contract completion. Sydney Water – Maintenance post contract completion.	Works to be undertaken utilising best practice bush regeneration techniques. Plants will be maintained according to aviation safety considerations and the Wildlife Hazard Management Plan.	The commencement of this maintenance period may be adjusted if there are delays beyond the contractor's control to achieving establishment. Commencement and completion dates of the maintenance period will be determined by the Vegetation management consultant assessment of performance with Table 16. The outcomes of performance will be reported for discussion to the John Holland, Sydney Water, and relevant authorities where necessary.

9 References

Aviation Safeguarding Guidelines; Western Sydney Aerotropolis ans surrounding areas, NSW Government, November 2022.

Biosecurity Act 2015 No 5. Canberra: Australian Government.

Biosis, 2023. *Review of the UDLP and VMP for the Upper South Creek – Advanced Water Recycling Centre*.

Biosis, 2022. *Upper South Creek Advanced Water Recycling Centre Biodiversity Development Assessment Report*.

Department of Planning and Environment, 2022. *Controlled activities – Guidelines for vegetation management plans on waterfront land (Fact sheet)*.

Department of Planning and Environment, 2022. *Western Sydney Aerotropolis Development Control Plan 2022*.

GoogleMaps, 2023. *GoogleMaps*.

John Holland Group, 2023. *Weed and Pathogen Management Procedure*.

Environmental Planning and Assessment Act 1979 No 203. New South Wales: NSW Government.

SESL Australia, 2023. *Soil Re-Use Assessment and Advice – Advanced Water Recycling Centre (AWRC)*.

State of New South Wales through Greater Sydney Local Lands Service, 2019. *Greater Sydney Regional Strategic Weed Management Plan 2017-2022*.

State of New South Wales, Office of Environment and Heritage, 2023. *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – profile*.

Sydney Water, 2021. *Western Sydney Aerotropolis (Initial Precincts) – Riparian Corridors Assessment Final Report*.

Appendices

Appendix A Landscape Documentation

Appendix B Controlled activities – Guidelines vegetation management plans on waterfront land (Fact sheet) Department of Planning & Environment, 2022

Appendix C Salvaged Logs and Rootballs

Appendix D Soil Re-Use Assessment and Advice - Advanced Water Recylcing Centre (AWRC) (SESL Australia, 2023)

Appendix A Landscape Drawings

Appendix B Controlled activities – Guidelines for vegetation management plans on waterfront land (Fact sheet), Department of Planning & Environment, 2022

Controlled activities – Guidelines for vegetation management plans on waterfront land

Controlled activities carried out in, on or under waterfront land are regulated by the *Water Management Act 2000* (WM Act). The department administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land.

Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary.

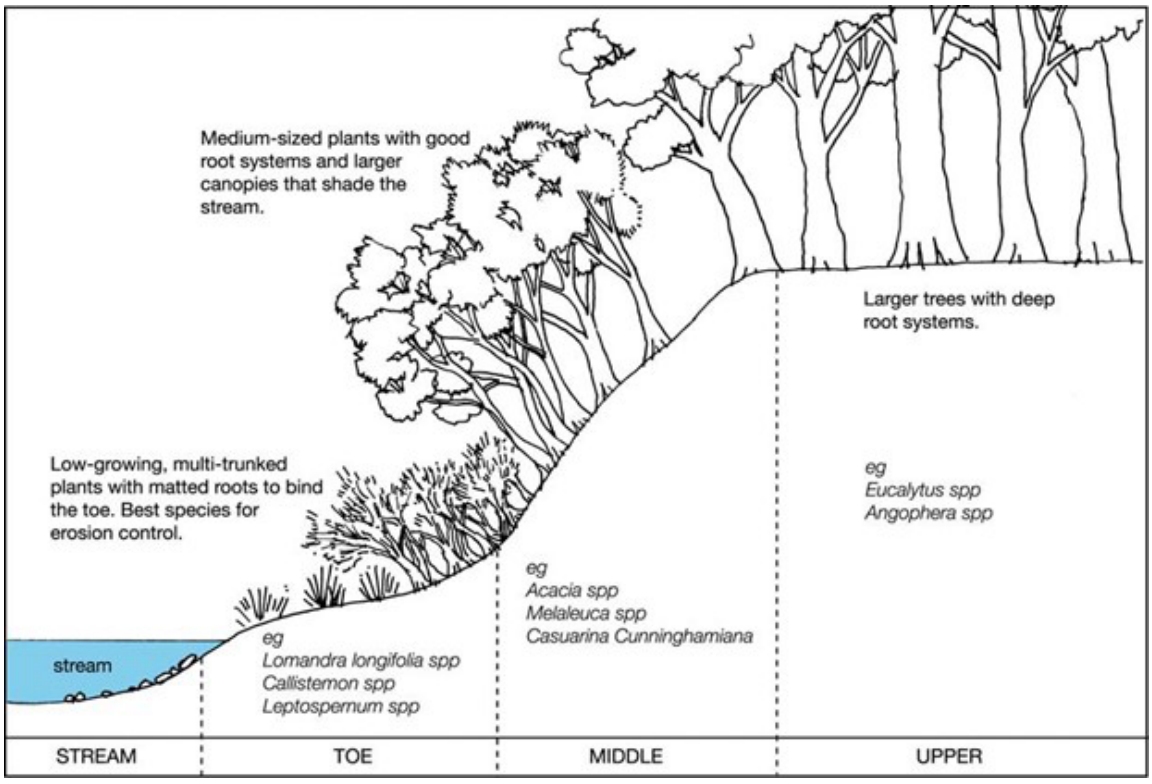
This means that a controlled activity approval must be obtained from the department before commencing the controlled activity.

A vegetation plan is required

When a proposed controlled activity disturbs or substantially modifies the riparian corridor, its restoration or rehabilitation will be a requirement of the controlled activity approval. A vegetation management plan (VMP) details how the restoration or rehabilitation will be carried out.

The main objective of a VMP is to provide a stable watercourse and riparian corridor which will emulate local native vegetation communities.

Figure 1: Typical riparian cross-section



Adapted from Rivercare: Guidelines for Ecological Sustainable Management of Rivers and Riparian Vegetation: Raine, A.W & Gardiner, J.N, (1995), Land and Water Resources Research and Development Corporation, Canberra

INT22/159010

Preparing a vegetation management plan

A VMP should be prepared by a suitably qualified person and should clearly address the following criteria:

- An appropriate width for the riparian corridor should be identified by consulting either the development consent, the relevant environmental planning instrument or the department's Guidelines for riparian corridors. The VMP should consider the full width of the riparian corridor and its functions including accommodating fully structured native vegetation.
- Maps or diagrams which clearly identify the riparian corridor; the existing vegetation; the vegetation to be retained; the vegetation to be cleared; the footprint of construction activities; and areas of proposed revegetation etc. should be prepared.
- The location of the bed and banks or foreshore of waterfront land and the footprint of the riparian corridor should be clearly identified. Vegetated riparian zones must be indicated.
- Photographs of the site should be supplied and photo points should be identified. To assist with future monitoring and reporting requirements, the photo points should be identified by GPS coordinates or by survey. This is particularly important for large-scale earthworks or extractive industries.
- Measures for controlling long-term access and encroachments (bollards, fences, etc.) into the riparian corridor should be identified.
- Vegetation species composition, planting layout and densities should be identified. The required mix of plant species relates to the actual community to be emulated and the size of the area or areas to be rehabilitated but mature vegetation communities are generally well structured, comprising trees, shrubs and groundcovers species. Planting densities should achieve quick vegetative cover and root mass to maximise bed and bank stability along the subject watercourse.
- Costs associated with high-density planting will be recovered through reduced maintenance costs for weeding or replacement planting in the maintenance period specified in the controlled activity approval (CAA).
- Seed or plant sources should be identified. Where possible, native plants and seed sources of local provenance should be used.
- Exotic vegetation should be avoided. The use of exotic species for temporary soil stabilisation is permitted provided they are sterile, non-invasive and easily eradicated when permanent vegetation is established.
- Details of the planting program, rehabilitation methods and staging should be provided. Techniques such as hydro-seeding, direct seeding, brush matting or assisted natural regeneration may be considered.
- Maintenance requirements should extend for a minimum of 2 years after the completion of works or until such time as a minimum 80% survival rate of each species planted and a maximum 5% weed cover for the treated riparian corridor-controlled activity is achieved.

- Project tasks should be defined and described, including a schedule detailing the sequence and duration of works necessary for the implementation of the VMP.
- Costings for the implementation of all components and stages of the work including materials, labour, watering, maintenance which includes plant replacement, monitoring and reporting should be prepared.
- Processes for monitoring and review, including a method of performance evaluation should be identified. This should include replacing plant losses, addressing deficiencies, problems, climatic conditions and successful completion of works.
- Regular reporting on the implementation and status of works covering progress, success or failures and completion should be provided. The number and duration of reporting periods will be identified in the CAA. Works as executed plans and reports detailing how the components of the VMP have been implemented will be required prior to the release of any security held by the department.
- Security such as bank guarantees may be required before a controlled activity involving the implementation of a VMP is commenced. The amount of security is usually based on the costings provided.

More information

- For more information about controlled activities on waterfront land visit the department's website at water.dpie.nsw.gov.au/licensing-and-trade/approvals.
- Copies of the Acts and associated regulations are available on the NSW Government legislation site at www.legislation.nsw.gov.au.

If you think you need to make a controlled activity application, our easy-to-use online support tool Water Assist can help you. Visit www.dpie.nsw.gov.au/water/water-assist.

Appendix C Salvaged Logs and Root balls

Images of salvaged trees and root balls as provided by John Holland Group via email on 1st November 2023.

Appendix D Soil Re-Use Assessment and Advice

DOCUMENT RECORD

Revision No.	Reviewed By	Action	Issued To	Date	Release Authorisation Signature
0.1	SL	Initial Draft	Internal	01/09/2023	
0.2	SL	Issue to Client	Client	06/09/2023	
1.0	SL	Minor Amendment	Client	20/09/2023	

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1. INTRODUCTION

SESL Australia Pty Ltd (SESL) was engaged by Tract Consultants Pty Ltd (The Client) to conduct soil sampling and analysis on site won soil for the purpose of re-use in landscaping within the Advanced Water Recycling Centre (AWRC) development footprint.

The AWRC project involves the construction of a large water treatment plant within the upper South Creek region which will provide clean water to the developing areas around the Western Sydney Airport and surrounds. Within the redevelopment of the area, there are areas where topsoil will be stripped, stockpiled and re-used for landscaping, along with areas that will be improved in-situ. The two main areas of management are;

1. Area within building footprint - topsoil to be stripped, stockpiled and re-used for general mass plantings and tree pits
2. Area around the building footprint - topsoil to be ameliorated in-situ and replaced for mass plantings, wetlands and/or riparian areas

It is understood that some areas of cut and fill within the building footprint are up to 4m in depth.

Within this report, SESL has provided an assessment for the re-use of site-soil and to developed soil management strategies to permit re-use of the excavated soils within the proposed landscape.

This report outlines the findings of the site investigation, sampling, laboratory analysis and recommended management strategies regarding stripping, stockpiling amelioration, and validation. This advice serves as a preliminary scope of the management and amelioration requirements will be onsite, however does not serve as a full characterisation which will be required after stripping and stockpiling and is outlined in section 8.

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2. PROJECT OVERVIEW AND SCOPE

The AWRC project is to be constructed on a site that is now a decommissioned satellite array. Most of the site is expected to be undisturbed from the previous land use which is known to be grazed pastures. The topography is typically flat with some slope towards the creek lines and areas which alluvial deposits will be expected. The western side of the side of the site is bordered by South Creek.

During bulk earthworks for the project, the topsoil will be stripped within the areas where the building is to be constructed. Surrounding areas will be treated for general mass plantings in-situ where landscapes are to be installed. It is assumed that subsoil will be stripped and stockpiled separately and used for fill material across the site.

In areas to have landscape installed, it is expected that exposed cut/fill material will have a minimum of 300 mm of topsoil installed. It is a critical requirement that the subsoil / subgrade is treated in these areas prior to the installation of ameliorated topsoil as Western Sydney subgrade is known for salinity and sodicity issues. These issues are likely to be even more prevalent where 4m cuts are planned.

The soil landscapes in the area vary depending on topography and location within the development footprint. Most of the site is dominated by the Blacktown and South Creek soil landscapes (Refer to appendix B - Site Maps for soil landscape positions). These soil landscapes are derived from differing parent material and possess different limitations depending on their origin and position within the landscape. This has implications on the soil characteristics and how soil is to be managed during stripping, stockpiling and amelioration. A summary has been provided in the table below.

Table 1 Soil landscapes within the AWRC development footprint

Soil Landscape	Characteristics and Limitations

Blacktown (bt)	• Residual soils derived from Wianamatta Group Shales developing into Red/Brown and Yellow Podzolic soil profiles usually < 2m on crests and > 2m at footslopes
	• Topsoil is typically a brown silty clay to clay loam
	• Limitations are;
	  ○ Acidic pH leading to aluminium toxicity
	  ○ Low fertility
	• Subsoil is typically a brown/red or yellow/grey silty clay to medium clay
	• Limitations are;
	  ○ Acidic pH leading to aluminium toxicity
	  ○ Heavy texture (low permeability)
	  ○ Salinity
	  ○ Sodicity
	  ○ Hardsetting properties
	  ○ High erodibility

South Creek (sc)	• Depositional soils derived from Wianamatta Group Shales developing into Red/Yellow and

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	Brown/Yellow Podzolic soil profiles usually < 2m on crests and > 2m at footslopes
	• Topsoil is typically a brown fine sandy clay loam to sandy clay loam
	• Limitations are;
	  ○ Acidic pH leading to aluminium toxicity
	  ○ High erodibility
	  ○ Hardsetting
	  ○ Low fertility
	• Subsoil is typically a brown light clay to medium clay
	• Limitations are;
	  ○ Acidic pH leading to aluminium toxicity
	  ○ Heavy texture (low permeability)
	  ○ Salinity
	  ○ Hardsetting properties
	  ○ Very high erodibility

Information in the table above has been derived from Chapman G.A. and Murphy C.L., 1989, *Soil Landscapes of the Sydney 1:100,000 Sheet* report, Soil Conservation Service of NSW, Sydney.

Given the scope of soil re-use for this project, it is critical that stripping, stockpiling, amelioration, and installation of site won material is managed in a sustainable and efficient manner that is conducive of landscape development and longevity. This is conducted through proper characterisation of topsoil and subsoil material onsite to ensure that these operations and quantities are being applied in manner that will achieve fit for purpose soils.

The subsoil characteristics onsite may pose concern for erosion and hostile conditions for landscape plants. When exposed, sodic / saline conditions result in erodible surfaces and are generally unsuitable for landscapes that require immediate planting. If the soil survey identified such subsoil conditions, the amelioration plan will include subgrade characterisation and treatment processes. Deep cuts into subsoil are likely to be particularly hostile and sodic, even saline in places.

In areas to be re-worked in-situ, topsoils are to be characterised and any chemical limitations identified to ensure that the landscape is provided with the best environment for establishment and longevity.

The characterisation of soil resources onsite at AWRC is critical to the sustainable generation of fit for purpose soils to be used in landscaping. Given the known limitations of the soil material present onsite, there is significant risk of landscape failure with associated with the re-use of site soil without amelioration.

Within this report, SESL will characterise the on-site soil resource and provide stripping, stockpiling, amelioration, and testing advice to provide fit for purpose soil material for re-use in future landscapes. This advice serves as a preliminary idea of what management and amelioration requirements will be required onsite, however does not serve as a full characterisation which will be required after stripping and stockpiling and is outlined in section 8.

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3. SAMPLING PLAN

SESL attended site on 10/08/2023. During the site sampling, SESL constructed boreholes to make a series of soil profile observations and conducted sampling. These boreholes, observations and samples serve as a preliminary characterisation of the material expected to be experienced across the site during bulk earthworks and/or reworked landscape areas.

24 boreholes were constructed across the site in strategic positions identified by the client. These areas are those expected to have varying soil characteristics and represent what is expected to be encountered across the whole of the site during bulk earthworks. The borehole locations and identifying numbers have been provided in table 2 in the following section and are presented in Appendix B – Site Maps.

Samples were collected from each soil layer identified from the boreholes / soil profiles extracted. Samples were selected for analysis based on overall representation of soil material that is expected during bulk earthworks and focused on some areas surrounding the cut/fill footprint to be reworked / replanted. The selection of samples for testing (SFT) was aimed at identifying the overall soil material onsite and providing adequate information for the amelioration plan and design of soil specifications.

NOTE – Some areas denoted by the client were excluded from this investigation due to issues with access and safety.

4. SUITE OF ANALYSIS

The suite of analysis conducted on the samples collected by SESL Australia have been selected to provide adequate data for the determination of soil limitations, required amelioration for the generation of suitable landscape soil from on-site material.

Topsoil samples were analysed for texture, organic matter, permeability, wettability, dispersibility, large particles, visual contaminants, pH (1:5 in H_2O and $CaCl_2$), Electrical Conductivity (1:5 in H_2O), nitrogen, phosphorus, potassium, exchangeable cations, iron, manganese, zinc, copper and boron.

Subsoil samples were analysed for texture, structure, sodium, chloride, and exchangeable cations.

All analysis was carried out at SESLs NATA Accredited laboratory (NATA#15633).

5. SITE OBSERVATIONS AND SOIL PROFILES

The soil profiles observed are mostly consistent with the soil landscapes identified within the landscape data sheets. Provided below is a summary of the observations made during the site sampling.

Topsoil depth within the cut and fill area averages at 200-250 mm.

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Table 2 Borehole locations and general observations

Borehole Number	Location	Observations	CSample Submitted
BH01	Eastern end of site, upper slope. Within cut and fill area.	• Pasture • Topsoil is 300mm deep	Composite 2 (Upper / Mid Slope) Subsoil Sample 1
BH02	Mid-area of site, upper slope. Within cut and fill area.	• Pasture • Topsoil is 200mm deep	Composite 2 (Upper / Mid Slope)
BH03	Mid-area of site, upper slope. Within cut and fill area.	• Pasture • Topsoil is 200mm deep	Composite 2 (Upper / Mid Slope)
BH04	Mid-area of site, mid slope. Within cut and fill area.	• Pasture • Topsoil is 200mm deep	Composite 2 (Upper / Mid Slope)
BH05	Mid-area of site, lower slope. Within cut and fill area.	• Pasture • Topsoil is 300mm deep	Composite 3 (Lower Slope)
BH06	Mid-area of site, lower slope. Within cut and fill area.	• Pasture • Topsoil is 250mm deep	Composite 3 (Lower Slope)
BH07	Mid-area of site, lower slope. Within cut and fill area.	• Pasture • Topsoil is 200mm deep	Composite 3 (Lower Slope)
BH08	Mid-area of site, mid slope. Within cut and fill area.	• Pasture • Topsoil is 250mm deep	Composite 2 (Upper / Mid Slope)
BH09	Mid-area of site, mid slope. Within cut and fill area.	• Pasture • Topsoil is 250mm deep	Composite 2 (Upper / Mid Slope) Subsoil Sample 3
BH10	Eastern end of site, upper slope. Within cut and fill area.	• Pasture • Topsoil is 250mm deep	Composite 2 (Upper / Mid Slope)
BH11	Mid-area of site, mid slope. Within cut and fill area.	• Fill material (asphalt)	Not Sampled.
BH12	Southern area of site, upper slope. Within cut and fill area.	• Pasture • Topsoil is 250mm deep	Composite 2 (Upper / Mid Slope)
BH13	Southern area of site, mid slope. Within cut and fill area.	• Observation only (near M12 works) • Topsoil approx. 200mm	Composite 2 (Upper / Mid Slope)

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BH14	Southern area of site, mid slope. Within cut and fill area.	• Pasture, near melaleuca trees • Topsoil is 200mm deep	Composite 2 (Upper / Mid Slope)
BH15	Southern area of site, mid slope. Within cut and fill area.	• Pasture • Topsoil is 250mm deep	Composite 2 (Upper / Mid Slope)
BH16	Middle of site, mid slope. Outside of cut and fill area	• Pasture • Topsoil is 250mm deep	Composite 1 (Upper Slope)
BH17	Middle of site, lower slope. Outside of cut and fill area	• Pasture • Topsoil is 250mm deep	Composite 1 (Upper Slope) Subsoil Sample 2
BH18	Middle of site, upper slope. Outside of cut and fill area	• Pasture • Topsoil is 300mm deep	Composite 1 (Upper Slope)
BH19	North East side of site, upper slope. Outside of cut and fill area	• Pasture • Topsoil is 400mm deep	Composite 1 (Upper Slope) Subsoil Sample 4
BH20	Northern (top) of site, mid slope. Outside of cut and fill area	• Pasture • Topsoil is 150mm deep	Composite 1 (Upper Slope)
BH21	Western side of site, lower slope. Alluvial area, Outside of cut and fill area	• Pasture • Topsoil is 500mm deep	Composite 3 (Alluvial / Riparian Area)
BH22	South west side of site, lower slope. Alluvial area, Outside of cut and fill area	• Pasture • Topsoil is 500mm deep	Composite 3 (Alluvial / Riparian Area)
BH23	West side of site, lower slope. Alluvial area, Outside of cut and fill area	• Pasture • Topsoil is 500mm deep	Composite 3 (Alluvial / Riparian Area)
BH24	North west side of site, Within Billabong Outside of cut and fill area	• Drained billabong • Soil is 400mm deep • Some odour due to long term waterlogging	Single Sample – Billabong Areas

Of notable interest is the condition of soil alongside the South Creek area (BH 21-23) an alluvial topsoil resource was observed that extends beyond the depth of investigation. This area should be managed in a manner that allows for this material to be exploited and re-used as topsoil. It is understood that these areas are to be revegetated with ephemeral riparian species in-situ, which is an appropriate use of such a soil resource.

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6. ANALYTICAL RESULTS

The samples collected from site were submitted to SESLs laboratory (SESL Batch reference 65786). The results obtained from the samples collected from the AWRC site show similarity in soil chemical and physical characteristics based on location. For ease of interpretation, the results have been summarised in groups based on these similarities. For full laboratory results and analysis, refer to Appendix A – Laboratory results. Refer to Appendix C – site photographs for sampling locations.

TOPSOIL RESULTS

Group 1 and 3 – Upper slope (composite Samples 1 and 3 – rework area)

Topsoil is typically a silty clay loam with low organic matter. Soil pH is slightly acidic in H_2O and strongly acidic in $CaCl_2$ with very low salinity. The exchangeable cations show presence of free hydrogen due to the acidic pH. The effective cation exchange capacity (eCEC) is low. Nitrogen and potassium are low. Phosphorus is low, ranging from 10-58 mg/kg. Micronutrients iron, zinc, copper and boron are low. Manganese is very high ranging from 120 – 260 mg/kg.

Group 2 - Mid and lower slope (Composite sample 2 in cut and fill area)

Topsoil is typically a silty clay loam with low organic matter. Soil pH is slightly acidic in H_2O and strongly acidic in $CaCl_2$ with very low salinity. The exchangeable cations show presence of free hydrogen due to the acidic pH. The effective cation exchange capacity (eCEC) is low. Nitrogen and potassium are low. Phosphorus is low, ranging from 10-58 mg/kg. Micronutrients iron, zinc, copper, and boron are low. Manganese is very high at 250 mg/kg.

Group 4 - Alluvial Areas (Composite Sample 4)

Topsoil is typically a silty clay loam with low organic matter. Soil pH is slightly acidic in H_2O and strongly acidic in $CaCl_2$ with very low salinity. The exchangeable cations show presence of free hydrogen due to the acidic pH. The effective cation exchange capacity (eCEC) is low. Nitrogen and potassium are low. Phosphorus is low. Micronutrients iron, zinc, copper and boron are low. Manganese is very high at 300 mg/kg.

Group 5 - Billabong Areas

Topsoil is typically a silty clay loam with moderate organic matter. Soil pH is moderately acidic in H_2O and very strongly acidic in $CaCl_2$ with very low salinity. The exchangeable cations show presence of free hydrogen due to the acidic pH, there is also presence of sodium within the sample. The effective cation exchange capacity (eCEC) is low. Nitrogen is low. Phosphorus and potassium are at reasonable levels. Micronutrients copper and boron are low. Iron, manganese and zinc are high.

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SUBSOIL RESULTS

Subsoil 1 – BH01 Subsoil (300 - 400 mm)

Subsoil is slightly acidic in H_2O and strongly acidic in $CaCl_2$ with very low salinity. Sodium is moderate and chloride is very low. The exchangeable cations indicate this soil is moderately sodic and high in magnesium. Dispersion is likely.

Subsoil 2 – BH17 Subsoil (200 - 700 mm)

Subsoil is close to neutral in H_2O and strongly acidic in $CaCl_2$ with very low salinity. Sodium and chloride are high. The exchangeable cations indicate this soil is moderately sodic and very high in magnesium. High levels of dispersion is likely.

Subsoil 3 – BH09 Subsoil (250 – 500 mm)

Subsoil is slightly acidic in H_2O and strongly acidic in $CaCl_2$ with slight salinity. Sodium and chloride are very high. The exchangeable cations indicate this soil is highly sodic and very high in magnesium. High levels of dispersion is likely.

Subsoil 4 – BH19 Subsoil (400 – 700 mm)

Subsoil is slightly acidic in H_2O and strongly acidic in $CaCl_2$ with slight salinity. Sodium and chloride are very high. The exchangeable cations indicate this soil is highly sodic and very high in magnesium. High levels of dispersion is likely.

7. DISCUSSION AND LIMITATIONS

The results of the site survey and laboratory analysis show the distribution of soil characteristics across the AWRC site. While there are some similarities within areas of the site, across the whole construction footprint there is some variability. This is to be expected considering the size of the site, and the differing soil landscapes present.

SOIL CHARACTERISTICS

While soil characteristics differ across the various groups presented in the results, there is a general trend of soil characteristics that can be observed for the data obtained. Topsoil is generally low in organic matter, with acidic pH conditions and high magnesium. Sodic conditions and dispersion are typically not observed in the topsoil. Nitrogen, phosphorus, and potassium are generally low and will require amendment. The overall limitations that will require amendment is the acidic pH, poor cation balance and low nutrients. Manganese is also high in all samples, likely due to the regular flooding that is experienced in the area, manganese toxicity will likely be seen if not managed correctly. These limitations are addressed in the preliminary soil amelioration plan.

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The subsoil across the site is also similar regarding characteristics and limitations. The subsoil conditions across the site are best described as hostile to plant growth and highly erodible. This is due to the acidic pH conditions, presence of high sodium and heavy texture. These soils are typical of the Western Sydney region and are known for difficulty in re-use for vegetation and construction.

When exposed, the subsoil material is very prone to dispersion due to the high sodium content. When re-used in landscaping operations, the highly sodic and acidic conditions interfere with the uptake of water and nutrients in plants that are not adapted to these conditions. Heavy textured subsoil also poses a significant risk of waterlogging without proper management. Subsoil constraints must be addressed prior to the installation of topsoil and plant out to avoid landscape failure.

It is important to note that the survey conducted in this report is preliminary only, and provides estimates to the likely amendments required for topsoil and subsoil re-use in landscaping. This highlights the requirements for testing outlined in section 8 of this report.

8. STRIPPING, STOCKPILING AND AMELIORAITON PLAN – AREAS TO BE STRIPPED

Topsoil depth is reasonably uniform in the area to be stripped within the project. On average, the topsoil depth is 200 - 250 mm, a safe stripping depth to avoid inclusion of sodic subsoil is 200mm. Provided below is a summary of the required stripping, stockpiling and amelioration requirements for the area to be stripped on site.

We also advise that some subsoil be stripped well to cover potentially saline soils in the deeper cut areas. On about ¼ of the site strip another 200 mm of clean clay subsoil avoiding locations BH9 and BH19. Reserve this separately to the topsoil stockpiles and clearly label and record the location of the stockpiles.

Please note that the application rates for soil amendments are preliminary only and serve to provide guidance for contractors and estimators. There are specific requirements outlined in the hold points table that list the testing required to confirm rates for on-site application. Failure to test stockpiled topsoil and exposed subsoil will likely lead to landscape failure.

STRIPPING, STOCKPILINING AND SOIL MANAGEMENT

The following section is divided into 5 areas for contractor use:

1. Soil stripping and stockpiling process
2. Site subgrade preparation, treatment and required testing
3. Topsoil Stockpile Treatment and required testing
4. Topsoil re-spreading for use in landscape.
5. Amelioration Validation

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SOIL STRIPPING AND STOCKPILING PROCESS

Stripping and stockpiling of topsoil should occur immediately before bulk earthworks and be done in such a manner as to minimise erosion and sediment loss from site. Preparation is necessary to ensure that rubbish and foreign matter is minimised in the stripped soil.

Stockpiles must be in a convenient place away from any risk of running water and subject to suitable erosion control measures. They must be protected from contamination during the construction process and records kept of their location and type of soil, if any, they contain.

Note: Use an excavator with a wide bucket for operations on the steeper batters or where access is difficult. Its imperative during the stripping that the process is carefully supervised to ensure that both weeds and subsoil are not included with the topsoil.

Table 3 – Stripping and stockpiling process

Process	Description
Preparation:	• Clear all debris including demolition waste, timber, rubbish wire fences, rock, graveled driveways etc. • Clear trees and shrub growth and slash if necessary. • Clear pasture and weed growth. • Habitat features such as tree hollows and logs will be salvaged where feasible during clearing and stockpiled for future use. • A licensed bushland regeneration contractor to undertake native seed collection prior to clearing. Seed to be collected in each season throughout the year from all strata, including felled trees, shrubs, grass and herb species. • Spray a systemic herbicide (such as glyphosate) and wait the withholding period prior to stripping.

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Stripping:	Remove and stockpile separately topsoil to a depth of 150mm. • Strip the remaining topsoil to depths defined in table 2. NOTE: These depths are a guide only and do not replace the requirement of stripping supervision and identification of subsoil layers. Where suitable topsoil is deeper than the nominated stripping depth, additional volume may be exploited at the discretion of the superintendent on advice from a soil scientist. • Avoid the inclusion of subsoil in topsoil stripping, adjust depth accordingly. Stop stripping if the more brightly coloured red or yellow clay subsoil starts showing.
Subsoil stripping	Over about ¼ of the site and avoiding locations BH9 and BH19 strip 2000 mm of the next layer, the subsoil or B horizon.
Locate stockpiles in a convenient location:	• Locate stockpiles 5 m or more from concentrated water flows (including drainage lines, roadways). • Locations should have less than 10% slope. • Locate greater than 8 m from any retained trees. • Protect upslope using diversion drains. • Protect downslope sediment loss using sediment control structures (silt fencing or other approved method).

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Management	• Stockpiles must never be trafficked. Fence stockpiles to exclude all vehicles. • Stockpiles must be no higher than 1 m but may be flat topped. • Label stockpiles with origin and date and record their location. • Protect stockpiles from waste and rubbish dumping and encroachment of works. • If stockpiles are to be in place longer than 3 months, sow with a seasonally appropriate sterile annual cover crop • Topsoil should be re-used and spread as soon as practicably possible

9. SITE SUBGRADE PREPARATION AND TREATMENT

Before laying topsoil, the following subgrade treatment must be applied to all finished subgrade areas:

Retest areas of deep cut for salinity and cation exchange properties

Where deep subgrade is found to be saline or otherwise very hostile place 300 mm of reserved subsoil over the hostile subgrade.

Fair and trim to relative level to accommodate the required overall soil depths

Remove rocks > 100 mm diameter.

Remove rubbish such as construction generated waste, plastics, metals and glass.

Due to the hostile conditions identified within this preliminary assessment, subgrade testing is strongly recommended in order to determine the exact treatments required prior to the application of ameliorated topsoil. Currently we can say gypsum, lime and/or iron sulfate will likely be required.

Test finished levels / exposed subgrade for landscaping use at a density of 1 composite sample per 1,000m^2 prior to amelioration. Sampling should be carried out by a suitably qualified soil scientist. Testing must include pH, EC, Cation Balance, Texture and Structure. Testing must be conducted by a NATA accredited laboratory and include interpretations and recommendations on the amelioration of soil to achieve fit for purpose subsoil.

ESTIMATED AMELIORATION RATES – SUBGRADE/ SUBSOIL

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Allow for lime and gypsum as specified below to ameliorate the subgrade. These application rates serve as an approximation only and should be used for estimations only. Characterisation of subgrade is required as mentioned above.

Gypsum is estimated to be required to be applied at 0.5 – 2.0 kg/m^2 into the top 200 mm of exposed subgrade. Chisel, disc plough or use an excavator with a tyne attachment to loosen the subgrade and mix the ameliorants to 200 mm depth to incorporate.

10. TOPSOIL TREATMENT AND TESTING PROCEDURE – STRIPPED/STOCKPILED TOPSOIL

PRIMARY AMELIORATION

Primary amelioration involves the addition of lime and gypsum to the soil to correct soil pH, improve cation balance and organic matter. The following section provides the recommended amelioration rate for the area to be stripped.

Guidance has been provided below on the expected amelioration requirements for site soil. These values are an estimate only and do not replace the requirements for topsoil stockpile testing prior to the amendment of soil.

Again, due to some variability within the site, it is strongly recommended that topsoil is tested after stripping to determine exact treatments required to achieve a fit for purpose topsoil.

Topsoil stockpiles must be tested at a rate of 1:1,000m^3 prior to amelioration to confirm the required amendments to achieve fit for purpose soil. Sampling should be carried out by a suitably qualified soil scientist. Testing must be conducted by a NATA accredited laboratory and include interpretations and recommendations on the amelioration of soil to achieve fit for purpose subsoil.

ESTIMATED PRIMARY AMELIORATION RATES - TOPSOIL

Allow for lime and gypsum according to the following schedule in Table 4 to ameliorate the topsoil. These application rates serve as an approximation only and should be used for estimations only. Characterisation of topsoil stockpiles is required as mentioned above prior to treatment.

<u>All topsoil should be screened to 50mm minus prior to amelioration</u>

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Table 4 – Estimated Primary Amelioration Recommended Gypsum and Lime rates for mass plantings and seeding.

Landscape treatment	Lime kg/m³	Gypsum kg/m³	Compost* %v/v
Group 2	0.5	0.25	20

*Compost must be compliant to AS4454 or equivalent.

Stockpiled soils are to be re-tested to determine the required application rates of gypsum and/or lime to ensure correct amounts are added to amend soil conditions.

SECONDARY AMELIORATION

Secondary amelioration involves the addition of fertilisers into the soil to improve the nutrient profile of the soils. SESL recommends that fertilisers are added shortly before topsoil is to be laid or just prior to planting to ensure the nutrients are utilised. Fertiliser recommendations have been provided in table 5 for stockpile blending (g/m^3) and post spread (g/m^2 to a 100 mm depth) for each landscape applications.

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Table 5 - Estimated fertiliser application rates for mass plantings and seeding*

Soil Group	Fertiliser Addition
Group 2	• For Non-P Sensitive Species, apply Nitrophoska Blue (or Similar NPK) at 25 g/m^2 or 250 g/m^3 • For P-sensitive species, apply Neutrog's Bush Tucker (or similar NPK) at 100 g/m^2 or 1.0 kg/m^3

Topsoils may be ameliorated by batch mixing or by incorporation post-spreading.

TOPSOIL RE-SPREADING FOR USE IN LANDSCAPE

The method of application that proves most economical is usually:

1. Spray weed growth on the soil stockpiles (mixed at the manufacturers specification) with Roundup or other brand of Glyphosate concentrate and wait 2 weeks
2. Remove excess rank weed growth
3. Screen material to 50mm minus
4. Apply the ameliorants as specified in table 5
5. Spread topsoil in appropriate landscape areas
6. Incorporate ameliorants outlined in table 6 into the surface 50mm using chisel ploughs
7. Leave in loose condition for planting, do not consolidate
8. Alternatively, the soils fertilisers can be blended into the stockpiles using the m^3 application rate.
9. Exclude any vehicular traffic across topsoiled areas

11.IMPORTANCE OF STOCKPILE TESTING AND VALIDATION

The preliminary amelioration process outlined above is based on the data obtained from the samples collected by SESL in the initial charactisation of site soils. These figures and estimates are accurate, however will not capture the natural variation across the site as stripping and stockpiling is conducted. There is a critical requirement for stockpile testing and characterisation prior to confirming the amelioration plan for each stockpile of topsoil.

Similarly, due to natural variations within stockpiles (especially those of large volume), there is a requirement to validate the efficacy of amelioration procedures. It is also essential that a validation 'check' is conducted on treated soil to ensure that

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the material is fit for purpose and does not require additional amendment prior to plantout.

12.TOPSOIL TREATMENT AND TESTING PROCEDURE – IN SITU SOIL

It is understood that the areas outside of the stripping area will require topsoil treatment for future plantings. These areas are to be treated differently to the topsoil treatment mentioned for stripped / stockpiled soils.

For shrubs and smaller plantings, no subsoil treatment is required, and the top 200mm may be re-worked to improve soil conditions prior to planting. These areas do not require additional testing prior to re-working. Outlined in table 6 below is the recommended amelioration for each area to be treated in-situ. Refer to groups listed in section 6 and marked in appendix B for locations.

Table 6 – Estimated Primary Amelioration Recommended Gypsum and Lime rates for mass plantings and seeding.

Landscape treatment	Lime g/m^2	Gypsum g/m^2	Compost* %v/v
Group 1 and 3 (Upper Slope)	100	500	20
Group 4 (Alluvial Areas)	100	200	20
Group 5 (Billabong Areas)	240	300	NIL

All ameliorants are to be incorporated to a depth of 200mm

*Compost must be compliant to AS4454 or equivalent.

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SECONDARY AMELIORATION

Secondary amelioration involves the addition of fertilisers into the soil to improve the nutrient profile of the soils. SESL recommends that fertilisers are added shortly before topsoil is to be laid or just prior to planting to ensure the nutrients are utilised.

Table 7 - Estimated fertiliser application rates for mass plantings and seeding

Soil Group	Fertiliser Addition
Groups 1 and 3	• For Non-P Sensitive Species, apply Nitrophoska Blue (or Similar NPK) at 25 g/m^2 • For P-sensitive species, apply Neutrog's Bush Tucker (or similar NPK) at 100 g/m^2
Groups 4 and 5	• For Non-P Sensitive Species, apply Nutricote Black (or similar CRF fertiliser) at 5 g per planting hole • For P Sensitive Species, apply Nutricote Pink (or similar CRF fertiliser) at 5 g per planting hole

Controlled release fertilisers have been recommended at a low rate for the alluvial / riparian areas and the billabong region in order to avoid nutrification within the surrounding creeks.

13.SUBSOIL TREATMENT AND TESTING PROCEDURE – IN SITU SOIL

For plantings that involve the excavation of subsoil (likely for all plant stock > 25L) it is recommended that the topsoil be stripped back (stockpiled separately) and subsoil be excavated 1m x 1m greater than the plant stock rootball. This subsoil should be tested for amelioration as it is likely hostile to plant species to be established. Amelioration rates may be estimated from section 9 however are subject to localised testing to ensure correct rates are applied.

All large plant stock will require the installation of a 65 mm U shaped ag pipe underneath the root ball, with the ends exposed above the topsoil to allow for aeration into the subsoil.

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14.AN IMPORTANT NOTE ON MANGANESE TOXICITY

The manganese levels measured within all topsoil samples within the AWRC footprint are high, at levels potentially toxic to plant species. It is understood that the area is subject to periodic flooding, which would cause waterlogged conditions and as a result, the accumulation of manganese.

It is critical to the landscape success that the topsoil is not allowed to become waterlogged from irrigation, rainfall, or flooding. Under these conditions is when manganese is mobilised and can be taken up by plants causing toxicity. Only very Mn tolerant plants will be suited to such a condition. Fortunately this includes most Cumberland Plain woodland species but plants from sandstone areas like Eucalyptus hemastoma do not tolerate this.

The installation of site-wide drainage required for infrastructure will likely prevent flooding conditions, and granted topsoils are free draining, should not waterlog under normal conditions. The installation of U-shaped Ag pipes will also assist in the drainage capacity underneath larger trees.

SESL encourages the inclusion of bedding sand at a 50mm depth under larger tree stock if these conditions are to be expected. It would be worthwhile inspecting the planting list to determine if any manganese sensitive speices are included within the palate to prevent particularly susceptible species being planted in these high manganese soils.

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15.CONCLUSION

Within this report SESL has discussed the preliminary assessment of site soil within the development footprint of the Advanced Water Recycling Centre using laboratory analysis interpreted by a soil scientist. SESL has provided a preliminary amelioration and amendment plan for estimation purposes.

Stripping, stockpiling, and testing requirements have also been outlined to achieve fit for purpose site soils. Recommendations for the amelioration of soil to remain in-situ has also been provided for the areas which are to remain intact and re-worked for future plantings.

Please feel free to contact the undersigned for any questions regarding this report.

Yours sincerely,

SESL AUSTRALIA PTY LTD

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BScAgr (Hons.) SSA

Simon Leake
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B Sc (Ag) Hons, ASSSI, CPSS

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LIMITATIONS OF THIS REPORT:

SESL has performed an investigation and consulting services for this project as outlined in our discussions and in accordance with current professional and industry standards for environmental site assessment. The findings of this report are the result of discrete/specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of this site and do not represent the actual state of the site at all points. Should materials or conditions be encountered other than those which have been described these will require additional assessment.

SESL assessment is based on the result of limited site investigation. SESL cannot provide unqualified warranties nor assume any liability for site conditions not observed, accessible during the time of the investigations.

Despite all reasonable care and diligence, the ground conditions encountered and the concentrations of contaminants measured may not be representative of conditions between the locations samples and investigated. In addition, site characteristics may change as a result of soil heterogeneity, chemical reactions and other events. These changes may occur subsequent to SESL investigation and assessment.

This report and associated documentation and the information herein have been prepared solely for the use of the client and any relevant authority. Any reliance assumed by third parties on this report shall be at such parties own risk. Any ensuring liability resulting from use of the report by third parties cannot be transferred to SESL.

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Appendix A

Laboratory Results

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
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Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

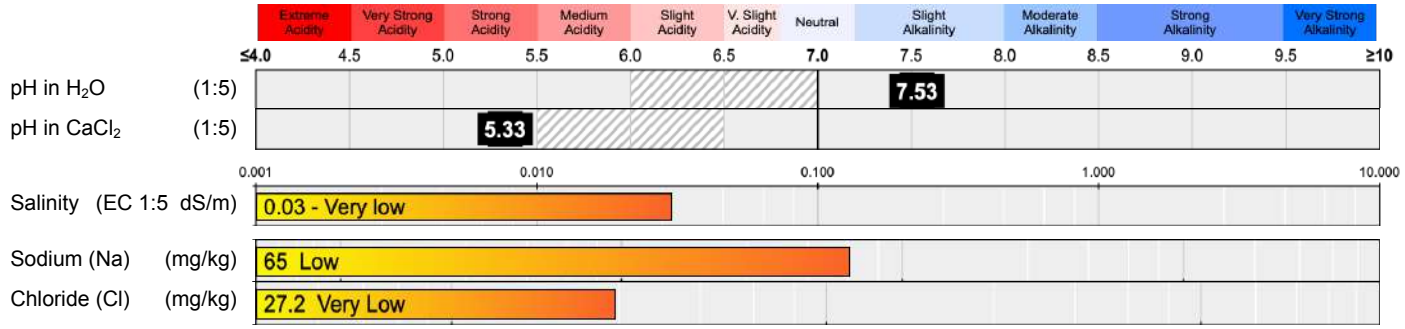
Batch N°: 65786 | **Sample N°: 1** | **Date Received: 11/8/23** | **Report Status: Final**

Client Name:	**Tract Consultants Pty Ltd**	Project Name:	**AWRC**
		SESL Quote N°:	
Client Contact:	**Adam Jeffery**	Sample Name:	**Composite 1**
Client Order N°:		Description:	**Soil**
Address:	**Level 8, 80 Mount St North Sydney NSW 2060**	Test Type:	**FSC_Plus**

RECOMMENDATIONS

For discussion and recommendations, see SESL report J004754.

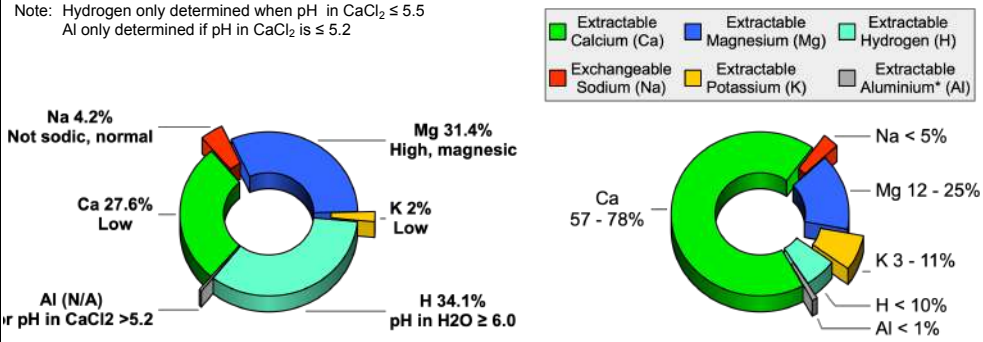
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**0.9**	3 – 6
Comment: Potential Calcium deficiency		
Mg:K	**20**	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	**0.03**	< 0.07
Comment: Acceptable		
K:Na	**0.46**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
0.28	0.13	1.82	2.07	2.25	-

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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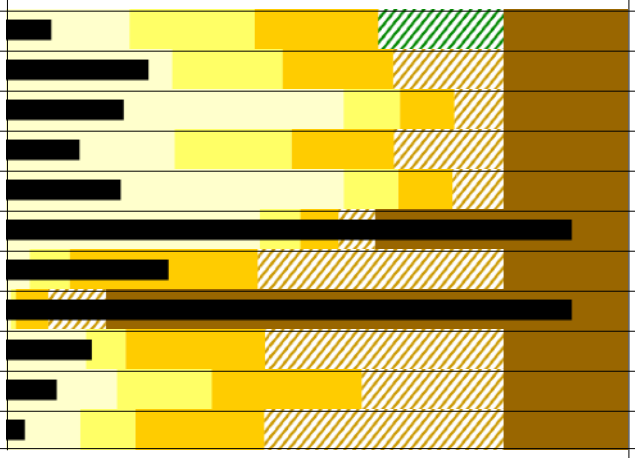
PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	1.9		0.3	4	3.7
Phosphorus (P)	mg P/kg	18		2.4	8.4	6
Potassium (K)	mg/kg	52		6.9	29.3	22.4
Sulfur (S)	mg S/kg	10		1.3	9	7.7
Calcium (Ca)	mg/kg	360		47.9	208.3	160.4
Magnesium (Mg)	mg/kg	250		33.3	21.7	Drawdown
Iron (Fe)	mg/kg	180		23.9	73.4	49.5
Manganese (Mn)	mg/kg	250		33.3	5.9	Drawdown
Zinc (Zn)	mg/kg	0.86		0.1	0.7	0.6
Copper (Cu)	mg/kg	<0.64		0.1	0.8	0.7
Boron (B)	mg/kg	<0.1		0	0.4	0.4



Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

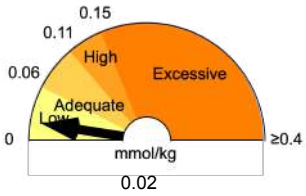
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.6**
Sum of Base Cations (cmol(+)/kg):	**4.3**
Eff. Cation Exch. Capacity (eCEC):	**6.6**
Base Saturation (%):	**65.15**
Exchangeable Acidity (cmol(+)/kg):	**-**
Exchangeable Acidity (%):	**-**

Lime Application Rate (g/sqm)

– to achieve pH 6.0: **0**
– to neutralise Al: **-**

Calculated Gypsum Application Rate (CGAR)

(g/sqm) to achieve 67.5 % exch. Ca: **302**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Silty Clay Loam**	Munsell Colour:	**-**	Organic Carbon (OC %):	**Low - 1.3**
Estimated clay content:	**25 - 35%**	Structure Size:	**Medium (11 - 25mm)**	Organic Matter (OM %):	**2.3**
Tactually gravelly:	**Gravelly**	Structural Organisation:	**Pedal - Moderate**	Est. Field Capacity (% water):	**43**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**20**
Calculated EC_{SE} (dS/m):	**0.3**	Potential infiltration rate:	**Moderate**	Est. Plant Available Water (% water):	**23**
– Non-saline. Salinity effects on plants are mostly negligible.		Est. Permeability Class (mm/hr):	**20 - 60**	Est. Plant Available Water (mm/m):	**230**
		Additional comments:			

Date Report Generated 20/09/2023

Consultant: Owen Guy

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

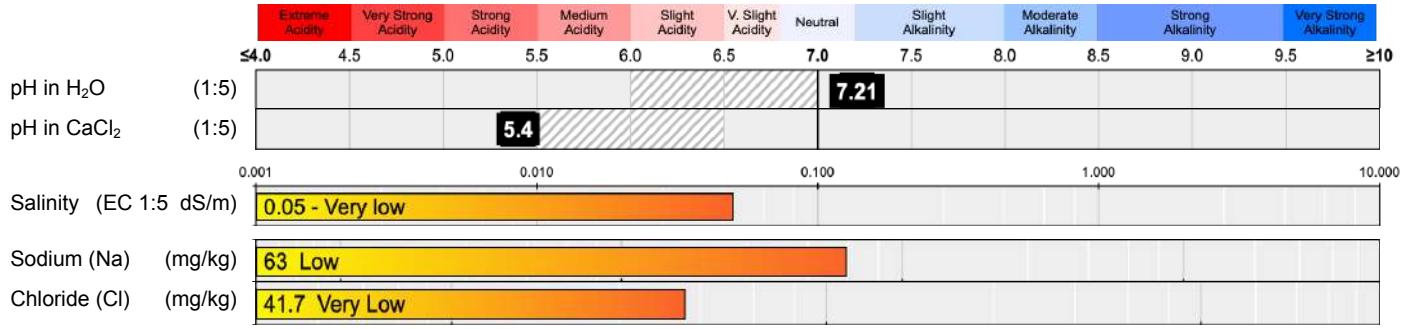
Batch N°: 65786 | **Sample N°: 2** | **Date Received: 11/8/23** | **Report Status: Final**

Client Name:	**Tract Consultants Pty Ltd**	Project Name:	**AWRC**
		SESL Quote N°:	
Client Contact:	**Adam Jeffery**	Sample Name:	**Composite 2**
Client Order N°:		Description:	**Soil**
Address:	**Level 8, 80 Mount St North Sydney NSW 2060**	Test Type:	**FSC_Plus**

RECOMMENDATIONS

For discussion and recommendations, see SESL report J004754.

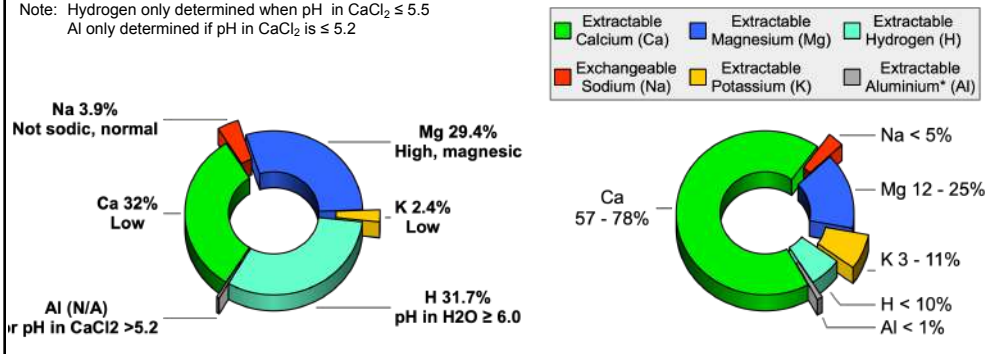
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



ACTUAL

IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**1.1**	3 – 6
Comment: Calcium low		
Mg:K	**10**	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	**0.04**	< 0.07
Comment: Acceptable		
K:Na	**0.61**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
0.28	0.17	2.27	2.09	2.25	-

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 65786 | **Sample N°: 2** | **Date Received: 11/8/23** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	2.6		0.3	4	3.7
Phosphorus (P)	mg P/kg	21		2.8	8.4	5.6
Potassium (K)	mg/kg	68		9	29.3	20.3
Sulfur (S)	mg S/kg	15		2	9	7
Calcium (Ca)	mg/kg	450		59.9	208.3	148.4
Magnesium (Mg)	mg/kg	250		33.3	21.7	Drawdown
Iron (Fe)	mg/kg	180		23.9	73.4	49.5
Manganese (Mn)	mg/kg	260		34.6	5.9	Drawdown
Zinc (Zn)	mg/kg	1.5		0.2	0.7	0.5
Copper (Cu)	mg/kg	0.85		0.1	0.8	0.7
Boron (B)	mg/kg	<0.1		0	0.4	0.4

Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

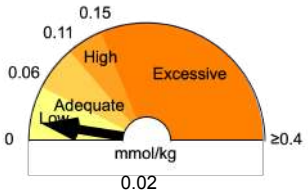
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.6**
Sum of Base Cations (cmol(+)/kg):	**4.8**
Eff. Cation Exch. Capacity (eCEC):	**7.1**
Base Saturation (%):	**67.61**
Exchangeable Acidity (cmol(+)/kg):	**-**
Exchangeable Acidity (%):	**-**

Lime Application Rate (g/sqm)

– to achieve pH 6.0: **0**
– to neutralise Al: **-**

Calculated Gypsum Application Rate (CGAR)

(g/sqm) to achieve 67.5 % exch. Ca: **289**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Silty Clay Loam**	Munsell Colour:	**-**	Organic Carbon (OC %):	**Moderate - 1.5**
Estimated clay content:	**25 - 35%**	Structure Size:	**Medium (11 - 25mm)**	Organic Matter (OM %):	**2.5**
Tactually gravelly:	**Gravelly**	Structural Organisation:	**Pedal - Moderate**	Est. Field Capacity (% water):	**43**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**20**
Calculated EC_{SE} (dS/m):	**0.4**	Potential infiltration rate:	**Moderate**	Est. Plant Available Water (% water):	**23**
– Non-saline. Salinity effects on plants are mostly negligible.		Est. Permeability Class (mm/hr):	**20 - 60**	Est. Plant Available Water (mm/m):	**230**
		Additional comments:			

Date Report Generated 20/09/2023

Consultant: Owen Guy

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

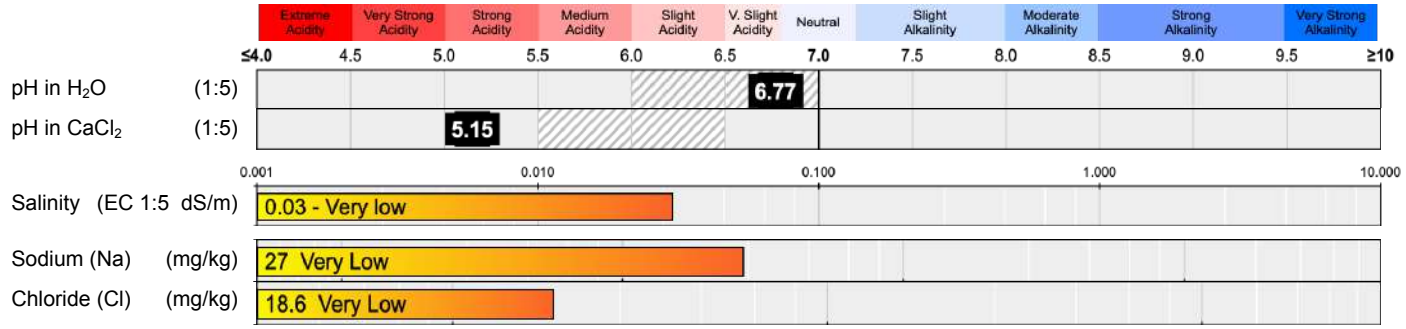
Batch N°: 65786 | **Sample N°: 3** | **Date Received: 11/8/23** | **Report Status: Final**

Client Name:	**Tract Consultants Pty Ltd**	Project Name:	**AWRC**
		SESL Quote N°:	
Client Contact:	**Adam Jeffery**	Sample Name:	**Composite 3**
Client Order N°:		Description:	**Soil**
Address:	**Level 8, 80 Mount St North Sydney NSW 2060**	Test Type:	**FSC_Plus**

RECOMMENDATIONS

For discussion and recommendations, see SESL report J004754.

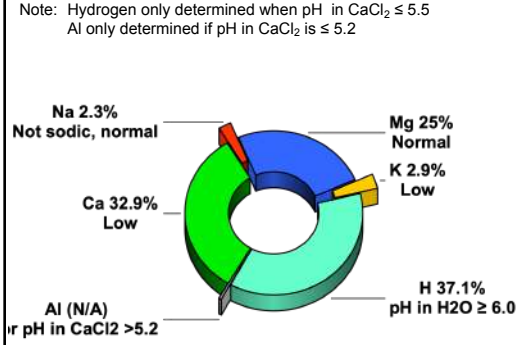
pH and ELECTRICAL CONDUCTIVITY



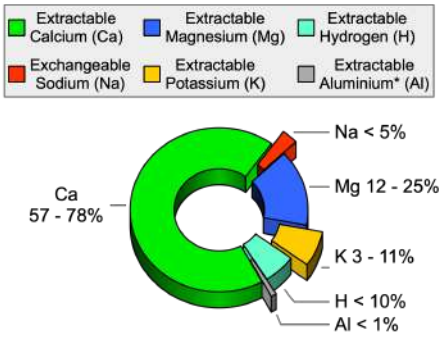
CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



ACTUAL



IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**1.3**	3 – 6
Comment: Calcium low		
Mg:K	**9**	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	**0.05**	< 0.07
Comment: Acceptable		
K:Na	**1.3**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
0.12	0.15	1.71	1.3	1.93	0

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

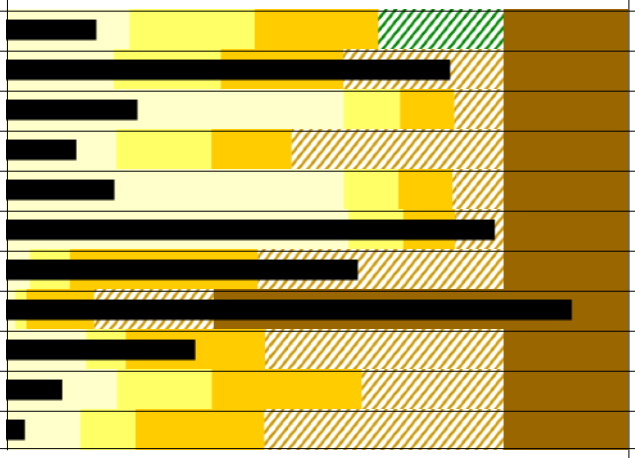
Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 65786 | **Sample N°: 3** | **Date Received: 11/8/23** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	3.8		0.5	4	3.5
Phosphorus (P)	mg P/kg	58		7.7	8.4	0.7
Potassium (K)	mg/kg	58		7.7	29.3	21.6
Sulfur (S)	mg S/kg	9.6		1.3	9	7.7
Calcium (Ca)	mg/kg	340		45.2	208.3	163.1
Magnesium (Mg)	mg/kg	160		21.3	21.7	0.4
Iron (Fe)	mg/kg	390		51.9	73.4	21.5
Manganese (Mn)	mg/kg	120		16	5.9	Drawdown
Zinc (Zn)	mg/kg	1.9		0.3	0.7	0.4
Copper (Cu)	mg/kg	0.71		0.1	0.8	0.7
Boron (B)	mg/kg	<0.1		0	0.4	0.4



Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

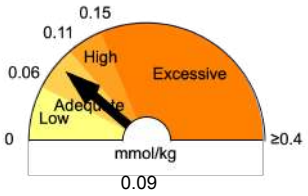
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Adequate. Economic response to P unlikely. P application recommended maintaining current P level.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.7**
Sum of Base Cations (cmol(+)/kg):	**3.3**
Eff. Cation Exch. Capacity (eCEC):	**5.2**
Base Saturation (%):	**63.46**
Exchangeable Acidity (cmol(+)/kg):	**-**
Exchangeable Acidity (%):	**-**

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	**0**

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **206**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Silty Clay Loam**	Munsell Colour:	**-**	Organic Carbon (OC %):	**Low - 1.3**
Estimated clay content:	**25 - 35%**	Structure Size:	**Medium (11 - 25mm)**	Organic Matter (OM %):	**2.2**
Tactually gravelly:	**Not gravelly**	Structural Organisation:	**Pedal - Moderate**	Est. Field Capacity (% water):	**43**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**20**
Calculated EC_{SE} (dS/m):	**0.3**	Potential infiltration rate:	**Moderate**	Est. Plant Available Water (% water):	**23**
– Non-saline. Salinity effects on plants are mostly negligible.		Est. Permeability Class (mm/hr):	**20 - 60**	Est. Plant Available Water (mm/m):	**230**
		Additional comments:			

Date Report Generated 20/09/2023

Consultant: Owen Guy

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
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Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

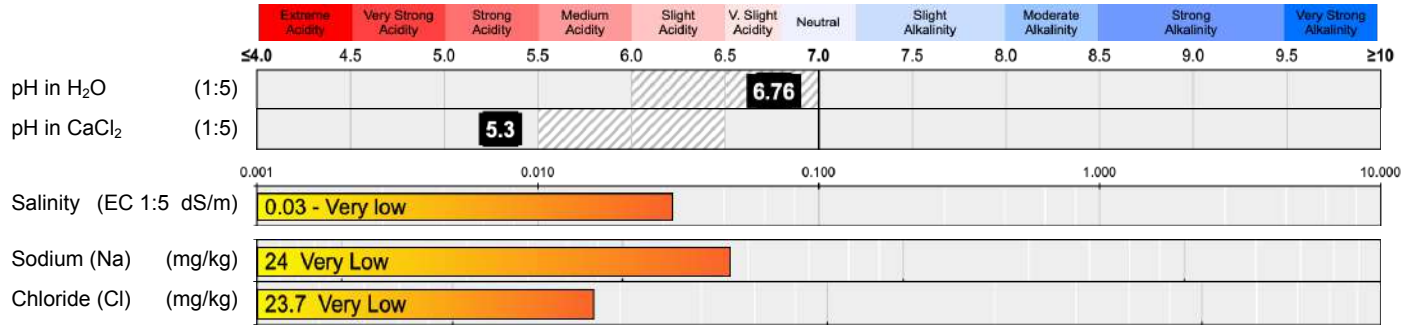
Batch N°: 65786 | **Sample N°: 4** | **Date Received: 11/8/23** | **Report Status: Final**

Client Name:	**Tract Consultants Pty Ltd**	Project Name:	**AWRC**
		SESL Quote N°:	
Client Contact:	**Adam Jeffery**	Sample Name:	**Composite 4**
Client Order N°:		Description:	**Soil**
Address:	**Level 8, 80 Mount St North Sydney NSW 2060**	Test Type:	**FSC_Plus**

RECOMMENDATIONS

For discussion and recommendations, see SESL report J004754.

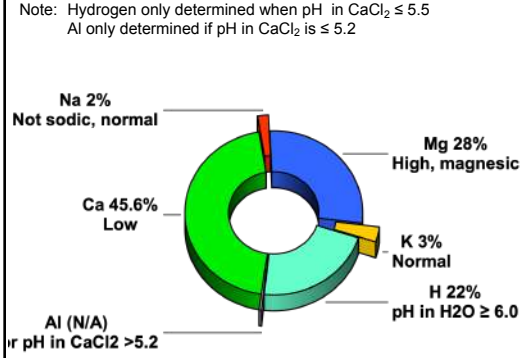
pH and ELECTRICAL CONDUCTIVITY



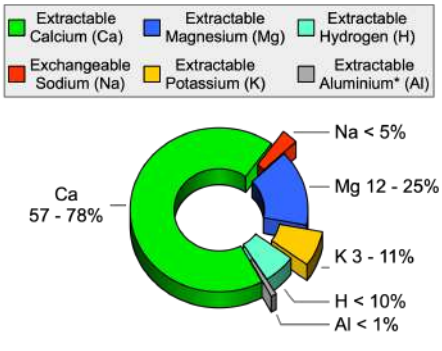
CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2 \leq 5.5$
Al only determined if pH in $CaCl_2$ is ≤ 5.2



ACTUAL



IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**1.6**	3 – 6
Comment: Calcium low		
Mg:K	**9**	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	**0.04**	< 0.07
Comment: Acceptable		
K:Na	**1.5**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
0.11	0.16	2.46	1.51	1.19	-

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
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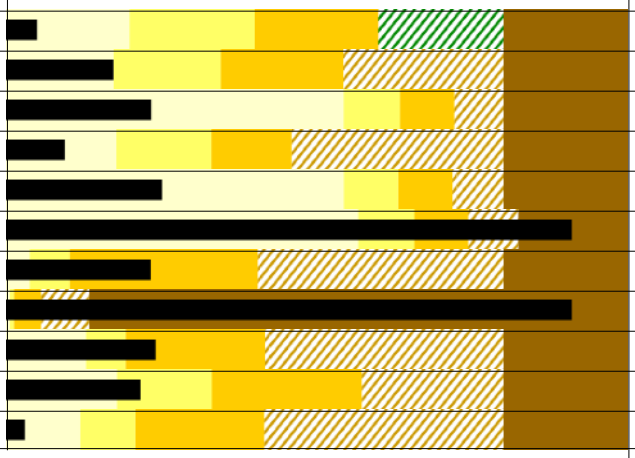
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 65786 | **Sample N°: 4** | **Date Received: 11/8/23** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	1.3		0.2	4	3.8
Phosphorus (P)	mg P/kg	14		1.9	8.4	6.5
Potassium (K)	mg/kg	64		8.5	29.3	20.8
Sulfur (S)	mg S/kg	8		1.1	9	7.9
Calcium (Ca)	mg/kg	490		65.2	208.3	143.1
Magnesium (Mg)	mg/kg	180		23.9	21.7	Drawdown
Iron (Fe)	mg/kg	160		21.3	73.4	52.1
Manganese (Mn)	mg/kg	300		39.9	5.9	Drawdown
Zinc (Zn)	mg/kg	1.5		0.2	0.7	0.5
Copper (Cu)	mg/kg	1.7		0.2	0.8	0.6
Boron (B)	mg/kg	<0.1		0	0.4	0.4



Explanation of graph ranges:

Very Low
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

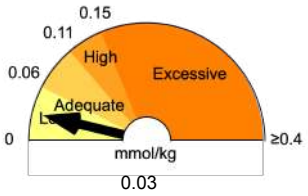
Marginal
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.8**
Sum of Base Cations (cmol(+)/kg):	**4.2**
Eff. Cation Exch. Capacity (eCEC):	**5.4**
Base Saturation (%):	**77.78**
Exchangeable Acidity (cmol(+)/kg):	**-**
Exchangeable Acidity (%):	**-**

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	**-**

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **136**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Silty Clay Loam**	Munsell Colour:	**-**	Organic Carbon (OC %):	**Low - 0.8**
Estimated clay content:	**25 - 35%**	Structure Size:	**Medium (11 - 25mm)**	Organic Matter (OM %):	**1.4**
Tactually gravelly:	**Gravelly**	Structural Organisation:	**Pedal - Moderate**	Est. Field Capacity (% water):	**43**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**20**
Calculated EC_{SE} (dS/m):	**0.3**	Potential infiltration rate:	**Moderate**	Est. Plant Available Water (% water):	**23**
– Non-saline. Salinity effects on plants are mostly negligible.		Est. Permeability Class (mm/hr):	**20 - 60**	Est. Plant Available Water (mm/m):	**230**
		Additional comments:			

Date Report Generated 20/09/2023

Consultant: Owen Guy

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

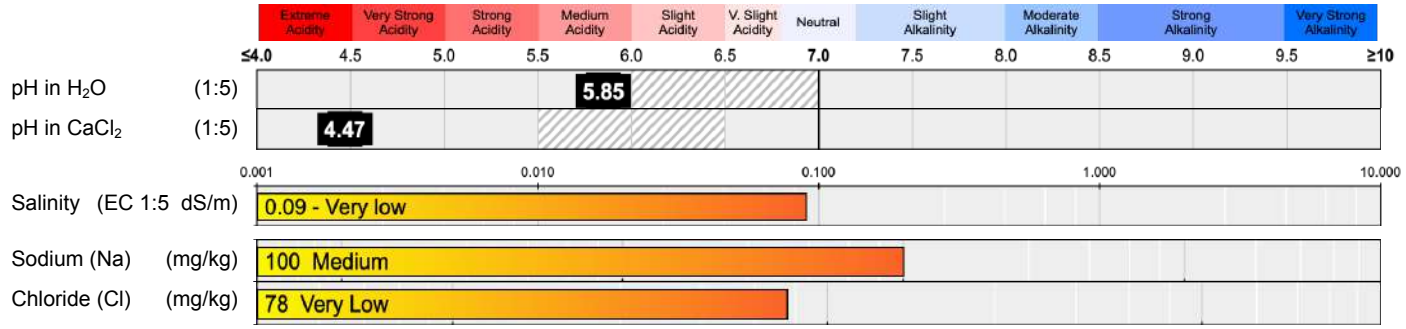
Batch N°: 65786 | **Sample N°: 5** | **Date Received: 11/8/23** | **Report Status: Final**

Client Name:	**Tract Consultants Pty Ltd**	Project Name:	**AWRC**
		SESL Quote N°:	
Client Contact:	**Adam Jeffery**	Sample Name:	**BH24 Topsoil**
Client Order N°:		Description:	**Soil**
Address:	**Level 8, 80 Mount St North Sydney NSW 2060**	Test Type:	**FSC_Plus**

RECOMMENDATIONS

For discussion and recommendations, see SESL report J004754.

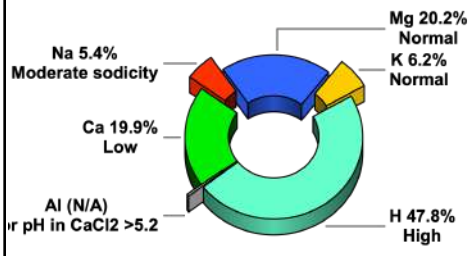
pH and ELECTRICAL CONDUCTIVITY



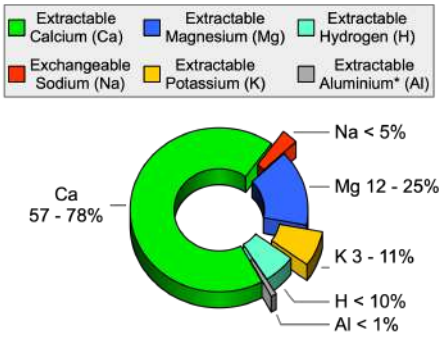
CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



ACTUAL



IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**1**	3 – 6
Comment: Calcium low		
Mg:K	**3**	2.6 – 5.0
Comment: Balanced		
K/(Ca+Mg)	**0.15**	< 0.07
Comment: High		
K:Na	**1.1**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
0.44	0.5	1.61	1.64	3.87	0

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 65786 | **Sample N°: 5** | **Date Received: 11/8/23** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	1.8		0.2	4	3.8
Phosphorus (P)	mg P/kg	46		6.1	8.4	2.3
Potassium (K)	mg/kg	190		25.3	29.3	4
Sulfur (S)	mg S/kg	33		4.4	9	4.6
Calcium (Ca)	mg/kg	320		42.6	208.3	165.7
Magnesium (Mg)	mg/kg	200		26.6	21.7	Drawdown
Iron (Fe)	mg/kg	1400		186.2	73.4	Drawdown
Manganese (Mn)	mg/kg	180		23.9	5.9	Drawdown
Zinc (Zn)	mg/kg	9.9		1.3	0.7	Drawdown
Copper (Cu)	mg/kg	1.7		0.2	0.8	0.6
Boron (B)	mg/kg	<0.1		0	0.4	0.4

Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

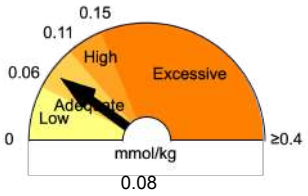
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Adequate. Economic response to P unlikely. P application recommended maintaining current P level.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.4**
Sum of Base Cations (cmol(+)/kg):	**4.2**
Eff. Cation Exch. Capacity (eCEC):	**8.1**
Base Saturation (%):	**51.85**
Exchangeable Acidity (cmol(+)/kg):	**3.87**
Exchangeable Acidity (%):	**47.78**

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**173**
– to neutralise Al:	**0**

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **144**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Silty Clay Loam**	Munsell Colour:	**-**	Organic Carbon (OC %):	**Moderate - 1.5**
Estimated clay content:	**25 - 35%**	Structure Size:	**Coarse (>25mm)**	Organic Matter (OM %):	**2.6**
Tactually gravelly:	**Not gravelly**	Structural Organisation:	**Pedal - Strong**	Est. Field Capacity (% water):	**43**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**20**
Calculated EC_{SE} (dS/m):	**0.8**	Potential infiltration rate:	**Moderate**	Est. Plant Available Water (% water):	**23**
– Non-saline. Salinity effects on plants are mostly negligible.		Est. Permeability Class (mm/hr):	**20 - 60**	Est. Plant Available Water (mm/m):	**230**
		Additional comments:			

Date Report Generated 20/09/2023

Consultant: Owen Guy

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

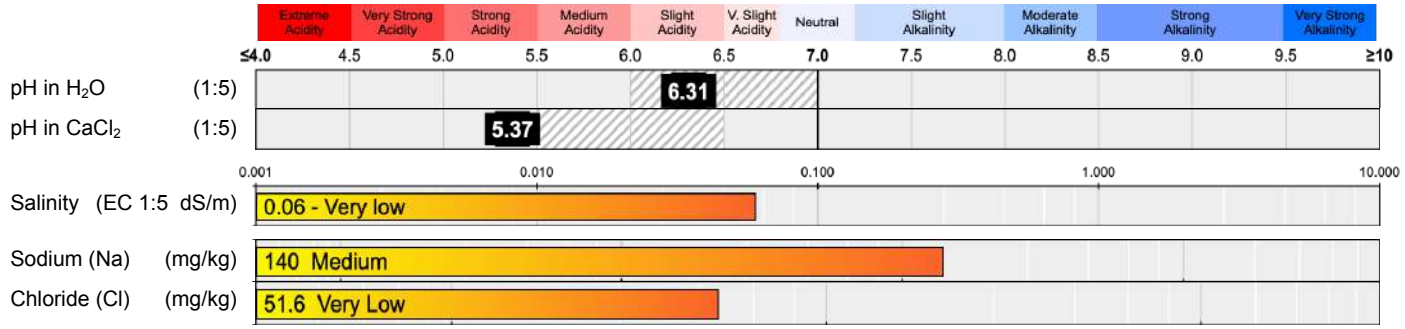
Batch N°: 65786 | **Sample N°: 6** | **Date Received: 11/8/23** | **Report Status: Final**

Client Name:	**Tract Consultants Pty Ltd**	Project Name:	**AWRC**
		SESL Quote N°:	
Client Contact:	**Adam Jeffery**	Sample Name:	**BH01 Subsoil**
Client Order N°:		Description:	**Soil**
Address:	**Level 8, 80 Mount St North Sydney NSW 2060**	Test Type:	**SSCP**

RECOMMENDATIONS

For discussion and recommendations, see SESL report J004754.

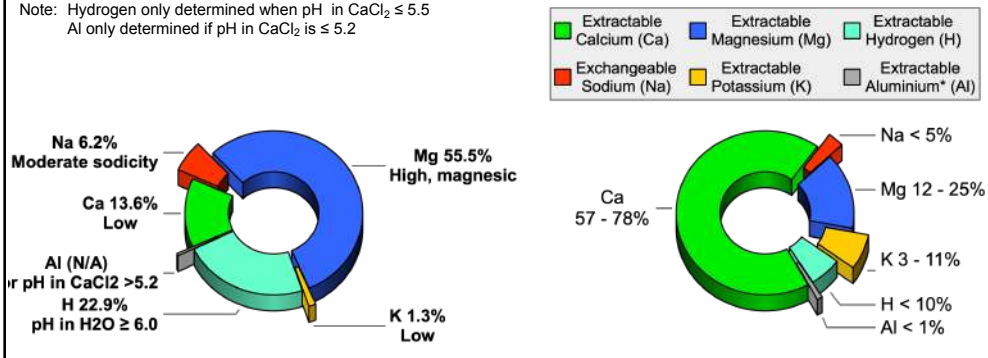
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2 \leq 5.5$
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**0.2**	3 – 6
Comment: Potential Calcium deficiency		
Mg:K	**40**	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	**0.02**	< 0.07
Comment: Acceptable		
K:Na	**0.2**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
0.59	0.12	1.29	5.27	2.18	-

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
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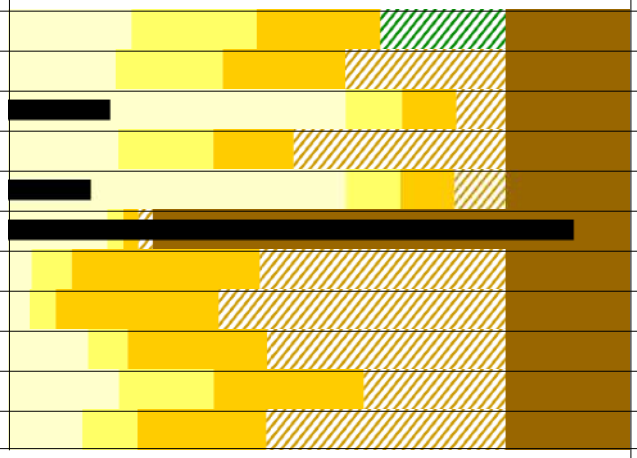
Web: www.sesl.com.au

Batch N°: 65786 | **Sample N°: 6** | **Date Received: 11/8/23** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	-		-	-	Did not test
Phosphorus (P)	mg P/kg	-		-	-	Did not test
Potassium (K)	mg/kg	45		6	29.3	23.3
Sulfur (S)	mg S/kg	-		-	-	Did not test
Calcium (Ca)	mg/kg	260		34.6	208.3	173.7
Magnesium (Mg)	mg/kg	640		85.1	21.7	Drawdown
Iron (Fe)	mg/kg	-		-	-	Did not test
Manganese (Mn)	mg/kg	-		-	-	Did not test
Zinc (Zn)	mg/kg	-		-	-	Did not test
Copper (Cu)	mg/kg	-		-	-	Did not test
Boron (B)	mg/kg	-		-	-	Did not test



Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

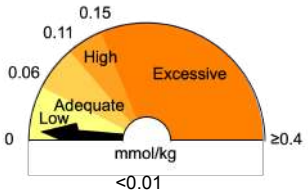
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.7**
Sum of Base Cations (cmol(+)/kg):	**7.3**
Eff. Cation Exch. Capacity (eCEC):	**9.5**
Base Saturation (%):	**76.84**
Exchangeable Acidity (cmol(+)/kg):	**-**
Exchangeable Acidity (%):	**-**

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	**-**

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **586**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Fine Sandy Clay Loam**	Munsell Colour:	**-**	Organic Carbon (OC %):	**-**
Estimated clay content:	**20 - 30%**	Structure Size:	**Medium (11 - 25mm)**	Organic Matter (OM %):	**-**
Tactually gravelly:	**Gravelly**	Structural Organisation:	**Pedal - Moderate**	Est. Field Capacity (% water):	**28**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**15**
Calculated EC_{SE} (dS/m):	**0.5**	Potential infiltration rate:	**Moderate**	Est. Plant Available Water (% water):	**13**
– Non-saline. Salinity effects on plants are mostly negligible.		Est. Permeability Class (mm/hr):	**20 - 60**	Est. Plant Available Water (mm/m):	**130**
		Additional comments:			

Date Report Generated 20/09/2023

Consultant: Owen Guy

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

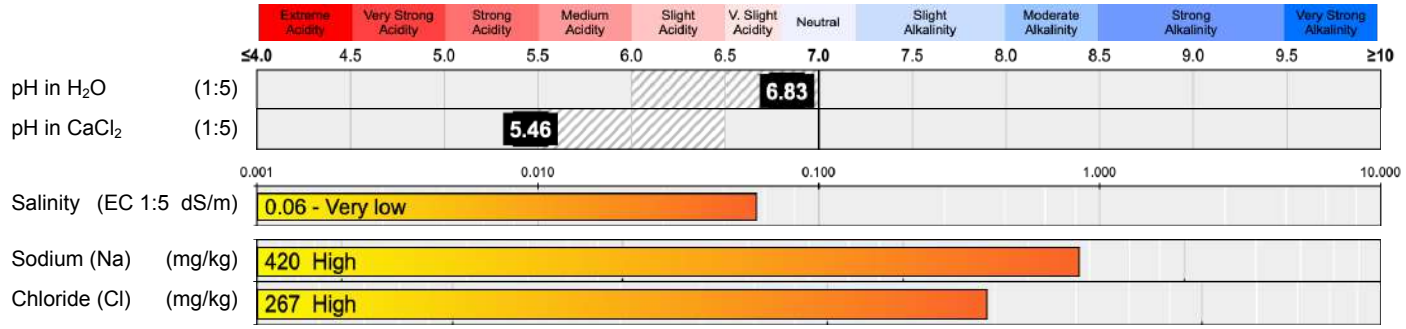
Batch N°: 65786 | **Sample N°: 7** | **Date Received: 11/8/23** | **Report Status: Final**

Client Name:	**Tract Consultants Pty Ltd**	Project Name:	**AWRC**
		SESL Quote N°:	
Client Contact:	**Adam Jeffery**	Sample Name:	**BH17 Subsoil**
Client Order N°:		Description:	**Soil**
Address:	**Level 8, 80 Mount St North Sydney NSW 2060**	Test Type:	**SSCP**

RECOMMENDATIONS

For discussion and recommendations, see SESL report J004754.

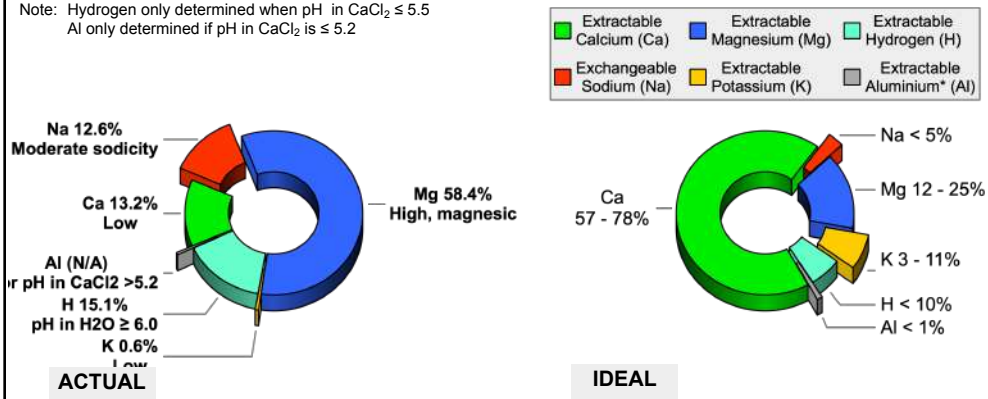
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**0.2**	3 – 6
Comment: Potential Calcium deficiency		
Mg:K	**100**	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	**0.01**	< 0.07
Comment: Acceptable		
K:Na	**0.04**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
1.81	0.08	1.9	8.41	2.18	-

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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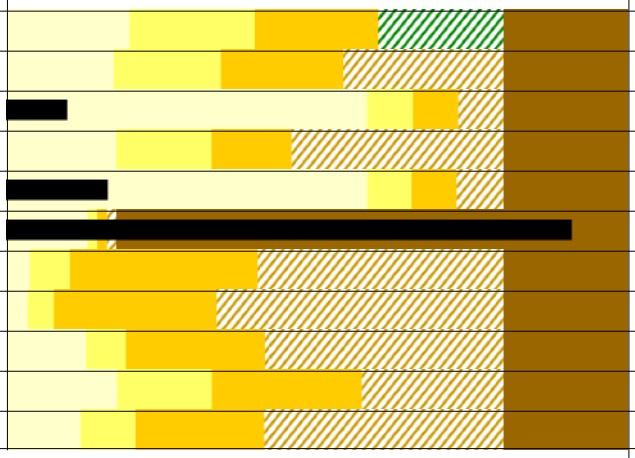
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 65786 | **Sample N°: 7** | **Date Received: 11/8/23** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	-		-	-	Did not test
Phosphorus (P)	mg P/kg	-		-	-	Did not test
Potassium (K)	mg/kg	32		4.3	34.8	30.5
Sulfur (S)	mg S/kg	-		-	-	Did not test
Calcium (Ca)	mg/kg	380		50.5	248	197.5
Magnesium (Mg)	mg/kg	1000		133	25.8	Drawdown
Iron (Fe)	mg/kg	-		-	-	Did not test
Manganese (Mn)	mg/kg	-		-	-	Did not test
Zinc (Zn)	mg/kg	-		-	-	Did not test
Copper (Cu)	mg/kg	-		-	-	Did not test
Boron (B)	mg/kg	-		-	-	Did not test



Explanation of graph ranges:

Very Low
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

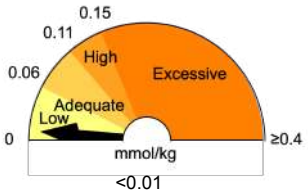
Marginal
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.7**
Sum of Base Cations (cmol(+)/kg):	**12.2**
Eff. Cation Exch. Capacity (eCEC):	**14.4**
Base Saturation (%):	**84.72**
Exchangeable Acidity (cmol(+)/kg):	**-**
Exchangeable Acidity (%):	**-**

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	**-**

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **895**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Clay Loam**	Munsell Colour:	**-**	Organic Carbon (OC %):	**-**
Estimated clay content:	**25 - 35%**	Structure Size:	**Medium (11 - 25mm)**	Organic Matter (OM %):	**-**
Tactually gravelly:	**Not gravelly**	Structural Organisation:	**Pedal - Strong**	Est. Field Capacity (% water):	**34**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**18**
Calculated EC_{SE} (dS/m):	**0.5**	Potential infiltration rate:	**Moderate**	Est. Plant Available Water (% water):	**16**
– Non-saline. Salinity effects on plants are mostly negligible.		Est. Permeability Class (mm/hr):	**20 - 60**	Est. Plant Available Water (mm/m):	**160**
		Additional comments:			

Date Report Generated 20/09/2023

Consultant: Owen Guy

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

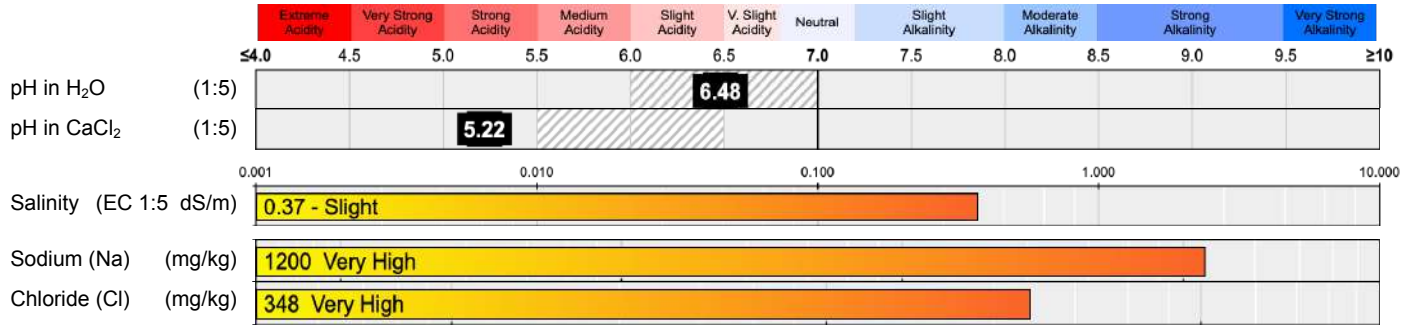
Batch N°: 65786 | **Sample N°: 8** | **Date Received: 11/8/23** | **Report Status: Final**

Client Name:	**Tract Consultants Pty Ltd**	Project Name:	**AWRC**
		SESL Quote N°:	
Client Contact:	**Adam Jeffery**	Sample Name:	**BH09 Subsoil**
Client Order N°:		Description:	**Soil**
Address:	**Level 8, 80 Mount St North Sydney NSW 2060**	Test Type:	**SSCP**

RECOMMENDATIONS

For discussion and recommendations, see SESL report J004754.

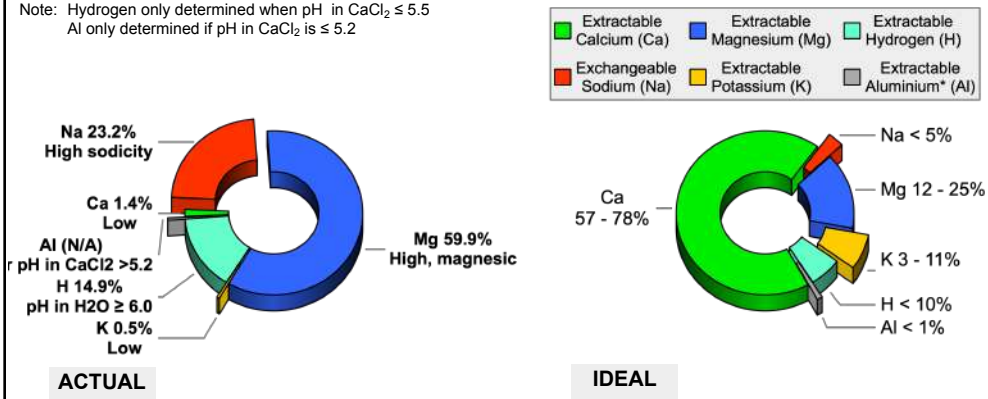
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2 \leq 5.5$
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**0**	3 – 6
Comment: Potential Calcium deficiency		
Mg:K	**100**	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	**0.01**	< 0.07
Comment: Acceptable		
K:Na	**0.02**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
5.16	0.1	0.31	13.3	3.31	-

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Tel: 1300 30 40 80
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Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 65786 | **Sample N°: 8** | **Date Received: 11/8/23** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	-		-	-	Did not test
Phosphorus (P)	mg P/kg	-		-	-	Did not test
Potassium (K)	mg/kg	37		4.9	46	41.1
Sulfur (S)	mg S/kg	-		-	-	Did not test
Calcium (Ca)	mg/kg	61		8.1	327.7	319.6
Magnesium (Mg)	mg/kg	1600		212.8	34.2	Drawdown
Iron (Fe)	mg/kg	-		-	-	Did not test
Manganese (Mn)	mg/kg	-		-	-	Did not test
Zinc (Zn)	mg/kg	-		-	-	Did not test
Copper (Cu)	mg/kg	-		-	-	Did not test
Boron (B)	mg/kg	-		-	-	Did not test

Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

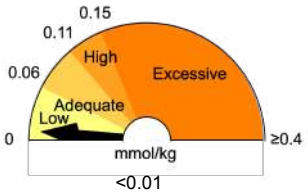
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.5**
Sum of Base Cations (cmol(+)/kg):	**18.9**
Eff. Cation Exch. Capacity (eCEC):	**22.2**
Base Saturation (%):	**85.14**
Exchangeable Acidity (cmol(+)/kg):	**-**
Exchangeable Acidity (%):	**-**

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	**-**

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **1680**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Light Clay**	Munsell Colour:	**-**	Organic Carbon (OC %):	**-**
Estimated clay content:	**35 - 40%**	Structure Size:	**Coarse (>25mm)**	Organic Matter (OM %):	**-**
Tactually gravelly:	**Not gravelly**	Structural Organisation:	**Pedal - Strong**	Est. Field Capacity (% water):	**38**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**23**
Calculated EC_{SE} (dS/m):	**3.2**	Potential infiltration rate:	**Slow**	Est. Plant Available Water (% water):	**15**
– Slightly saline. Growth on sensitive plant species is affected.		Est. Permeability Class (mm/hr):	**5 - 20**	Est. Plant Available Water (mm/m):	**150**
		Additional comments:			

Date Report Generated 20/09/2023

Consultant: Owen Guy

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

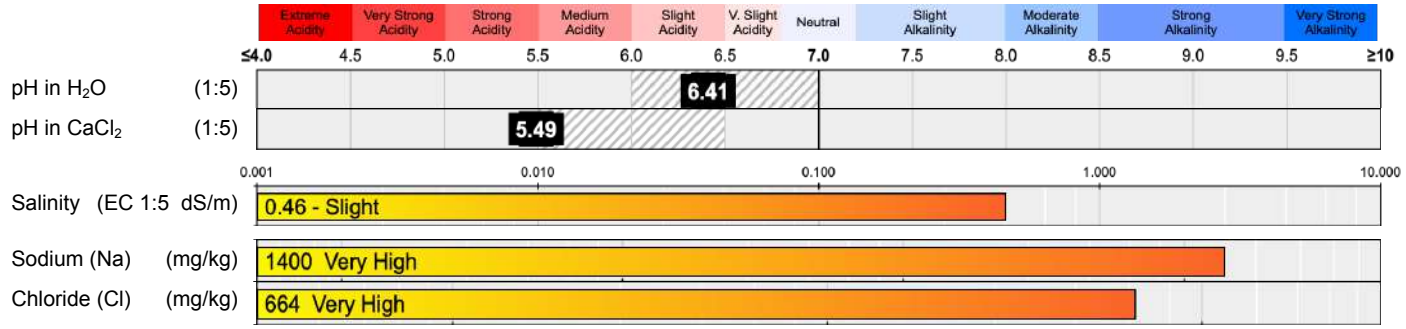
Batch N°: 65786 | **Sample N°: 9** | **Date Received: 11/8/23** | **Report Status: Final**

Client Name:	**Tract Consultants Pty Ltd**	Project Name:	**AWRC**
		SESL Quote N°:	
Client Contact:	**Adam Jeffery**	Sample Name:	**BH19 Subsoil**
Client Order N°:		Description:	**Soil**
Address:	**Level 8, 80 Mount St North Sydney NSW 2060**	Test Type:	**SSCP**

RECOMMENDATIONS

For discussion and recommendations, see SESL report J004754.

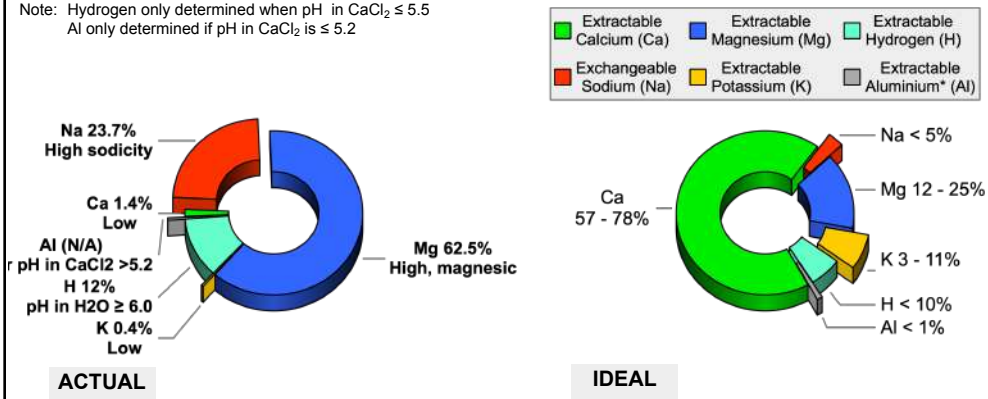
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**0**	3 – 6
Comment: Potential Calcium deficiency		
Mg:K	**200**	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	**0.01**	< 0.07
Comment: Acceptable		
K:Na	**0.02**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
6.28	0.11	0.37	16.57	3.18	-

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
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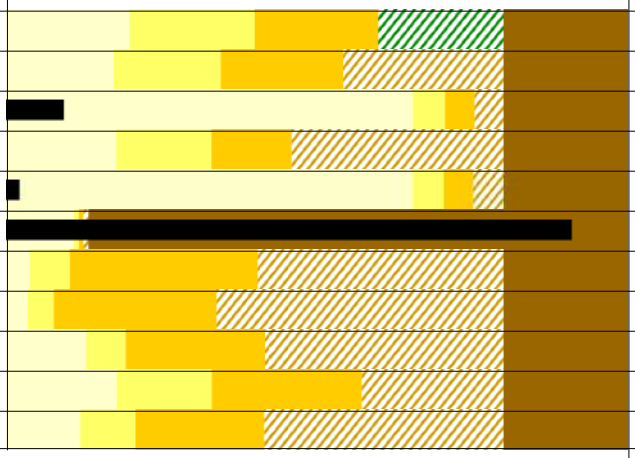
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 65786 | **Sample N°: 9** | **Date Received: 11/8/23** | **Report Status: Final**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	-		-	-	Did not test
Phosphorus (P)	mg P/kg	-		-	-	Did not test
Potassium (K)	mg/kg	45		6	51.6	45.6
Sulfur (S)	mg S/kg	-		-	-	Did not test
Calcium (Ca)	mg/kg	74		9.8	367.5	357.7
Magnesium (Mg)	mg/kg	2000		266	38.4	Drawdown
Iron (Fe)	mg/kg	-		-	-	Did not test
Manganese (Mn)	mg/kg	-		-	-	Did not test
Zinc (Zn)	mg/kg	-		-	-	Did not test
Copper (Cu)	mg/kg	-		-	-	Did not test
Boron (B)	mg/kg	-		-	-	Did not test



Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

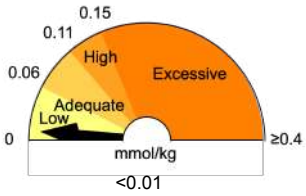
High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	**7.5**
Sum of Base Cations (cmol(+)/kg):	**23.3**
Eff. Cation Exch. Capacity (eCEC):	**26.5**
Base Saturation (%):	**87.92**
Exchangeable Acidity (cmol(+)/kg):	**-**
Exchangeable Acidity (%):	**-**

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	**-**

Calculated Gypsum Application Rate (CGAR)

(g/sqm) to achieve 67.5 % exch. Ca: **2005**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Clay Loam**	Munsell Colour:	**-**	Organic Carbon (OC %):	**-**
Estimated clay content:	**25 - 35%**	Structure Size:	**Coarse (>25mm)**	Organic Matter (OM %):	**-**
Tactually gravelly:	**Not gravelly**	Structural Organisation:	**Pedal - Strong**	Est. Field Capacity (% water):	**34**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**18**
Calculated EC_{SE} (dS/m):	**4**	Potential infiltration rate:	**Moderate**	Est. Plant Available Water (% water):	**16**
– Slightly saline. Growth on sensitive plant species is affected.		Est. Permeability Class (mm/hr):	**20 - 60**	Est. Plant Available Water (mm/m):	**160**
		Additional comments:			

Date Report Generated 20/09/2023

Consultant: Owen Guy

Authorised Signatory: Simon Leake

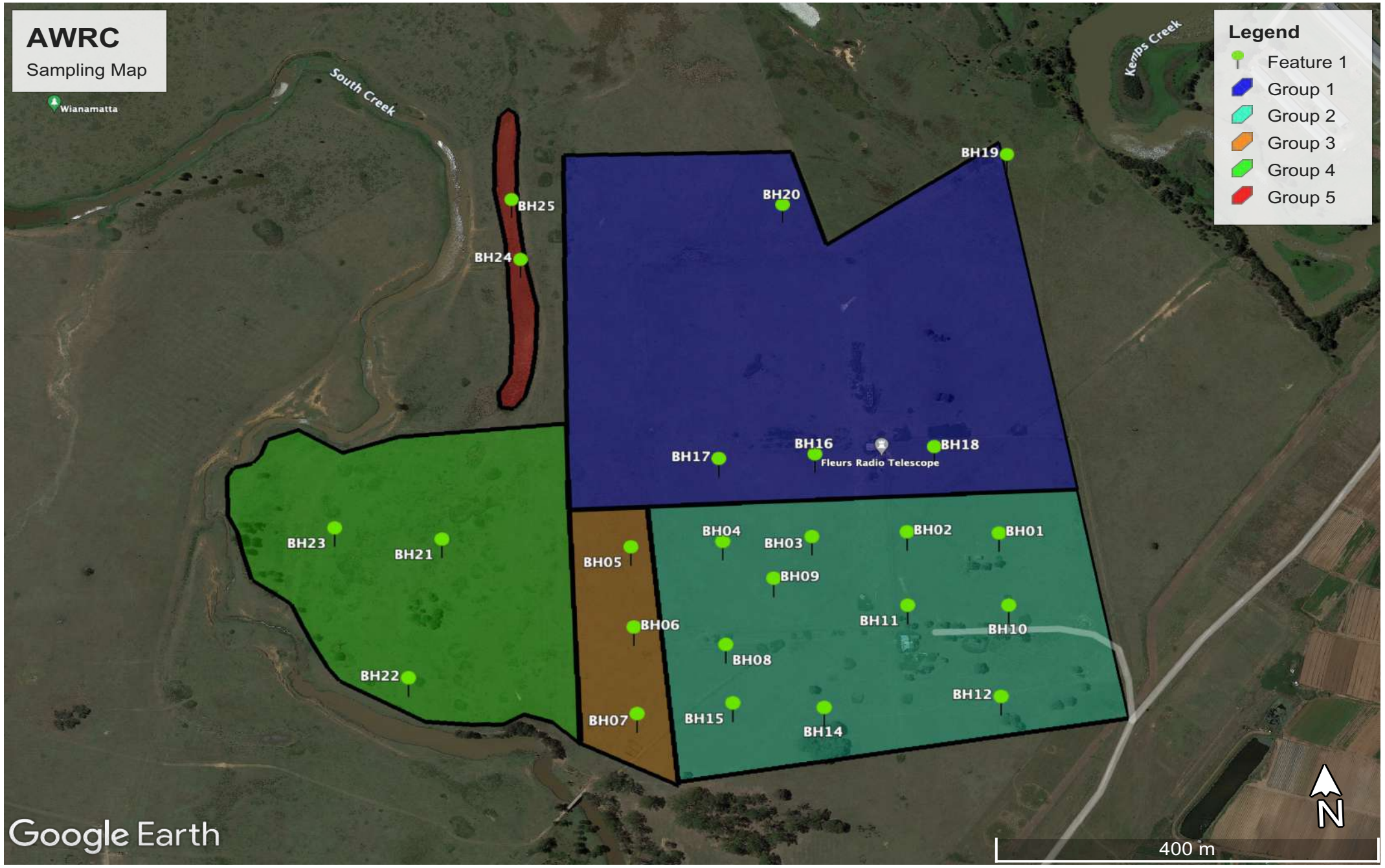
METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Appendix B

Site Maps

SESL AUST.	16 Chilvers Rd Thornleigh NSW 2120	T: 1300 30 40 80 info@sesl.com.au www.sesl.com.au	**Ref: J004754** Client: Tract Consultants Pty Ltd Soil Resource Assessment - AWRC	**Figure 1** Sampling Map	March 2023	N	Prepared: OG 06/09/2023



SESL AUST.	16 Chilvers Rd Thornleigh NSW 2120	T: 1300 30 40 80 info@sesl.com.au www.sesl.com.au	**Ref: J004754** Client: Tract Consultants Pty Ltd Soil Resource Assessment - AWRC	**Figure 2** Sampling Map and Groups	March 2023	N	Prepared: OG 06/09/2023

Appendix C

Site Photographs

Image 1.	Borehole 1 Profile

Image 2.	Borehole 2 Profile

Image 3.	Borehole 3 Profile

Image 4.	Borehole 4 Profile

Image 5.	Borehole 5 Profile

Image 6.	Borehole 6 Profile

Image 7.	Borehole 7 Profile

Image 8.	Borehole 8 Profile

Image 9.	Borehole 9 Profile

Image 10.	Borehole 10 Profile

Image 11.	Borehole 11 Profile

Image 12.	Borehole 12 Profile

Image 13.	Borehole 14 Profile

Image 14.	Borehole 15 Profile

Image 15.	Borehole 16 Profile

Image 16.	Borehole 17 Profile

Image 17.	Borehole 18 Profile

Image 18.	Borehole 19 Profile

Image 19.	Borehole 20 Profile

Image 20.	Borehole 21 Profile

Image 21.	Borehole 22 Profile

Image 22.	Borehole 22 Profile

Image 23.	Borehole 24 Profile

Appendix E Weed Mapping Report

AMBS Ref: 24447

10/09/2024

Ryan Maxwell
John Holland Group
Level 3, 65 Pirrama Road
Pyrmont, NSW 2009

Dear Ryan,

Upper South Creek AWRC – Weed Mapping

On the 4th of July 2024, AMBS Ecology & Heritage undertook a weed mapping assessment of the riparian corridor of South Creek on the western boundary of the Advanced Water Recycling Centre (AWRC) and an area in the facility designated as a future solar farm. This weed assessment will be used by the client to make informed decisions on appropriate weed management prior to revegetation.

Study Area

The first assessment area is part of the Advanced Water Recycling at Paper Rd, Kemps Creek NSW 2178. It comprises of the riparian corridor of 40m width (approximately 4.2ha) from the eastern bank of South Creek which runs along the western boundary of the property on Lot 211 DP 1272676 and Lot 212 DP1272676 (Figure 1-3). The second assessment area is in the northern part of the property designated as the solar farm on Lot 211 DP 1272676 (approximately 4ha). Both assessment areas are in the Cumberland subregion of the Sydney basin IBRA bioregion. Both assessment areas are not mapped as a PCT (DCCEEW, 2021a) and could be classed as cleared exotic grassland due to the high abundance of exotic ground cover and limited native species abundance, however both upstream and downstream of South Creek are mapped as PCT 4025 Cumberland Red Gum Riverflat Forest.

Methods

A walkthrough of assessment area one was undertaken on July 4th 2024 by Lachlan Palmes and Julian Herting, in area two where a 5x30m representative floristic plot was undertaken. Assessment area two was slashed prior to the weed assessment, potentially limiting the number of species that can be identified. During the walkthrough assessment, large continuous patches of weeds were recorded, additionally incidental occurrences of weed species were recorded.

Results

Riparian corridor

In total forty different non-native species from thirty-five genera have been recorded in the riparian corridor (Table 1). Ten species of these species are classified as high threat weeds by the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW,

2021b), of which three species are designated manageable high threat exotics (Table 1). Additionally, four species classified as weeds of national significance (WONS) as classified by the Department of Primary Industry (DPI, 2024) have been recorded (Table 1).

The riparian corridor is dominated by *Paspalum dilatatum* (Paspalum) which covers approximately 50-75% of the assessment area, with cover becoming less dense closer to the creek bank. Unless otherwise indicated on the map, other exotic species are generally found interspersed within the cover of *Paspalum dilatatum* (Paspalum) (Figures 1-3). Figures 1-3 depict patches where cover were highest for that particular weed species.

Close to the bank of South Creek patches dominated by *Cenchrus clandestinus* (Kikuyu) or *Andropogon virginicus* (Whisky Grass) were observed. In addition, there are significant patches of *Alternanthera philoxeroides* (Alligator Weed) and *Nassella neesiana* (Chilean Needle Grass) along the drainage of a billabong and along the bank of the creek.

Table 1 Exotic species recorded in the riparian corridor of the South Creek. Listing the scientific name, common name, high threat weed status according to DCCEEW and DPI.

Scientific Name	Common Name	High Threat Weed Status	Weed of National significance Status	Priority Weed for Greater Sydney region
Alternanthera philoxeroides	Alligator Weed	HTW	WONS	Priority Weed
Andropogon virginicus	Whiskey Grass	HTW	–	–
Arujia sericifera	Moth Vine	HTW – manageable	–	–
Bidens pilosa	Cobbler's Pegs	HTW	–	–
Briza subaristata		HTW	–	–
Bromus catharticus	Prairie Grass	–	–	–
Bromus sterilis	Sterile Brome	–	–	–
Carduus spp.	Thistles	–	–	–
Cenchrus cladestinus	Kikuyu	HTW	–	–
Cestrum parqui	Green Cestrum	HTW	–	Priority Weed
Cinnamomum camphora	Camphor Laurel	HTW – manageable	–	–
Cirsium vulgare	Spear Thistle	–	–	–
Eragrostis curvula	African Lovegrass	HTW	–	–
Galium aparine	Goosegrass	–	–	–
Leontodon spp.		–	–	–
Ligustrum sinense	Small Leaved Privet	HTW	–	–
Lycium ferocissimum	African Boxthorn	HTW – manageable	WONS	Priority Weed
Modiola caroliniana	Red-Flowered Mallow	–	–	–
Nassella neesiana	Chilean Needle Grass	HTW	WONS	Priority Weed
Paspalum dilatatum	Paspalum	HTW	–	–
Paspalum spp.	Paspalum	HTW	–	–
Pavonia hastata		–	–	–
Phalaris spp.		–	–	–

Phytolacca octandra	Inkweed	–	–	–
Plantago lanceolata	Plantain	–	–	–
Prunus spp.	Peach/Plum	–	–	–
Rubus fruticosus species aggregate	Blackberry	HTW	WONS	Priority Weed
Rumex obtusifolius		–	–	–
Senecio madagascariensis	Fireweed	HTW	WONS	Priority Weed
Setaria parviflora	Pale Pigeon Grass	–	–	–
Sida rhombafolia	Paddy's Lucerne	–	–	–
Solanum nigrum	Blackberry Nightshade	–	–	–
Solanum pseudocapsicum	Jerusalem Cherry	–	–	–
Solanum sisymbriifolium	Sticky Nightshade	–	–	–
Sporobolus africanus		–	–	–
Taraxacum officinale		–	–	–
Trifolium spp.		–	–	–
Verbena bonariensis	Purpletop	–	–	–
Vicia sativa	Common Vetch	–	–	–
Vicia sp.	Vetch	–	–	–

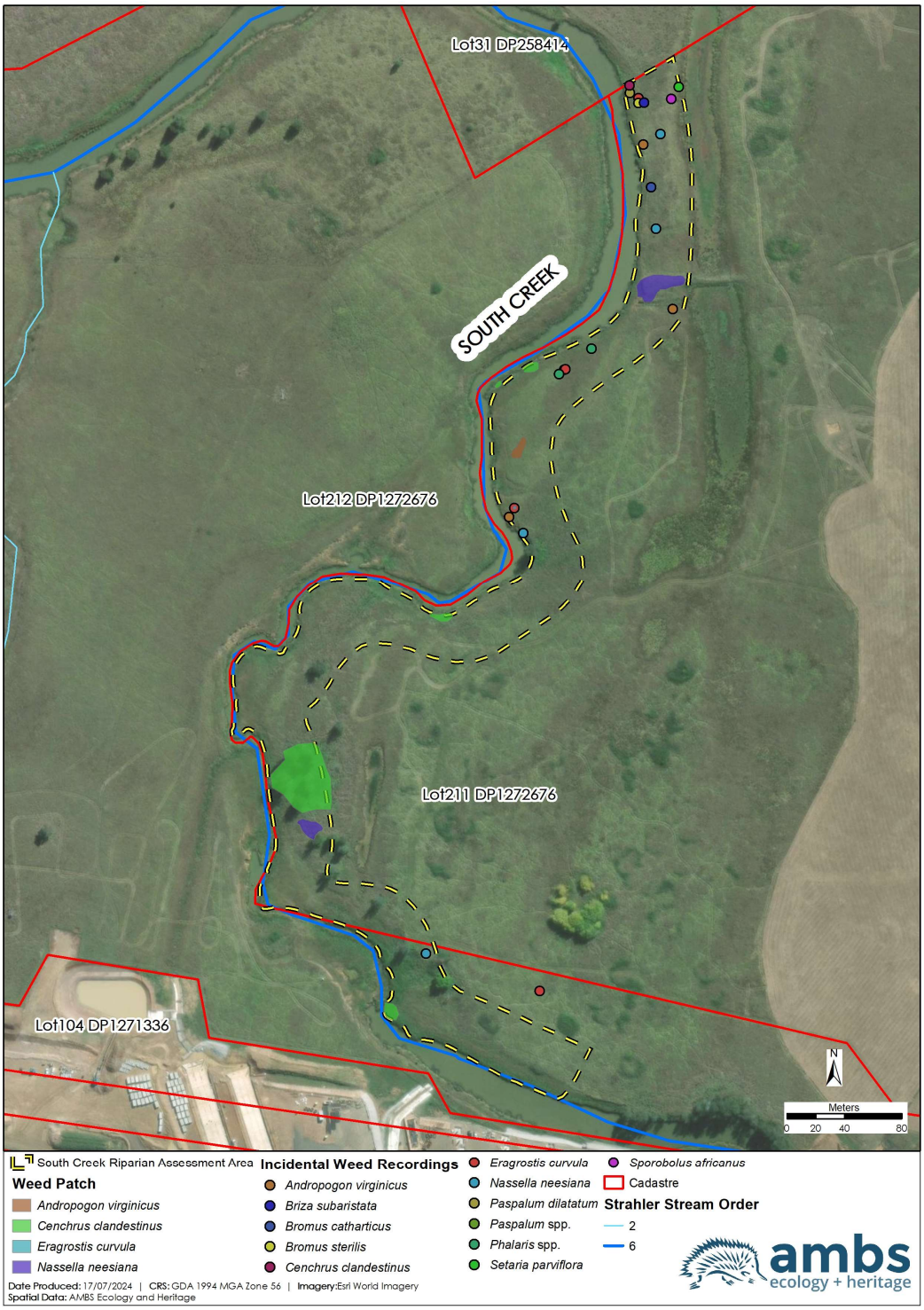


Figure 1 Weedy grass species recorded on riparian corridor of South Creek

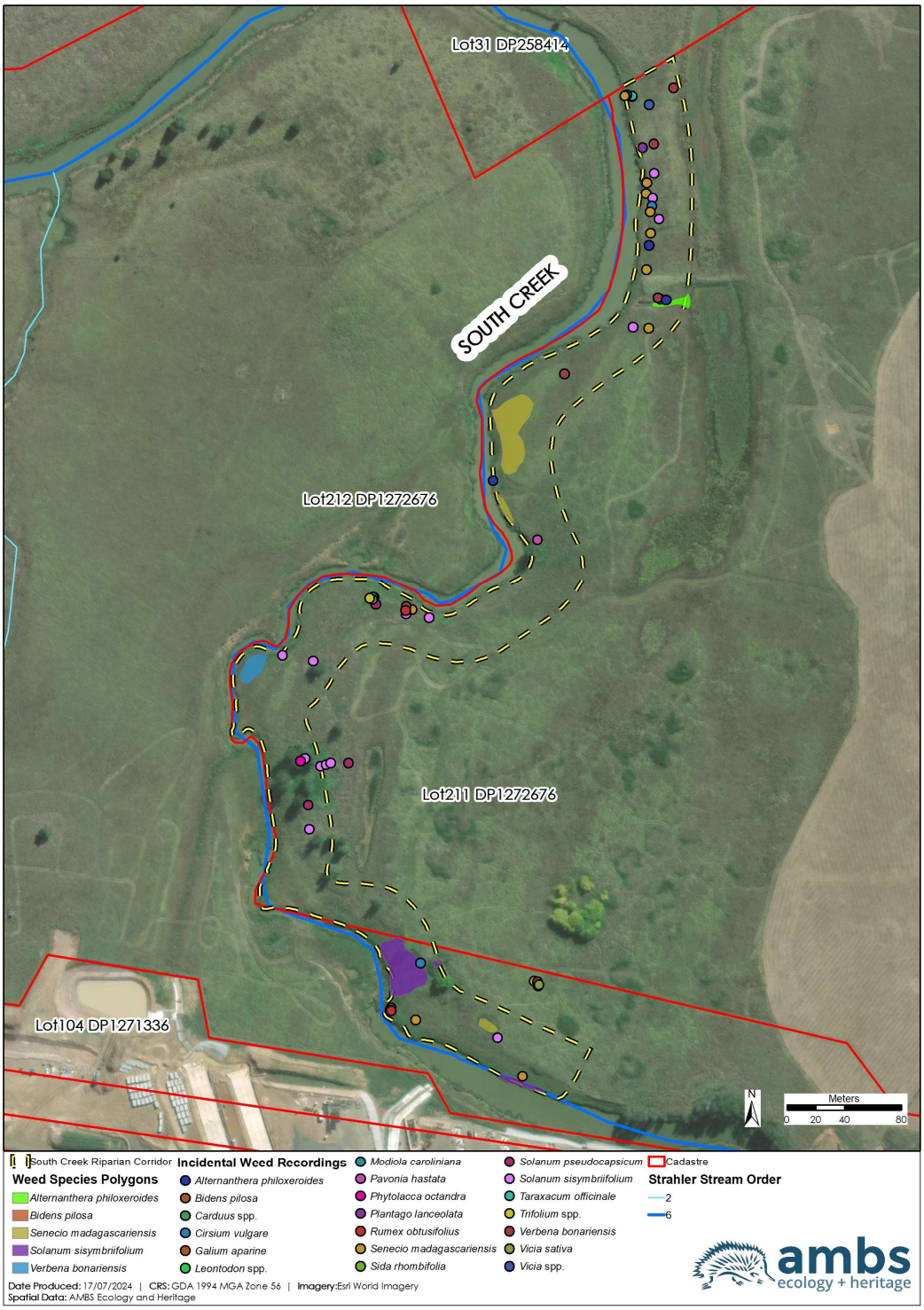


Figure 2 Weedy herb species recorded on riparian corridor of South Creek

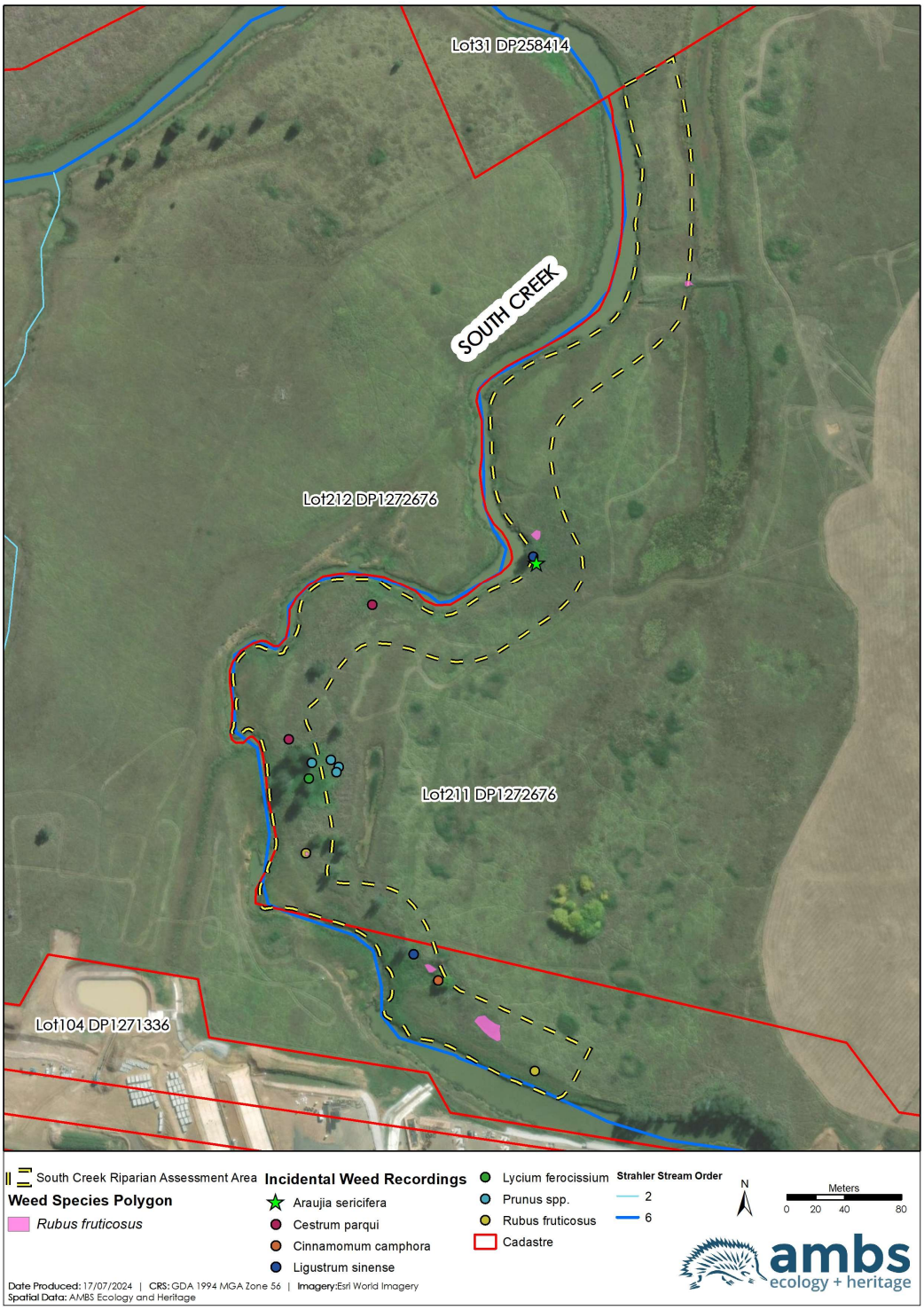


Figure 3 Weedy woody and vine species recorded on riparian corridor of South Creek

Solar Farm

In total, eight different non-native species have been recorded in assessment area two Solar Farm (Table 2). Two of the recorded species are classified as high threat weeds and one additional species as a weed of national significance (Table 2; DCCEEW, 2021b). Similar to the riparian corridor, the Solar Farm is dominated by *Paspalum dilatatum* interspersed with the recorded species in Table 2.

Table 2 Exotic species recorded in the Solar Farm. Listing the scientific name, common name and classification according to DCCEEW and DPI.

Scientific Name	Common Name	High Threat Weed Status	Weed of National significance Status	Priority Weed for Greater Sydney region
Cirsium vulgare	Spear Thistle	–	–	–
Eragrostis curvula	African Lovegrass	HTW	–	–
Leontodon spp.		–	–	–
Paspalum dilatatum	Paspalum	HTW	–	–
Senecio madagascariensis	Fireweed	HTW	WONS	Priority Weed
Setaria parviflora	Pale Pigeon Grass	–	–	–
Solanum sisymbriifolium	Sticky Nightshade	–	–	–
Verbena bonariensis	Purpletop	–	–	–

Figure 4 AWRC Solar Farm weed mapping extent

Discussion

High threat weeds (HTWs) listed in Tables 1 and 2 are weeds which if uncontrolled, will invade and outcompete native plant species (DPIE 2020). Manageable HTWs are a subset of high threat weeds that have sufficient evidence to suggest that with appropriate management, their impact and abundance can be effectively reduced (DPIE 2020).

In total, six weeds of national significance (WONS) were identified during the weed mapping survey (Table 3). WONS are regarded as the worst weeds in Australia due to their invasiveness, potential for spread and economic and environmental impacts. These weeds require coordination across governments, organisations and individuals for effective management, with land managers being primarily responsible for their control.

These weeds have state and regional priorities under the *Biosecurity Act 2015* and the Greater Sydney Regional Strategic Weed Management Plan (LLS 2023). All WONS identified on the AWRC site have a General Biosecurity Duty for NSW to prevent, eliminate or minimise any biosecurity risk it poses, so far as is reasonably practicable (DPIE 2020). *Alternanthera philoxeroides* (Alligator Weed) and *Cestrum parqui* (Green Cestrum) have an additional Regional Recommended Measure for Greater Sydney where land managers should mitigate the risk of the plant being introduced on their land and mitigate the spread of the plant from their land (LLS 2023).

Management recommendations

Due to the riparian corridor being dominated by mostly grassy and herbaceous weed species, a combination of slashing and spraying with appropriate herbicides is recommended. Special attention should be paid to controlling WONS and priority weeds of the Greater Sydney region listed in Table 3 with appropriate recommended control options (see NSW WeedWise for a full list of control options).

Table 3 Recommended weed control options for Weeds of National Significance and Greater Sydney region priority weeds.

Scientific Name	Common Name	Recommended Control Options
Alternanthera philoxeroides *	Alligator Weed	Chemical Control • Three treatments per growing season with herbicide containing metsulfuron-methyl Physical removal • Deep manual or shallow machine digging up
Cestrum parqui	Green Cestrum	Chemical Control • Treat actively growing plants. Mature plants early spring, seedlings autumn • Spraying • Cut stump • Cut scrape and paint Mechanical removal • Repeated cutting down and digging up Competition • Planting vigorous pasture to suppress seedling

Lycium ferocissimum	African Boxthorn	Chemical Control • Foliar spraying, spring actively growing plants • Soil spraying, before bud burst • Cut stump treatment • Stem injection • Basal bark treatment Physical removal • Remove as much root as possible
Nassella neesiana	Chilean Needle Grass	Chemical Control • Spot-spraying with regular follow-up
Rubus fruticosus species aggregate	Blackberry	Chemical Control • Spray actively growing plants • Follow-up after Slashing Physical removal • Slashing, only in combination with chemical control follow-up Biological Control • Grazing, goats can make start on controlling infestations
Senecio madagascariensis	Fireweed	Chemical Control • Spraying, best time late autumn Biological Control • Grazing, goats and sheep intended for slaughter

* Aquatic weeds such as Alligator Weed can be difficult to effectively control. Water input from upstream is likely to introduce new infestations, and due to the AWRC location on the catchment, it is unlikely that Alligator Weed can be eradicated. A local biosecurity or council weed officer should be consulted prior to treatment of aquatic species to ensure treatment is in keeping with local catchment management strategies.

Should you require any additional information or if I can be of assistance in any way, please contact me on (02) 9518 4489 or email lachlan.palmes@ambs.com.au.

Yours sincerely

Lachlan Palmes
Ecologist
AMBS Ecology & Heritage

References

Department of Climate Change, Energy, Environment and Water, 2021a. Trees Near Me NSW, available at: https://treesnearme.app/explore. Access 10th July 2024.

Department of Climate Change, Energy, Environment and Water, 2021b. NSW BioNet, available at https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet. Access 15th July 2024.

Department of Planning, Industry and Environment, 2020. Biodiversity Assessment Method. Available at: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/biodiversity-assessment-method-2020-200438.pdf

Department of Primary Industries, 2024. NSW WeedWise. Available at https://weeds.dpi.nsw.gov.au/. Access 15th July 2024.

Local Land Services, 2023. Greater Sydney Regional Strategic Weed Management Plan 2023 – 2027. Available at: https://www.lls.nsw.gov.au/__data/assets/pdf_file/0010/722368/Greater-Sydney-Regional-Strategic-Weed-Management-Plan-2023-2027.pdf

Appendix B Landscape Management Plan

LANDSCAPE MANAGEMENT PLAN

SYDNEY WATER UPPER SOUTH CREEK ADVANCED WATER RECYCLING CENTRE

Prepared for John Holland

Tract

Gamaragal Country
Level 8, 80 Mound Street, North Sydney
NSW 2060

(02) 9954 3733
www.tract.com.au

4 October 2024

Acknowledgement of Country

We pay our respects to the Traditional Custodians of Country throughout Australia, their Elders and ancestors, recognising their rich heritage and enduring connection to Country and acknowledging the ongoing sovereignty of all Aboriginal and Torres Strait Islander Nations.

We recognise the profound connection to land, waters, sky and community of the First Nations peoples, with continuing cultures that are among the oldest in human history. We recognise that they are skilled land shapers and place makers, with a deep and rich knowledge of this land which they have cared for, protected and balanced for millennia.

Our Country, 2022
88 x 119 cm Acrylic on canvas
Original artwork by
Alfred Carter
Gunaikurnai

Quality Assurance

LANDSCAPE MANAGEMENT PLAN
SYDNEY WATER UPPER SOUTH CREEK ADVANCED WATER RECYCLING CENTRE

Project Number
221-0062-00

Document Number
AWRC-TRA-PLN-DES-0003

Revisions

No.	Date	Description	Prepared By	Reviewed By	Project Principal
00	04/04/2024	Draft for Review	Julie Lee	Matthew Easton	Julie Lee
01	16/07/2024	Draft for Review	Eliza Fagan	Julie Lee	Julie Lee
02	17/07/2024	Final Issue	Eliza Fagan	Julie Lee	Julie Lee
03	16/09/2024	Revised following Sydney Water review	Alyce Harrington Mark Trethewy	Julie Lee	Julie Lee
04	04/10/2024	Revised following Sydney Water review and issue to DPHI	Alyce Harrington Mark Trethewy	Julie Lee	Julie Lee

Contents

Figures

Tables

1 Introduction

1.1 Background

This Landscape Management Plan (LMP) has been prepared by Tract Consultants for John Holland Group (JHG) on behalf of Sydney Water (SW) for the Upper South Creek Advanced Water Recycling Centre (AWRC) on Dharug Country. The AWRC is located at the confluence of the Wianamatta South Creek and Kemps Creek and is within an open space and environmental corridor. It is directly below Western Sydney Airport's flight path and will be bordered to the south by the M12 Motorway which is currently under construction by another contractor. Refer Figure 1 Local Context Plan, Figure 2 Stage 1 Plan, and Figure 3 Stage 1 Render.

Sydney Water will operate the wastewater infrastructure to service the southwest and Western Sydney Aerotropolis Growth areas. Through treating wastewater, the AWRC will produce high quality water suitable for a wide range of non-drinking uses in homes, various industrial services, businesses, agriculture, and public open spaces.

Figure 1 Local Context Plan (Tract)

Figure 2 Stage 1 Plan

Figure 3 Stage 1 Render

1.2 Purpose and Scope

The AWRC has been planned to be implemented in stages to grow according to demand. Stage 1 will be completed by 2026 and (of the SSI-8609189 approval scope relevant to this LMP), includes the following:

- construction and operation of a sewage treatment plant at Kemps Creek sized to treat an average dry weather flow of 35ML/day during Stage 1
- construction and operation of the overland flow swale from the plant to Wianamatta South Creek
- the vegetation riparian zone (VRZ) immediately adjacent to Wianamatta South Creek, to the extent of the northern and southern boundaries of the AWRC site.

Collectively, the area subject to construction of the sewage treatment plant and the overland flow swale, are referred to as the AWRC Operational site in this document and is the geographical scope of this Landscape Management Plan (LMP). The purpose of the LMP is to provide a description of the management activities to be undertaken for the long-term care of the environment within the AWRC Operational site. The VRZ is addressed in the Vegetation Management Plan (VMP) (Appendix 1 of the Urban Design and Landscape Plan (UDLP)).

This LMP will be implemented following construction of Stage 1 of the AWRC. The ongoing management of the landscape is fundamental in creating and maintaining a safe environment within the AWRC operational site constraints and establishing a biodiverse environment supporting networked systems through the use of endemic native species.

The LMP identifies post construction activities that ensure design intent and compliance with relevant approvals has been achieved. This LMP documents a standardised approach to the maintenance of landscape plantings and re-vegetation works, both in technique and frequency.

Stage 2 is proposed to be completed by 2035 with the space required for the potential future expansion allowed for within the AWRC Operational site. Outside of the AWRC Operational site and VRZ, is 38 hectares of green space and a potential Circular Economy Zone. Figure 4 provides an indicative representation of the stage development of the AWRC site.

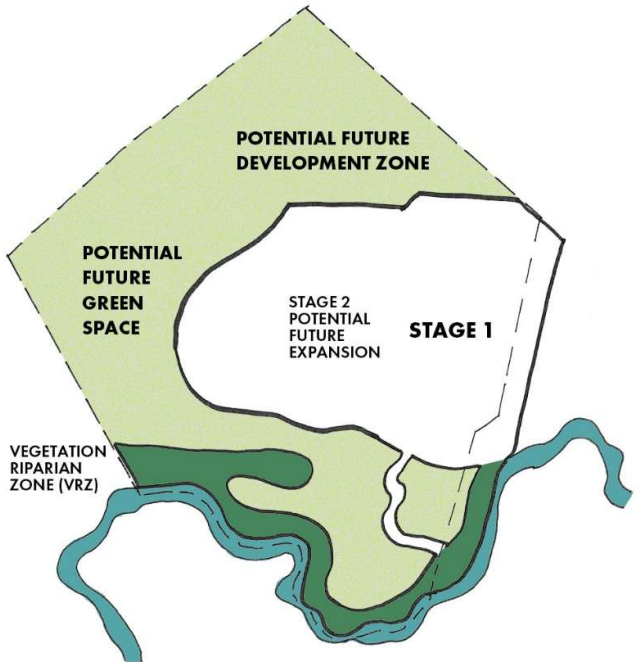


Figure 4 Staged Development of AWRC site

1.2.1 Where this Plan Applies

For clarity and to assist with implementation of the LMP, three distinct landscape management zones have been established as detailed below and are presented in Figure 5.

Zone 1: Operations Zone

The treatment plant zone, access road, fire trails and overland flow swale.

Zone 2: Wianamatta South Creek Zone

The restored areas adjoining Wianamatta South Creek and billabongs, documented in the Vegetation Management Plan (VMP).

Zone 3: Potential Future Greenspace

Future master planning of the Greenspace and the Circular Economy Zone is proposed, and the landscape management of these areas will need to be reevaluated should any development occur.

This LMP applies to Zone 1 and Zone 3 (to the extent of maintaining walking access to riparian areas in Zone 2). Use of this zoning is also adopted throughout the plan to assist with the identification of vegetation zones, landscape management requirements, and maintenance requirements. Section 3 provides additional detail on each of the landscape management zones beyond what is visually presented in Figure 5 below.

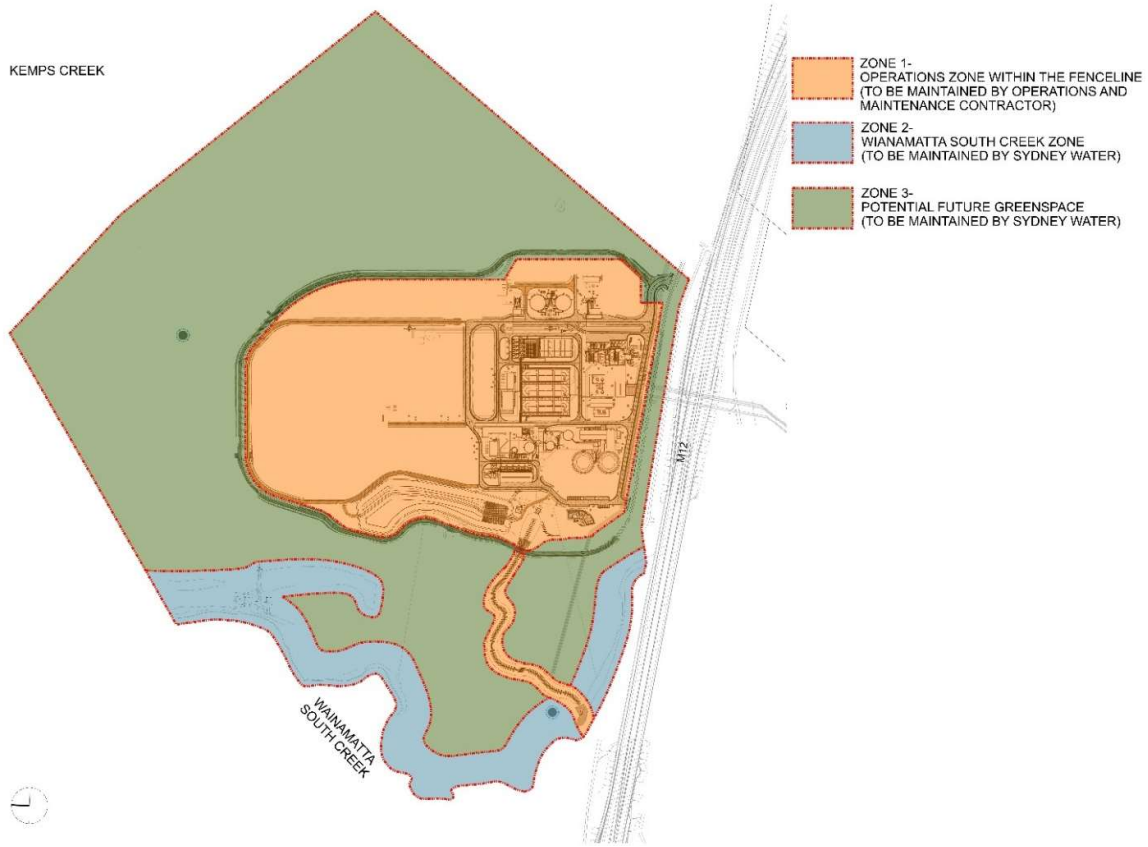


Figure 5 Landscape Management Zones

1.3 Vision and Principles

The creation of high quality, robust and sustainable urban design underpins the integration of the site's development with the existing landscape and adjoining waterways. The following outlines the vision and key principles as required as part of the urban and landscape outcomes that are described in the project Urban Design and Landscape plan.

The project vision is:

> *Upper South creek AWRC is a place where the connection of people to the land, water and sky are appreciated and deepened, bringing community together to restore, discover, meet and enjoy.*

Landscape Management Principles incorporated into this LMP are expressed in the USC AWRC Urban Design and Landscape Plan – Stage 1 (Tract 2023). How they are explored in this plan is detailed in Table 1: Landscape Management Principles.

Table 1 Landscape Management Principles

	Principle	LMP Reference /comment
1	Minimise environmental impacts that may result from landscape management activities and utilise environmentally sustainable practices.	Refer to Section 4
2	Enhance and promote the Cumberland Plain character of the site.	Plant species Appendix A
3	For new and replacement plantings, use of endemic plant species.	Plant species Appendix A
4	Provide a safe environment, minimising potential risks to people, buildings, and property.	Sections 5.1, 5.2, and specific landscape management activities in Section 4.
5	Continue to incorporate water sensitive urban design (WSUD) techniques to manage stormwater, slow runoff, recharge groundwater, store for re-use and to passively irrigate landscape areas.	Constructed biodetention and retention basins and grass swales adjoining roads.
6	Apply best practice bush regeneration in revegetated areas and best practice landscape maintenance in the Treatment Plant zone.	Documented in Section 4 Specific Landscape Maintenance Activities.
7	Provide a high-quality path network that provides for safe, equitable movement.	To be considered in the development of the Greenspace Masterplan.
8	Ensure that all new works comply with the requirements of AS 1428 Access and Mobility Design.	Appendix C
9	Target noxious weeds and feral animals using integrated pest management approaches	Sections 4.7, 4.12.
10	Provide opportunities for Aboriginal, environmental, and informal learning and study in the landscape.	To be considered in the development of the Greenspace Masterplan.
11	Maintain high quality outdoor spaces and public interfaces.	Visitors will access the Administration Building precinct & this area is the public interface for this project.
13	Manage bushfire risk in accordance with recognised guidelines	Section 5.1
14	Manage wildlife hazard risks in accordance with the Wildlife Management Plan.	Section 5.2
15	Provide opportunities for greater community involvement.	To be considered in the development of the Greenspace Masterplan.
16	Appropriately fund, plan and manage landscape maintenance to provide a measurable improvement of the AWRC landscape appearance, safety and amenity.	This LMP

1.4 Legislation, standards, guidelines and other references

The Minister of Planning gave the works consent under Section 5.19 of the Environmental Planning and Assessment Act 1979. The CSSI-8609189 Minister's Conditions of Approval specific to the project and relevant to this LMP are listed below in Table 2, along with a reference to what stage and where each condition will be addressed within the relevant chapter of the LMP.

Table 2 Conditions of Approval

ID	Condition	Reference in this document
E64	**(b)** The UDLP (including this LMP) must document how the following matters have been considered in the design and landscaping of the project: o The requirements of the Wildlife Management Plan under condition E130;	Section 5.2 Wildlife Strike Mitigation
	(f) The UDLP (including this LMP) must document how the following matters have been considered in the design and landscaping of the project: o Constraints associated with bushfire, flooding and airport safeguarding;	Section 5.1 Bushfire Protection Actions Section 5.2 Wildlife Strike Mitigation The Operational zone will be constructed and operated entirely within the 1% AEP flood level. This is reflected in the landscape design drawings presented in Appendix C.
	(g) The UDLP (including this LMP) must document how the following matters have been considered in the design and landscaping of the project: o Vegetation management that considers the principles of Guidelines for Vegetation Management Plans on Waterfront Lands (NSW Office of Water, DPI 2012) o Draft Western Sydney Aerotropolis Riparian Re-vegetation Strategy o Riparian Revegetation Strategy (RRS) in Section 4 of the Western Sydney Aerotropolis (initial Precincts) Riparian Corridors Assessment by Sydney Water (December 2021)	Not applicable to the LMP as the guideline is applicable to vegetation management zones only. The RRS aims to identify strategies for enhancing, protecting, and maintaining waterways, riparian corridors, and water-dependent ecosystems. It aims to stabilise waterways, enhance, and protect native riparian and floodplain ecology and create VRZs that support waterway health and social objectives. The RRS is not applicable to the LMP as the Operational zone is outside of these areas.
	(j) The UDLP (including this LMP) must document how the following matters have been considered in the design and landscaping of the project: • Inputs from relevant experts in architecture, landscape architecture, bushfire management, heritage, revegetation, ecology, wildlife	This condition is addressed in Chapter 1.3 of the Urban Design and Landscape Plan (UDLP) of which the LMP is an appendix of.

ID	Condition	Reference in this document
	hazard management and flooding.	
E65	The UDLP (including this LMP) must include descriptions and visualisations (as appropriate) of: **(c)** design of the project landform and landscaping elements;	This condition is addressed in Chapters 6.1, 8, 9.1, 10 of the UDLP of which the LMP is an appendix of. Appendix A and C
	(e) details of strategies to rehabilitate, regenerate or revegetate disturbed areas with local native species;	This condition is addressed in Chapter 17 of the UDLP of which the LMP is an appendix of. Appendix C
	(f) management and routine maintenance standards and regimes for design elements and Landscaping work (including adequate watering of plants following planting depending on forecast weather conditions and weed management) to ensure the success of the design and landscape outcomes.	Section 1.6 Climate Positive Design Section 1.7 Landscape Management Objectives Section 3 Landscape Management Zones Section 4 Specific Landscape Management Activities
E66	The ongoing maintenance and operation costs of urban design, open space, landscaping and recreational items and work implemented for the AWRC site as part of this approval remain the Proponent's responsibility until satisfactory arrangements have been put in place for the transfer of the asset to the relevant authority. Before the transfer of assets, the Proponent must maintain items and work to at least the design standards established in the UDLP, required by Condition E65.	Section 4 Specific Landscape Management Activities Section 5 Protective Measures Section 6 Monitoring and Reporting Section 7 Performance Criteria

1.5 Climate Positive Design

The United Nations Decade of ecosystem Restoration 2021-2030 aims to prevent, halt and reverse degradation of ecosystems on every continent. Climate positive design assists in the delivering of cool green cities, climate resilient landscapes and beautiful places that foster health and mental well-being. (AILA Climate Positive Design Action Plan Oct. 2022)

In southern Australia, climate projections suggest that hot days will become hotter and more frequent, rainfall will decrease, droughts will increase, harsher fire weather will occur, and extreme rainfall events will become more intense (CSIRO & BOM 2022).

Management actions detailed in this LMP have been designed to maximise the resilience of re-vegetated areas to climate change as much as possible:

- Using local seed banks to propagate plants that will be best adapted to local conditions.
- Using species and densities consistent with plant community types that have been removed.
- Specifying performance criteria that ensure the regenerated areas meet suitable benchmarks to restore the ecological integrity of the communities.
- Consideration of fauna habitat restoration to attract wildlife that will be integral in creating resilient ecosystem functioning.
- Compliance with the aims and objectives of the NSW Rural Fire Service's Planning for Bush Fire Protection (PBP) 2019 and Australian Standard 3959 (Sydney Water 2021b)
- Ensuring adequate watering occurs during the establishment phase based on the prevailing weather conditions.
- Continued watering through the maintenance phase to support the survival and successful establishment of young plants during times of limited resources and stress (Section 3.5).
- Weed control in both the establishment and maintenance phases to maximise survivorship of installed plants and minimise competition for resources from weeds.

1.6 Landscape Management Objectives

The following landscape management objectives and outcomes are consistent with the Urban Design Landscape Plan (Tract 2023) and will be monitored according to the requirements of this plan to ensure the performance criteria set out in Section 7 are achieved:

- Minimise environmental impacts that may result from landscape management activities and utilise environmentally sustainable practices.

- Preserve, enhance, and promote the reestablishment of the Cumberland Plain Woodland communities relevant to the site.
- Provide a safe environment, minimising potential risks to people, buildings, and property.
- Apply best practice landscape maintenance.
- Give precedence to biodiversity outcomes.
- Target noxious weeds and feral animals through the use of integrated pest management approaches.
- Provide opportunities for Aboriginal social impact, supply nation, trainee programs.
- Maintain high quality landscaped spaces.
- Maintain high quality Administration precinct.
- Maintain high quality passive recreation areas.
- Manage bushfire risk in accordance with Risk Assessment Report.
- Minimise aviation risk in accordance with Wildlife Management Plan (WMP).
- Maintain Ecological outcomes as identified in the Vegetation Management Plan (VMP).
- Appropriately fund, plan, and manage landscape maintenance to provide a measurable improvement in the establishment and adaptive landscape outcomes to form green networks.
- Establish ongoing stewardship.
- Maintain assets of heritage significance and value through protecting and preserving the two remaining radio telescope arrays from the Fleurs Radio Telescope Site.
- Heritage enhancement through the design and inclusion of elements that reflect and symbolise the history of the Project site which would be the landscape features that mark the previous location of the arrays with signage to hold onto the history of the site

1.7 References

This report is to be read in conjunction with the following documents:

- *Upper South Creek Advanced Water Recycling Centre - Urban Design and Landscape Plan – Stage 1, Tract Consultants*
- *Upper South Creek Advanced Water Recycling Centre – Vegetation Management Plan, Tract Consultants*
- *Kemps Creek Sewerage Network ST0079 Water Resource Recovery Facility-Kemps Creek- Landscape documentation prepared by Tract Consultants*

2 General Site Conditions

2.1 Soil

The AWRC is in the Wianamatta South Creek Alluvial soil landscape, characterised by floodplains, valley flats and drainage depressions (>5%) on the flat, incised channels of the Cumberland Plain with local relief of 10 metres. Soils consist of deeply layered sediments over bedrock comprising structured plastic clays or structured loams in or adjacent to drainage lines, red and yellow podzolic soils on terraces, usually in combination with patchy structured grey clays, leached clay, and yellow formerly saline soils. Soils exhibit low fertility, are strongly acidic, have hard-setting surfaces, poor drainage, and are susceptible to extreme erosion. Vegetation associated with this soil landscape consists of riparian forests and wetlands.

Soil health will be restored if required as part of the implementation and establishment of the landscape. Primary and secondary amelioration for all areas of the LMP will be confirmed by more detailed testing and/or assessment by the landscape contractor of existing information available and visual inspection of site conditions at the commencement of landscaping works, to the approval of JHG.

2.2 Vegetation Communities

The USC AWRC Biodiversity Development Assessment Report (Biosis, 2021) identifies the Plant Community Types (PCTs) relevant to the project.

The BDAR identified three Plant Community Types (PCTs) on the AWRC site, as summarised in Table 3 below. Clearing of some of these PCTs has occurred to facilitate construction within the plant operational zone, including:

- PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion – Thinned

- PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion - Scattered Trees

- PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion - Scattered Trees

Figure 6 provides a visual representation of the location of the PCTs that were present on the AWRC site prior to the commencement of construction.

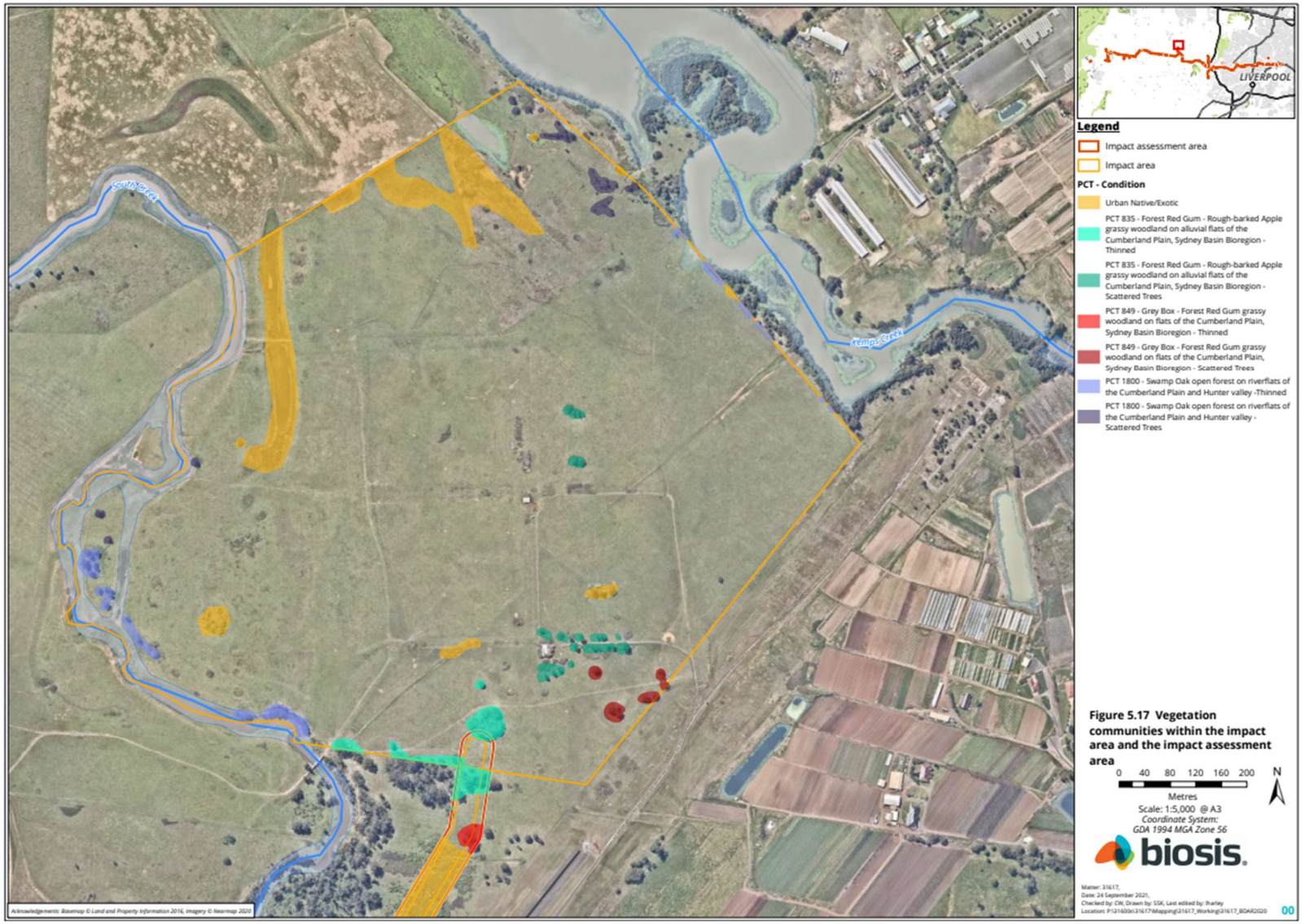


Figure 6 PCTs present at the AWRC site prior to construction (Source: USC EIS, Appendix J Biodiversity Assessment Report, Figure 5.17 (Biosis, 2021))

Table 3 Vegetation communities

PCT ID	PCT NAME	COMMON NAME	CONDITION	EPBC Act TEC	BC Act TEC
835	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	**Cumberland River-flat Forest**	Thinned, scattered trees	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (CEEC)	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin, and South East Corner Bioregions (EEC)
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	**Cumberland Shale Plains Woodland**	Scattered trees	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (CEEC)	Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)
1800	Swamp Oak open forest on river-flats of the Cumberland Plain and Hunter Valley	**Cumberland Swamp Oak Riparian Forest**	Thinned, scattered trees	Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (EEC)	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin, and South East Corner Bioregions (EEC)

3 Landscape Management Zones

Three distinct landscape strategies have been used to align with the three Zones established in Section 1.2.1and identified in Figure 5 and are referred to as Landscape Management Zones. Zone 2 should be read in conjunction with the USC AWRC Vegetation Management Plan. The three zones are to be implemented in the following form:

3.1 Zone 1: Operations Zone (generally within fence line)

Zone 1 includes the treatment plant zone and overland flow swale.

- Planted garden areas with shrubs and groundcovers.
- Trees spaced to meet fire protection requirements associated with Inner Protection Zone (IPZ). Refer Figure 6.
- Bioretention and retention basin landscape.
- Grass areas.
- Administration Building area where planting design has been used to create a public facing precinct.
- The grassed overland drainage swale linking to Wianamatta South Creek.
- Permanent stockpiles placed within the Operational Zone.
- Zone to be established in accordance with the information set out in Appendix A Plant Species, Appendix 2 Solar Farm Panels and Appendix 3 Landscape Document Package.

Maintenance for Zone 1 will be undertaken by JHG until contract completion and Trility / JHG (Operations & Maintenance Contractor) thereafter during operation of the AWRC.

3.2 Zone 2: Wianamatta South Creek (Vegetation Management Plan)

Zone 2 includes the proposed areas to be restored adjoining Wianamatta South Creek and the billabongs. Refer Figure 5 Vegetation Management Zones.

The vegetation management zones will be managed to control and remove exotic weed species. The retention of native, remnant elements of the degraded Cumberland Swamp Oak Riparian Forest will be prioritised to foster natural regeneration.

Revegetation will occur with a diverse array of native canopy trees, shrubs, and groundcovers of the Cumberland Swamp Oak Riparian Forest alogn the riparian zone, including within:

- Vegetation Management Zone 1: Revegetation of Existing Cumberland Swamp Oak Riparian Forest
- Vegetation Management Zone 2: Wianamatta South Creek Embankment Revegetation
- Vegetation Management Zone 3: Wianamatta South Creek Edge Revegetation

Maintenance for Zone 2 will be undertaken by JHG until contract completion and Sydney Water thereafter during operation of the AWRC.

3.3 Zone 3: Potential Future Greenspace including access paths, road and fire trails (generally outside the fence line and excluding Zone 2)

Zone 3 includes the area of remnant trees and pasture grasses that are outside Zone 1 and Zone 2. Whilst Zone 3 is being preliminarily scoped as part of a Greenspace Master Plan and will be documented in detail via future landscape management documentation, there are some items / areas within the zone that will be implemented and maintained according to the following:

- Individual plantings around the outer perimeter of the APZ. Refer Figure 6.
- The fire trail established as part of the perimeter APZ requirements. Refer Figure 6.
- Access paths to Wianamatta South Creek and planting areas developed as part of Stage 1 and delivered as part of the Zone 2 VMP works.

Maintenance for only the above elements within Zone 3 will be undertaken by JHG until contract completion and Sydney Water thereafter during operation of the AWRC.

3.4 Proposed Planting Species

The selection of proposed planting species associated with this LMP have been selected to suit soil conditions and existing vegetation communities. Refer to Appendix A for the full species list.

4 Specific Landscape Management Activities

4.1 Introduction

Section 4 of the LMP addresses landscape management activities in Zones 1 and 3, unless otherwise specified to address a key requirement that may be unique to a specific zone.

Planting in Zone 1 garden beds contain advanced trees, low shrubs and groundcovers. All beds are planted with native species in ameliorated site soils where deemed required by the Bush Regeneration Contractor to maximise biodiversity outcomes. Management of native plants requires low phosphorous fertilisers and a lower fertiliser rate than exotic species generally. Natives also have lower water requirements in comparison to exotics and adapted to the local conditions.

The long-term landscape management of the landscape should replace any failures with native species before exotic species.

The following sections detail maintenance activities that are to be implemented in Zone 1 and 3 of the AWRC. Unless noted otherwise, during the landscaping maintenance period, these activities are the responsibility of the Operation and Management Contractor. Refer to the following tables in this section for maintenance frequencies for each activity.

Supporting information is available in the following appendices to support the LMP:

- Appendix A - full plant species list
- Appendix B - the solar farm plans
- Appendix C - landscape design drawings
- Appendix D - weed mapping

It should be noted that the information provided in Appendices 1 to 3 represent documentation approved by Sydney Water at the time of submitting the LMP for approval. These items may be subject to revision, pending the onboarding of subcontractors who will perform the work, ad-hoc advice received by specialists engaged to support the implementation of the landscape design (for example a bush regeneration specialist), and/or other factors including availability and supply of listed species at the time. These documents will remain live, and the ongoing status tracked in the project's document management system, Aconex.

Sections 4.2 to 4.16 detail maintenance activities to be undertaken during the landscape maintenance period in Zones 1 and 3 in the following areas:

- Grassed areas
- Individual plantings
- Garden beds and bioretention basin

4.2 General Maintenance

General maintenance requirements for Zone 1 and 3 are outlined in Table 4 below.

Table 4 Zone 1 and 3 General Maintenance Requirements

Issue/ Element	Type of Activity	Work Required	Frequency	Responsibility
Landscape planting and revegetation	Monitoring	Landscape establishment in accordance with Technical Specification WL 21 Urban Design Landscape to assess landscape plant establishment and growth. Assessment of progress, recording of activities and identification of emergent issues.	Monthly	Site Manager, Landscape Supervisor and Landscape Maintenance staff
Mowing	Maintenance	Mowing and weed control in grass areas in accordance with Technical Specification WL 21 Urban Design Landscape. Recommendations arising from monitoring (refer above).	Implemented as required. Mowing where grasses exceed 75mm.	Site Manager, Landscape Supervisor and Landscape Maintenance staff
Weeding and replacement planting	Maintenance	Application of herbicide and manual removal where applicable. Plants to be replaced where assessed as dead.	Replacement plantings to occur within 14 days of detection. Weeding to occur at not more than 4 weekly intervals.	Site Manager, Landscape Supervisor and Landscape Maintenance staff
Administration Building precinct	Maintenance	Plant replacement, mowing or pruning to maintain presentation	Ongoing	Site Manager and Landscape Maintenance Manager

4.3 Fertilising, composting and mulching

All mass planted areas whether native or exotic will perform better when the soil conditions are healthy. Building healthy soils is the key to achieving the long-term maintenance goals of mass planted landscape areas.

Soil health is primarily achieved with regular applications of organic soil conditioners such as animal manures, decomposed green waste or proprietary blends of compost.

Fertilising and composting are not critical maintenance activities except where there are obvious deficiencies but should be assessed on an annual basis by observation and leaf analysis. For all trees, shrubs and grass species, Table 5Table 5 outlines the required fertilising regime. These standards apply to tree, shrub and groundcover associated with Zone 1.

Maintain mulch to a depth of 75mm in the garden beds.

4.4 Mowing

Management of grass is dependent on variety and location and will be undertaken so as to achieve an appropriate level of presentation and to meet Inner Protection Zone requirements for bushfire risk.

Zone 1:

Turf grass zones no lower than 25mm and no higher than 75mm and area is to be tidied post mowing.

The solar farm is to be on mown and maintained in a low fuel condition (<100 mm in length). Refer to appended plans on solar farm arrangement.

Zone 3:

Native grass zones are to be slashed frequently to reduce fire loading. Grass within pathways should not exceed 100mm.

4.5 Removal of Dead or Dying Plant Material and Pruning

All dead or dying plant material is to be removed during maintenance activities, including mass planted areas on the site as required. This may become necessary as plantings mature, after damage or adverse environmental conditions.

Ground cover and shrubs should be maintained at a maximum height of 0.5m along path edges for personal security. Monitor vegetation growth to ensure bushfire risk and safety is maintained.

Pruning will be carried out to remove dead and damaged branches and to retain natural shape and to improve health and vigour. Lower branches should be removed as per APZ requirements (refer Section 5.1).

Where die-back of plant material has been identified, new plants will be planted as soon as possible using species originally specified or that maintain the character and continuity of planting

Trees shall be pruned to the extent that:

- Dead branches should be removed so it does not build up a fuel load for fire.
- Tree form should be maintained.

For all trees, shrubs and grass species, Table 5 outlines the required pruning. These standards apply to tree, shrub and groundcover associated with Zone 1.

Table 5 Fertilising and Pruning Standards

Type	Action	Frequency of Work
Trees	Fertilising	
	2 X 20-gram slow-release fertiliser tablet per plant. N:P: K ratio– 18:3:10 Only to be applied if plants are obviously under stress and it has been agreed that the plant/s will benefit from application of the fertiliser.	Inspect annually but apply late Spring if, and when, required.
	Pruning	
	Prune to remove split leaders, remove dead limbs, and remove heavily damaged limbs. As maturity permits prune lower branches to collar to 5.5m above ground level where these overhang carriageways and roads. In other areas, prune lower branches to 3.3m above ground level.	As required
Shrubs	Fertilising	
	2 x 20-gram slow-release fertiliser tablet per plant. N:P: K ratio– 18:3:10 Only to be applied if plants are obviously under stress and it has been agreed that the plant/s will benefit from application of the fertiliser.	Inspect annually but apply late Spring if, and when, required
	Pruning	
	Pruning of shrubs would not occur unless there is evidence of dieback or were creating issues within the vicinity of the planting. Pruning of shrubs would be undertaken at the discretion of the maintenance contractor and dependent on	As required

Type	Action	Frequency of Work
	the assessment of the plant made at the time. Pruning would not be a regular occurrence due to the selection of native species. Lower branching of shrub species is preferable to create habitat for fauna and shade for groundcovers.	

4.6 Replacement Plantings (including tree staking)

Replacement of plants is to occur as specified in Technical Specification: WL 21 Urban Design-Landscape (the '*Specification*'). This includes the replacement of any missing or dead plants, or plants nominated by the Landscape Supervisor as unsatisfactory, within fourteen (14) days of detection.

Plantings that are failed, senescent or damaged are to be replaced and densities, sizes, and species used are to be similar to those being replaced. All replacements must be planted in accordance with the Specification.

With respect to tree staking:

- Repair any ties that have been broken.
- Replace any missing stakes as required.
- When trees are established, remove stakes.

4.7 Weed Management

In NSW all plants are regulated with a general biosecurity duty to prevent, eliminate, or minimise any biosecurity risk they may pose. Weeds that compete with and suppress growth of vegetation established by the landscape works are to be removed without damaging other plants. As part of this process, invasive weeds may be listed as one of the following:

- Weeds of National Significance
- National Environmental Alert List Weeds
- Water Weeds
- Native plants considered weeds
- Plants not to be sold in all or parts of NSW

The various listings have different requirements on the management of the specific weed. Once identified within the landscape, the management of an invasive weed should be undertaken in accordance with the relevant listed requirements.

Weed management is often a concern in new areas of mass planting in garden beds. A noxious weed is a plant declared to be noxious under the NSW Noxious Weeds Act 1993. Noxious weeds can be agricultural weeds, environmental weeds or have a direct impact on human health.

Environmental weeds are non-local plants that can invade and change natural areas and threaten the survival of native plants and animals. After land clearing, environmental weeds are considered to be the next greatest threat to our indigenous biological diversity. Environmental weeds have the potential to readily invade garden bed areas and potentially impact on the adjacent lands.

In addition to the environmental hazard posed by weeds, weeds occurring in mass planted beds, growing from the base of trees and from pavement can be unsightly and presents an untidy appearance. To ensure that environmental and noxious weeds do not reproduce within or spread into mass planted areas and compete with plantings and spread to other areas or nearby Wianamatta South Creek, weed management is a critical maintenance action. Active monitoring of weeds is critical to ensuring appropriate management within Zone 1, including in garden beds and lawn at the Administration Building Precinct.

Weed management will be completed during construction in accordance with the Upper South Creek (USC) Biodiversity CEMP Sub-plan, Appendix F Weed and Pathogen Management Procedure and will be maintained to less than or equal to 10% Percent Foliage Cover (PFC) across the entire footprint.

Initial weed mapping has been undertaken by AMBS Ecology and Heritage at the AWRC site. The mapping undertaken thus far is to assist with the development of the landscape design and subcontract package and pending timing of the commencement of landscaping works, may need to be refreshed by a suitably qualified ecologist at a later time to ensure consistency with the requirements specified in the Weed and Pathogen Management Procedure. A copy of the weed mapping provided by AMBS Ecology and Heritage is provided in Appendix D.

Carry out weed removal at intervals consistent with the details provided in Table 8 and ensure that weeds do not flower to form seed heads. Upon Construction Completion, weed monitoring and removal must be undertaken and occur throughout the Landscaping Maintenance Period.

Where herbicide has the potential to makes its way into a waterbody or biodetention basin or when wind conditions could cause drift outside the area to be treated or onto desirable plants, herbicide approval must be sought from the O&M Contractor prior to commencement of the activity. Herbicide use to be in accordance with regulation rates and manufacturers recommendations.

After spraying, lop any dead weeds flush with the ground surface and dispose of the cuttings to an appropriately licensed waste facility, ensuring that these are not mulched and included for reuse onsite.

Remove by hand any weeds which cannot be controlled by herbicide. Ensure that the entire weed including all roots is removed and disposed of to an appropriately licensed landfill.

In grassed areas, the management of weeds will occur using approved selective herbicides, where weed is a visual issue or noxious. Herbicide use to be in accordance with regulation rates and manufacturers recommendations. Dye shall be added to herbicides to show extent of treated area.

4.8 Tree Planting in Grassed Areas

Soil moisture levels are to be maintained around plantings during the landscape establishment and maintenance period. Watering is to be carried out to ensure this occurs.

Maintain mulch to a depth of 75mm around the base of the individual tree and shrub beds. Mulched areas to be free from grasses and weeds.

Prune plantings in accordance with AS 4373-2007 Pruning of Amenity Trees.

4.9 Rubbish Removal

Remove all rubbish and debris that is within area of landscape planting, and recycle or dispose in a responsible manner, and leave Zone 1 in a clean and tidy condition.

4.10 Graffiti and Vandalism Repairs

Notify Site Manager as soon as possible following graffiti or vandalism attacks on site. All vandalism and graffiti attacks are to be reported to the Site Manager for recommended action to be taken. Notwithstanding the above, the Landscape Supervisor is to ensure that the site is left in a neat, tidy, and safe state.

4.11 Fungal and Insect Attack

Regular inspections of the landscape works are to include identification of any outbreaks of pests or disease. Where pests are known, and a strategy of control has been identified this should be undertaken after approval from the Site Manager.

Where issues are unknown, samples are to be collected and sent for testing to confirm the pest species or type of disease. A program of control based on recommendations of the testing organisation is to be implemented and monitored to confirm effective control has been achieved.

Control of pests and disease should be undertaken to minimise loss of plant material or impacts to plant material health and future growth.

4.12 Pest Control

A pest control program for the site should be implemented based on identification of pests during monitoring activities (Section 6). If rabbit warrens, foxes, and other pests are identified, fumigation will occur. This is to be undertaken in consultation with Local Land Services. The site is to be constantly monitored for evidence of pest activity. Monitoring will occur during the establishment and maintenance periods. Any damage by pests, primarily due to grazing on young plants, will require rectification to reduce impacts to and loss of plants.

4.13 Watering

Trees in grass and mass planted areas shall be watered regularly with an evenly deep penetrating application to ensure continuous healthy growth. All other plants will be watered according to the watering program provided in Table 6. Is should be noted that the information presented is indicative and subject to confirmation by the onboarded landscape contractor, including nominating appropriate methods of irrigation at the time of undertaking the work, with consideration of the weather conditions. The frequency of watering will be gradually reduced as the plantings mature.

The Administration Precinct is to be maintained to a high quality for the operations staff and visitors to the site. The landscape has been designed to create amenity and suitable outdoor spaces for staff use. These areas should be maintained to a higher level than the Plant. Therefore, should be watered more regularly and as required to ensure the grass remains green and all plants are established and reach their growth potential.

Table 6 Watering Program for Zone 1 and 3

Phase	**Implementation**				**Establishment**	**Maintenance**	
Timing	Week 1	Week 2-4	Months 2-5	Months 5-6	Months 6-12	12-18 Months	18-36 Months
Frequency	Daily	Weekly	Fortnightly	Monthly	Monthly	Monthly	Monthly
Per m2 of Zone	6 Litres	6 Litres	30 Litres	30 Litres	30 Litres	30 Litres	30 Litres
Note Watering **ONLY** to occur post 18 months if periods of prolonged dry and hot weather are experienced in excess of one (1) month.*							

4.14 Management of permanent stockpiles

Stockpiles placed permanently in the Operational Zone will be vegetated in accordance with the approved landscape management documents (Appendix C).

Stockpiles will be managed consistently with relevant requirements set out in Section 4 of this LMP. Access to stockpiles for the purpose of undertaking maintenance and monitoring activities are to be consistent with the AWRC site Safety Management System.

The site was used for radio astronomy when it was leased to CSIRO. The Fleurs Field station was a major technological innovation. Master planning of the Greenspace is currently underway by Tract, on behalf of Sydney Water and will include detail around key heritage elements to be implemented and retained at the AWRC site.

Remnant antennae

The two remaining antennae will be protected via the installation of permanent fencing that will serve as an interim solution prior to final decision-making being made for Greenspace Master Planning.

The presentation of the approximate location of the remnant antennae is provided in greater detail in Appendix C, drawings ST0079-A9008-01 (northern antennae) and ST0079-A9008-14 (south-western antennae).

Cross-array markers

The interpretation of the cross-array points is acknowledged in the landscape design. There are two cross array markers placed at locations within the Operational zone. The markers consist of curved steel edging to radii. The locations are set to important historical alignments and should not be altered.

The curved and straight alignments of steel plate are to be maintained to the design levels. Gravel areas are to be topped up where it has settled below the steel edge. Remove weeds and maintain adjoining garden beds to the levels to match steel edging.

The presentation of the cross-array layout is provided in greater detail in Appendix C, drawing ST0079-A9008-21.

4.16 Summary of Activities

Error! Reference source not found. to **Error! Reference source not found.** summarise the landscape maintenance and inspection requirements, including the time frames and frequencies required, for the different maintenance activity categories in Zones 1 and 3.

Table 7 Summary of maintenance activities

General Maintenance Activities	Timeframe / Frequency			Responsibility
	Inspections		Performance of the work	
Pruning of Vegetation for Bush Fire and aviation Risk Safety		Yearly	Once per year as required	Landscape Supervisor
Management & removal of dead tree branches		Yearly	Once per year as required	Landscape Supervisor
Noxious weed control	Monthly		As required	Landscape Supervisor
Prevent reproduction of weeds by destroying seedlings and established weeds before seed set or other propagules form. Remove by hand in the first instance (where infestations are low). Ensure that the entire weed including all roots is removed. Dispose of the weeds off site	Monthly		Monthly, however, may increase to fortnightly during Summer months subject to the advice of the Landscape Supervisor.	Landscape Supervisor
Remove by Herbicide application any weeds which cannot be controlled by hand removal. Herbicide application must occur before weed seed set. Non-target species and areas must be reinstated if damaged by herbicide application.	Monthly		Monthly, however, may increase to fortnightly during Summer months subject to the advice of the Landscape Supervisor.	Landscape Supervisor
Herbicide use to be in accordance with regulation rates and manufacturers' recommendations. Herbicide use must comply with the requirements of the Noxious and environmental weed control handbook: A guide to weed control in non-crop, aquatic and bushland situations (New South Wales Weed Control Handbook A Guide to weed control in non-crop, aquatic and bushland situations, NSW Department of	Monthly		Monthly, however, may increase to fortnightly during Summer months subject to the advice of the Landscape Supervisor.	Landscape Supervisor

General Maintenance Activities	Timeframe / Frequency			Responsibility
	Inspections		Performance of the work	
Primary Industry, Seventh Edition).				
After spraying, lop any dead weeds flush with the ground surface and dispose of the cuttings. Not to be mulched or added to green waste.	Monthly		Monthly, however, may increase to fortnightly during Summer months subject to the advice of the Landscape Supervisor.	Landscape Supervisor
Use of bio-degradable herbicide is mandatory.	Monthly		Monthly, however, may increase to fortnightly during Summer months subject to the advice of the Landscape Supervisor.	Landscape Supervisor
Fungal and disease control	Monthly		As required	Landscape Supervisor
Rubbish removal	Monthly		As required	Landscape Supervisor
Auditing and Reporting	Monthly		Monthly	Landscape Supervisor

Table 8 Summary of Activities Related to grassland areas

Maintenance Activities (Grasslands only)	Timeframe / Frequency			Responsibility
	Inspections		Performance of the work	
Mowing	Monthly		As required	Landscape Supervisor
Replacement of damaged grass areas	Monthly		Once per Year as required	Landscape Supervisor
Tree Planting in Grassland (along Zone 3)	Monthly		As required	Sydney Water
Maintain mulch around base of Plant at 75mm depth		Yearly	Every year for first 4 years	Sydney Water
Prune and fertilise as per specified horticultural maintenance		Yearly	As required	Sydney Water
Watering (Administration Precinct)	Fortnightly		As required	Landscape Supervisor

Table 9 Summary of Activities Related to garden beds

Maintenance Activities (Garden Beds only)	Timeframe / Frequency			Responsibility
	Inspections		Performance of the work	
Weed garden beds prior to weeds setting flower	Monthly		As required (priors to weeds setting flowers)	Landscape Supervisor
Mulching within 0.5m of the boundary of a planted area		Yearly	As required	Landscape Supervisor
Removal of Dead/Dying Plant Material		Yearly	As required	Landscape Supervisor
Replacement Plantings	Monthly		As required	Landscape Supervisor
Replace failed plantings		Yearly	Every year for first 4 years	Landscape Supervisor
Inspect replacement plantings		Yearly	As required	Landscape Supervisor
Water the replacement plantings	Not applicable (n/a)		A minimum of 12 weeks	Landscape Supervisor
Tree stakes - replace stakes during establishment	Monthly		As required	Landscape Supervisor
Fertilising and Pruning				
Fertilise all plantings at specified rates		Yearly		Landscape Supervisor / Landscape Architect*
Prune planting in specified manner	n/a		n/a	n/a
Trees		Yearly	n/a	Landscape Supervisor / Landscape Architect*
Tall, medium, low shrubs		Yearly	n/a	Landscape Supervisor / Landscape Architect*
Watering (Administration Building Precinct)	Fortnightly		As required	Landscape Supervisor

*Note *Denotes inspection only.*

5 Protective Measures

5.1 Bushfire Protection Actions

A ten-metre perimeter APZ has been established around the Operations Zone perimeter fence line, as indicatively presented in Figure 7 and includes an accessible fire trail for the purpose of implementing bushfire management requirements and responding to emergencies should they occur.

The APZ performance requirements for the Operational Zone where it is being maintained as an inner protection area as defined under Planning for Bushfire Protection PBP, are as follows:

- Tree canopy cover <15% at maturity
- Trees at maturity do not touch or overhang buildings
- Lower limbs to be removed up to 2 m above the ground
- Tree canopies separated by 2-5 m
- Preference for smooth barked and low flammability trees and shrubs
- Large gaps between shrubs
- Shrubs not placed directly under trees
- Shrubs form <10% ground cover
- Shrubs separated from doors and windows by a distance of at least twice shrub height
- Grass mown/slashed, maintained at no more than 100mm
- Remove leaves and vegetation debris.

If internal landscaping is not maintained to the APZ standards, it should be separated from external bush fire-prone vegetation by the facility's APZ (as a minimum) such that there is no connectivity, and no pathway for fire to travel into the facility. Any vegetation within 15m of site buildings should be planned and maintained to comply with the above considerations.

Note: All buffer planting areas are required to have annual assessment by a bush fire and aviation risk contractor and maintenance carried out if required. Refer to Table 11.

The solar farm is to be on mown or dwarf grass substrates, maintained in a low fuel condition (<100 mm in length). This can be achieved through regular mowing.

Figure 7 Asset Protection Zones

5.2 Wildlife Strike Mitigation

The Aviation Safeguarding Guidelines Western Sydney Aerotropolis and surrounding areas (NSW Department of Planning, Industry and Environment 2021) sets out planning guidelines to inform land use planning decisions on land impacted by safeguarding controls. The objectives allow for the assessment on land surrounding Western Sydney International (Nancy-Bird Walton) Airport (WSI) where wildlife may present risk to operation and ensure wildlife management provisions when undertaking land use planning.

The activity of birds and animals in the vicinity of the WSI Airport is a recognised potential source of hazard to the safe operation of aircraft. This hazard results from the possibility of a collision between an aircraft and one or more birds or animals i.e., a bird strike. The site falls within the 8km wildlife buffer zone, refer Figure 8. National Airports Safeguarding Framework Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports has been incorporated into the Aerotropolis SEPP and Aerotropolis DCP provides a framework for how to manage the risk of wildlife strike on aircrafts. New land uses within 13km of airport property should be regularly monitored and action plans created to mitigate any unacceptable risk of bird strike.

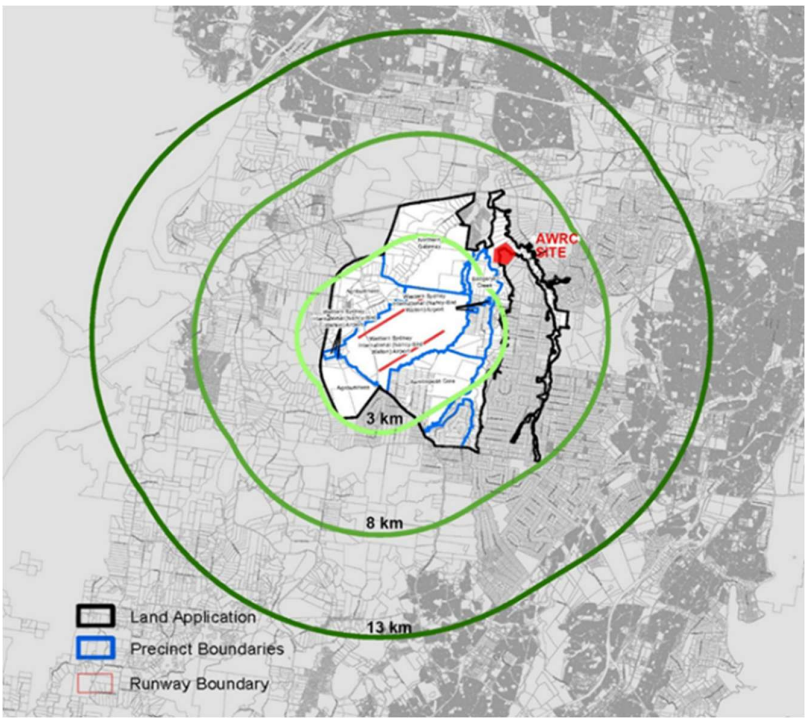


Figure 8 Wildlife Buffer Zone Map, adapted from State environment Planning Policy

Wildlife management will be an important aspect of operations and maintenance at the AWRC. Aviation risks mitigated in the landscape design are around the creation of habitats that are attractive to birds and bats. Key considerations include ensuring that the design does not create wildlife attractive features (natural and built), bird and bat populations are monitored to assess strike risk. The Wildlife Management Plan (WMP) will identify mitigation actions where hazards are identified. Further the WMP will integrate routine monitoring, wildlife awareness, wildlife management and performance standards, wildlife deterrent and surveillance patrols.

The wildlife strike mitigation strategy should not preclude the development of the site to improve biodiversity in the region by attracting and supporting microfauna. The design of the landscape has considered plant species selection, density of vegetation cover, depth of wetlands and the operation of the site to minimise habitats that attract wildlife hazards.

5.2.1 Species selection

The Western Sydney Aerotropolis Draft Wildlife Management Assessment Report (Western Sydney Planning Partnership & Avisure 2020) provides guidelines for planting species to minimise the attraction of birds and flying foxes within the Aerotropolis. It is recommended that "trees and shrubs planted in the area should not bear edible berries, fruits, seeds, nuts, nectar, or bear flowers profusely. Such vegetations attract flying foxes and birds such as lorikeets. Plants that attract insects may also pose a risk in attracting small numbers of birds.

Landscape implementation proposes a variety of different species sparsely inter-mixed to allow local biodiversity to evolve. For example, the planting of *Acacia spp*. will improve soil fertility through nitrogen fixation and allow cross pollination.

This Landscape Management Plan will allow for the continual monitoring and maintenance of the landscape across the entire site to minimise wildlife hazards.

5.2.2 Density of vegetation cover

Planting density has been predominately determined using bushfire risk criteria, except for the planting proposed along the Wianamatta South Creek which is part of the regional green networks and falls within the category of enhanced riparian and wetland corridor landscape to improve biodiversity.

Additionally, hazardous wildlife deterrents have been considered in the design and ongoing management of the landscape. A Wildlife Management Plan will be prepared to inform the operation of the AWRC prior to operations commencing. Particular consideration includes the design and management of the landscape to deter bird populations. The facilities' grass areas will be kept to 100mm in height for the solar farm zone and 75mm for turf areas in accordance with guidelines for asset protection within fire zones. Large, still permanent water bodies will be netted. Monitoring will inform the need for the introduction of sonic devices or ultrasonic repellers to deter wildlife.

The Landscape Management Plan describes the management activities to be undertaken for the long-term care of the environment. There will be focus on particular management activities which support the goals and objectives of wildlife and bush fire management.

5.2.3 Detention and Bioretention Basins

The restoration of Wianamatta South Creek has a strong emphasis on waterway and catchment health to satisfy commitments to tree planting, align with biodiversity principles in the Cumberland Plain Conservation Plan, enhance ecological value and mitigate impacts against threatened species. Slow moving water and where water accumulates for extended periods of time can be attractive to wildlife. Artificial wetlands can attract significant numbers of wildlife and as such haven't been implemented. The retention basin is ephemeral and only holds water after rain which dissipates within 24 -48 hours. The bioretention basin is fully planted and not at a depth for wading birds.

Specific measures that have been incorporated into the landscape include:

- Bioretention and detention basins: Temporarily hold water and fully drain within 24-48 hours.
- Retention basin embankments: 4 horizontal to 1 vertical to basin bank slopes
- Drainage grass swale depth: 200 - 400mm maximum in height
- Billabong water depth: between 0.5m and 1.18m is less likely to attract hazardous flocking bird such as pelicans, swans, and cormorants; or upending ducks such as Pacific Black Ducks; or wading birds such as ibis and egrets.
- Sedge/wetland planting: designed with steeper slopes.
- Bioretention basins: vegetation 300 - 600mm in height.

6 Monitoring and Reporting

6.1 Monitoring Procedures and Performance Indicators

General monitoring procedures will be adopted in Zones 1 and 3 to assess if the revegetation has achieved an acceptable standard as measured against the performance criteria. Areas of landscaping that have failed will be clearly identified and the nature of the failure documented.

Based on the results of the monitoring program appropriate remedial action will be determined and implemented until vegetation has established and the required landscape performance is achieved.

The planting survivorship method includes:

- Planting success recorded as either ALIVE or FAILED (failed includes missing and deceased).
- Signs of predation or disturbance (plant damaged, presence of scat, tree guard damaged or removed, etc.,)
- General management: correctly planted, sufficient watering undertaken, plant health and vigour (observed nutrient deficiencies).

Monitoring of the landscape works will commence from the time of installation and extend until maintenance responsibilities for the project are handed over to Operations Maintenance Contractor.

Monitoring will be carried out monthly in two phases as summarised below and with reference to the relevant performance criteria detailed in Table 10:

1. **Initial establishment and maintenance period** – monitoring to assess the trajectory of the outcomes after approval of the work until contract completion; the purpose is to enable timely intervention or corrective actions if required to ensure vegetation growth.
2. **Post-completion** – monitoring will continue throughout the maintenance period; the purpose is to ensure that each landscape area has reached a condition that indicates a high probability that the intended mature outcome is achieved in the longer term.

7 Performance criteria

Performance criteria are detailed below within Table 16. Failure to achieve the stated performance criteria may require the 6 to 12 month establishment period to be extended and relevant actions proposed and agreed between all relevant parties. Therefore, the establishment phase must continue until the performance criteria are achieved and evidenced to Sydney Water for formal acceptance, concluding the establishment phase and commencing the maintenance phase.

A suitably qualified and experienced person in landscaping must prepare a statement certifying compliance with the performance criteria at the end of the establishment period.

If monitoring indicates that the LMP tasks are not achieving the performance criteria, the management actions and program will be revised. The client (JHG or Sydney Water) and the landscape contractor can adapt the criteria and actions as required in response to the success of rehabilitation works.

The performance criteria are detailed below within Table 10 and the management actions within

Table 11.

Table 10 Landscape Performance Criteria

Performance Action	Zone	Responsibility	Performance Criteria	Timing (Phase)
Weed control	Zones 1 & 3	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Trility/JHG (O&M Contractor) – Maintenance for Zone 1 during Operation. Sydney Water – Maintenance for Zone 3 during Operation.	All weeds within the area of the Landscape Management Plan (LMP), must be maintained to less than or equal to 10% Percent Foliage Cover (PFC) across the entire footprint. Weeds for the purpose of this requirement are defined within: • Section 4.7 Weed Management, Landscape Management Plan (Revision 2) • John Holland Upper South Creek AWRC - Weed Mapping report (AMBS: 24447) dated 10/09/2024, all weeds identified as High Threat Weeds (HTW), Weeds of National Significance (WOFS) & Priority Weeds.	From the commencement of landscape management plan works: • Implementation • Establishment • Maintenance
Revegetation / Planting Maintenance	Zone 1 & 3	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Trility/JHG (O&M Contractor) – Maintenance for Zone 1 during Operation. Sydney Water – Maintenance for Zone 3 during Operation.	A minimum 80% survival rate of individual plant species must be achieved. The survival rate should be calculated based on the species percentage (%) coverage rate per square meter (m2) reference to the coverage nominated in the design, landscape specification, vegetation and landscape	From the commencement of landscape management plan works: • Implementation • Establishment • Maintenance

Performance Action	Zone	Responsibility	Performance Criteria	Timing (Phase)
			management plans for the respective management zone or area of the riparian corridor. The measurement of plant survival rates will be undertaken by the landscape contractor at the following prescribed milestones: • Establishment completion • Maintenance completion • Handover from John Holland to another party (if required) These milestones serve as checkpoints to assess and monitor the survival rates of the planted species. The landscape contractor will be responsible for conducting the measurements and ensuring that the minimum survival rate of 80% is achieved for each individual plant species based on the specified coverage rate per square meter. For relevant areas within the operational space, a minimum of 90% coverage of grass growth/strike per square meter (m2) must be achieved and maintained. The coverage rate should be calculated based on the percentage (%) of the area that is covered by grass in the respective management zone or area.	

Table 11 Landscape Management Actions

Management Action (MA#)	Management Zone	Responsibility	Task/ Performance Criteria	Timing (Phase)
MA1 - Weed control	Zone 1 & 3	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Trility/JHG (O&M Contractor) – Maintenance for Zone 1 during Operation. Sydney Water – Maintenance for Zone 3 during Operation.	Primary and secondary weed control works are to include the following actions: • All priority, environmental, vine and woody weeds are to undergo initial primary treatment in accordance with Project Biodiversity CEMP sub-plan weed and pathogen movement procedure. • Commencement of maintenance works will occur once mature exotic species have been reduced in accordance with project Biodiversity CEMP sub-plan weed and pathogen management procedure.	From the commencement of landscape works: • Implementation • Establishment • Maintenance
MA2 - Revegetation	Zone 1 & 3	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Trility/JHG (O&M Contractor) – Maintenance for Zone 1 during Operation. Sydney Water – Maintenance for Zone 3 during Operation.	Following the preliminary works (weed control, mulch/ jute installation), revegetation is to be undertaken to ensure sufficient vegetation cover exists to prevent soil erosion and to assist in the rehabilitation of the area.	Following the preliminary works (weed control, mulch/ jute installation).
MA3 - Planting maintenance	Zone 1 & 3	JHG (Principal Contractor) - Implementation, Establishment and	• Installed plantings are to be maintained with key elements of water,	Establishment – Commence immediately post plant installation.

Management Action (MA#)	Management Zone	Responsibility	Task/ Performance Criteria	Timing (Phase)
		Maintenance until contract completion. Trility/JHG (O&M Contractor) – Maintenance for Zone 1 during Operation. Sydney Water – Maintenance for Zone 3 during Operation.	prevention of predation and suppression of smothering weeds. • Replacement planting is to be carried out throughout the maintenance period to sustain the 80% survival rate at the completion of the maintenance period. • Losses of greater than 20% of originally installed plantings may have the maintenance period extended until survival rates have been achieved.	Maintenance – Post establishment until completion.
Maintenance	Zone 1 & 3	JHG (Principal Contractor) - Implementation, Establishment and Maintenance until contract completion. Trility/JHG (O&M Contractor) – Maintenance for Zone 1 during Operation. Sydney Water – Maintenance for Zones 3 during Operation.	All mature priority weeds are to be appropriately managed prior to commencement of maintenance period. Works to be undertaken utilising best practice regeneration techniques. Plants will be maintained according to aviation safety considerations and the Wildlife Hazard Management Plan. Mowing of grasses is to be undertaken regularly in accordance with the maximum and minimum heights specified in section 4.4 to manage bushfire risk.	The maintenance period will run for a 24-month term following successful completion of establishment. The commencement of this maintenance period may be adjusted if there are delays beyond the contractor's control. Commencement and completion dates of the maintenance period will be determined by the Vegetation management consultant assessment of performance against the criteria in Table 16. The outcomes of performance will be reported for discussion to the John Holland, Sydney Water, and relevant

Management Action (MA#)	Management Zone	Responsibility	Task/ Performance Criteria	Timing (Phase)
				authorities where necessary.

8 Adaptive Management

As this is a long-term project implemented over several years, an adaptive management approach will enable the contractor to learn from and respond to successful and unsuccessful techniques used on the site and inform future priorities and work plans. In its simplest form, this may include substituting species identified in the planting tables or undertaking advanced direct seeding techniques instead of manual planting techniques for revegetation. A record will be kept of such changes through the monitoring and reporting scheme as outlined in Section 6.

The success of the works will be determined by meeting the performance criteria identified in Section 7. Contractors can implement different techniques to those specified here providing that performance criteria are met. However, any major departures from the LMP or proposed changes to performance criteria must be approved in writing by JHG, Sydney Water, and where necessary, resubmission to the Planning Secretary in accordance with the CSSI-8609189 Minister's Conditions of Approval.

Appendices

Appendix A Plant Species

OPERATIONAL ZONE PLANTING

TREE PLANTING				
CODE	**BOTANIC NAME**	**COMMON NAME**	**SIZE**	**QUANTITY**
FIRE TRAIL TREES				
ANG flo	*Angophora floribunda*	Rough-barked Apple	25L	41
ANG sub	*Angophora subvelutina*	Broad leaved Apple	25L	41
COR mac	*Corymbia maculata*	Spotted Gum	25L	67
EUC amp	*Eucalyptus amplifolia*	Cabbage Gum	25L	67
EUC cre	*Eucalyptus crebra*	Narrow-leaved Ironbark	25L	41
EUC mol	*Eucalyptus molucanna*	Grey Box	25L	41
EUC sid	*Eucalyptus sideroxylon*	Red Ironbark	25L	40
EUC ter	*Eucalyptus tereticornis*	Forest Red Gum	25L	67
			Total	**405**
FEATURE TREE				
MEL dec	*Meleluca decora*	White Feather Honeymyrtle	25L	27
			Total	**27**

GARDEN BED TYPE 1					7270m²
SHRUBS					
CODE	**BOTANIC NAME**	**COMMON NAME**	**DENSITY**	**SIZE**	**QUANTITY**
ACA flo	*Acacia floribunda*	White Sally	As shown	25L	24
BUR spi	*Bursaria spinosa*	Blackthorn	1/4m²	Forestry Tube	606
Cal cit	*Callistemon citrinus*	Crimson Bottlebrush	1/4m²	Forestry Tube	606
MEL nod	*Melaleuca nodosa*	A Tea Tree	As shown	25L	24
IND aus	*Indigofera australis*	Native Indigo	1/4m²	Forestry Tube	606
				Total	**1866**
GRASSES 4/m²					
AUS ten	*Austrodanthonia tenuior*	Wallaby Grass		Viro Tube	4847
IMP cyl	*Imperata cylindrica*	Bladey Grass		Viro Tube	4847
LOM lon	*Lomandra longifolia*	Spiny-headed Mat-rush		Viro Tube	4847
MIC sti	*Microlaena stipoides*	Weeping Grass		Viro Tube	4847
POA lab	*Poa labillardieri var. labillardierei*	Common Tussock Grass		Viro Tube	4846
THE tri	*Themeda triandra*	Kangaroo Grass		Viro Tube	4846
				Total	**29080**
FORBS 1/m²					
COM cya	*Commelina cyanea*	Scurvy Weed		Viro Tube	1818
DIC rep	*Dichondra repens*	Kidney Weed		Viro Tube	1818
EIN pol	*Einadia polygonoides*	Knotted Goosefoot		Viro Tube	1817
GER sol	*Geranium solanderi var. solanderi*	Native Geranium		Viro Tube	1817
				Total	**7270**
CLIMBERS 1/10m²					
CLE gly	*Clematis glycinoides var. glycinoidesfgg*	Headache Vine		Viro Tube	243
BIL sca	*Billardiera scandens*	Apple Berry		Viro Tube	242
GEI cym	*Geitonoplesium cymosum*	Scrambling Lily		Viro Tube	242
				Total	**727**

GARDEN BED TYPE 2				630m²
GRASSES 4/m²				
LOM lon	*Lomandra longifolia*	Spiny-headed Mat-rush	Viro Tube	1260
LOM lim	*Lomandra longifolia confertifolia 'Lime Tuff'*	Basket Grass	Viro Tube	1260
			Total	**2520**
GROUNDCOVERS 1/m²				
DIC rep	*Dichondra repens*	Kidney Weed	Viro Tube	630
			Total	**630**

GARDEN BED TYPE 3					10662m²
SHRUBS					
CODE	**BOTANIC NAME**	**COMMON NAME**	**DENSITY**	**SIZE**	**QUANTITY**
BUR spi	*Bursaria spinosa*	Blackthorn	1/4m²	Forestry Tube	889
Cal cit	*Callistemon citrinus*	Crimson Bottlebrush	1/4m²	Forestry Tube	889
IND aus	*Indigofera australis*	Native Indigo	1/4m²	Forestry Tube	889
				Total	**2667**
GRASSES 4/m²					
AUS ten	*Austrodanthonia tenuior*	Wallaby Grass		Viro Tube	7108
IMP cyl	*Imperata cylindrica*	Bladey Grass		Viro Tube	7108
LOM lon	*Lomandra longifolia*	Spiny-headed Mat-rush		Viro Tube	7108
MIC sti	*Microlaena stipoides*	Weeping Grass		Viro Tube	7108
POA lab	*Poa labillardieri var. labillardierei*	Common Tussock Grass		Viro Tube	7108
THE tri	*Themeda triandra*	Kangaroo Grass		Viro Tube	7108
				Total	**42648**
FORBS 1/m²					
COM cya	*Commelina cyanea*	Scurvy Weed		Viro Tube	2666
DIC rep	*Dichondra repens*	Kidney Weed		Viro Tube	2666
EIN pol	*Einadia polygonoides*	Knotted Goosefoot		Viro Tube	2665
GER sol	*Geranium solanderi var. solanderi*	Native Geranium		Viro Tube	2665
				Total	**10662**
CLIMBERS 1/10m²					
CLE gly	*Clematis glycinoides var. glycinoidesfgg*	Headache Vine		Viro Tube	356
BIL sca	*Billardiera scandens*	Apple Berry		Viro Tube	355

GEI cym	*Geitonoplesium cymosum*	Scrambling Lily	Viro Tube	355
			Total	**1066**

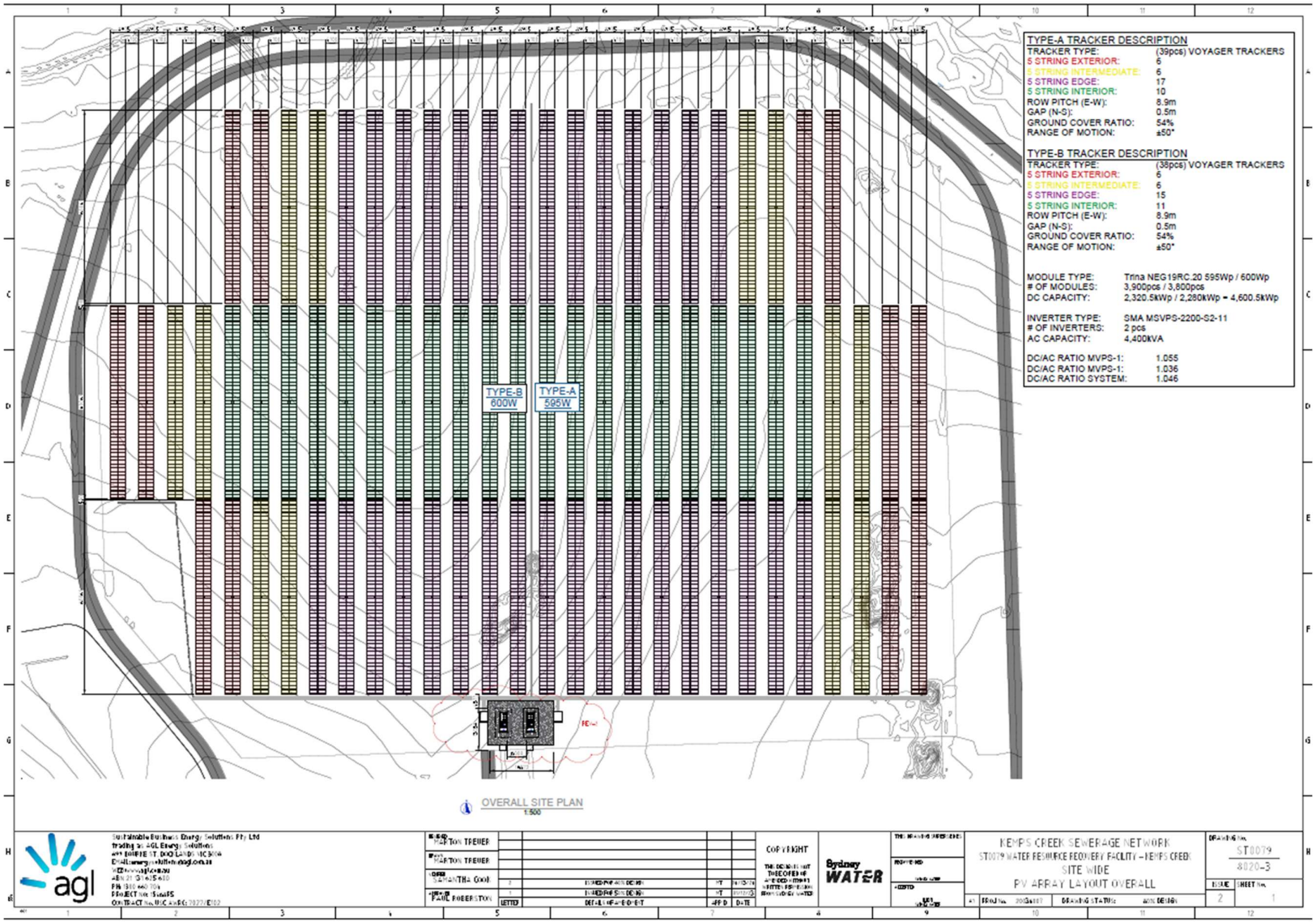
BIORETENTION PLANTING				**319m²**
SEDGES 8/m²				
CAR app	*Carex appresa*	Tall Sedge	Viro Tube	340
FIC nod	*Ficina nodosa*	Knobby Club Rush	Viro Tube	340
JUN usi	*Themeda australis*	Kangaroo Grass	Viro Tube	340
JUN kra	*Juncus kraussii*	Sea Rush	Viro Tube	766
JUN usi	*Juncus usitatus*	Common Rush	Viro Tube	766
			Total	**2552**

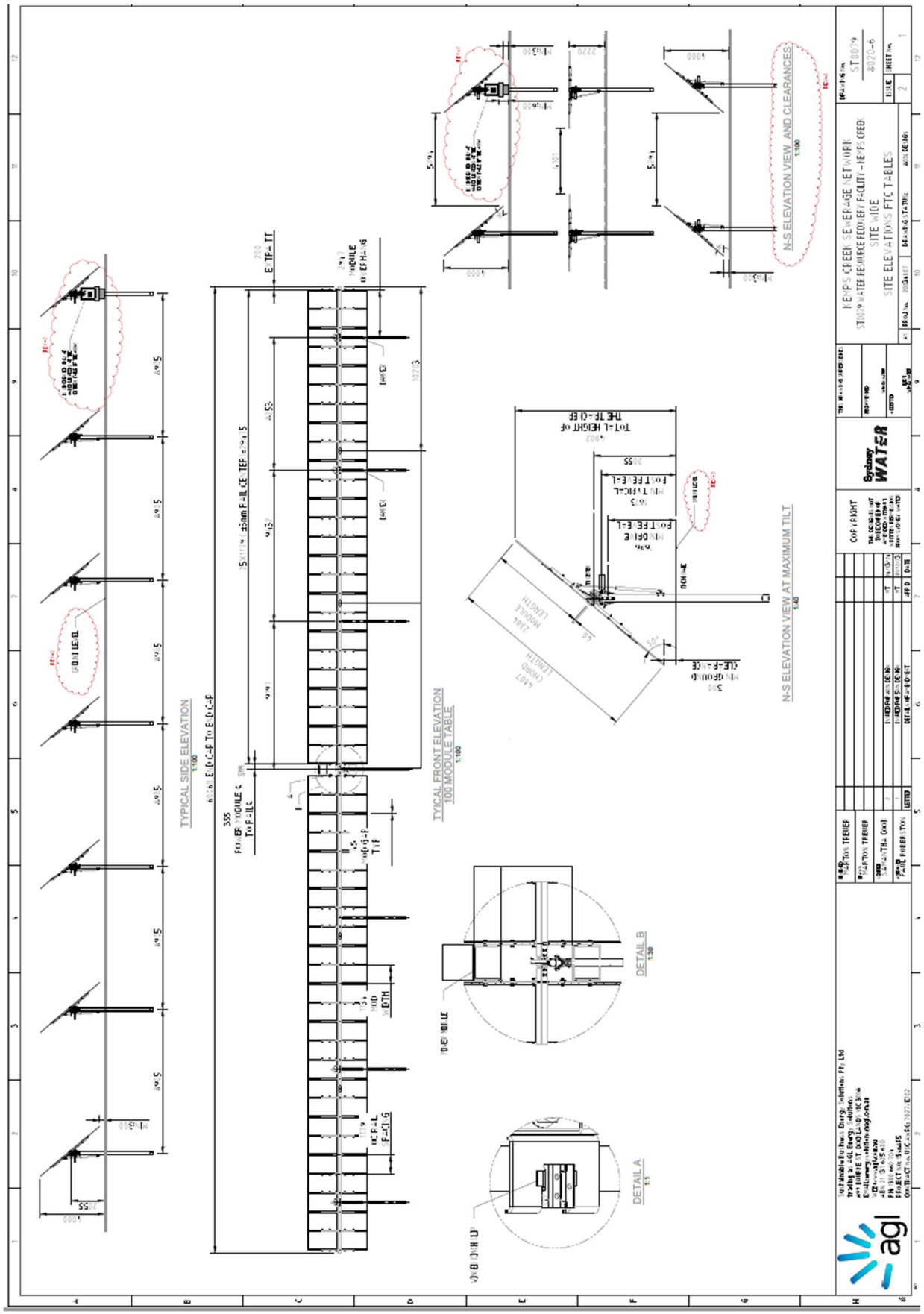
BIORETENTION PLANTING (DRY)				**1148m²**
GRASSES/SEDGES 8/m²				
CAR app	*Carex appresa*	Tall Sedge	Viro Tube	1225
FIC nod	*Ficina nodosa*	Knobby Club Rush	Viro Tube	1225
JUN usi	*Themeda australis*	Kangaroo Grass	Viro Tube	1225
AUS sti	*Austrostipa stipoides*	Coast Spear Grass	Viro Tube	1102
DIA lon	*Dianella longifolia*	Blueberry Lily	Viro Tube	1102
GAH fil	*Gahnia filum*	Chaffy Saw-sedge	Viro Tube	1102
LOM lon	*Lomandra longifolia*	Tanika, Spiny Mat-rush	Viro Tube	1102
MIC sti	*Microlaena stipoides*	Weeping Grass	Viro Tube	1102
			Total	**9185**

BATTER PLANTING				**1525m²**
SHRUBS 1/2 m²				
DAV uli	*Daviesia ulicifolia*	Gorse Bitter Pea	Viro Tube	190
DOD vis	*Dodonaea viscosa*	Sticky Hop Bush	Viro Tube	190
GOO ova	*Goodenia ovata*	Hop Goodenia	Viro Tube	190
MEL eru	*Melaleuca erubescens*	Pink Honey Myrtle	Viro Tube	190
GRASSES 4/m²				
LOM lon	*Lomandra longifolia*	Tanika, Spiny Mat-rush	Viro Tube	3050
DIA lon	*Dianella longifolia*	Blueberry Lily	Viro Tube	3050
			Total	**6860**

GRASS TYPES				
CODE	**BOTANIC NAME**	**DESCRIPTION**		
GRASS TYPE 1				
TYPE 1	*Empire Zoysia*	Turf as specified on 100mm improved site fill over 200mm cultivated site fill		
			Total Area (m^2)	**17158**
GRASS TYPE 2				
TYPE 2	*Sir Grange Zoysia*	Turf as specified on 100mm improved site fill		
			Total Area (m^2)	**17032**
GRASS TYPE 3				
TYPE 3	*Empire Zoysia*	Turf sprigging as specified on 100mm improved site fill over 200mm cultivated site fill		
			Total Area (m^2)	**165757**
GRASS TYPE 4				
CODE	**BOTANIC NAME**	**COMMON NAME**	**MINIMUM APPLICATION RATE (kg/ha)**	**QUANTITY (kg)**
Type 4	*Echinochlora esculenta or Secale cereale*	Japanese Millet @ 20kg/ha (warmer months) or Rye Corn @25kg/ha (cooler months)	20-25	14-18
	Microlaena stipoides	Weeping Grass	12	9
			Total Area (m^2)	**7039**

Appendix B Solar Farm Plans


TYPE-A TRACKER DESCRIPTION
TRACKER TYPE: (39pcs) VOYAGER TRACKERS
5 STRING EXTERIOR: 6
5 STRING INTERMEDIATE: 6
5 STRING EDGE: 17
5 STRING INTERIOR: 10
ROW PITCH (E-W): 8.9m
GAP (N-S): 0.5m
GROUND COVER RATIO: 54%
RANGE OF MOTION: ±50°
TYPE-B TRACKER DESCRIPTION
TRACKER TYPE: (38pcs) VOYAGER TRACKERS
5 STRING EXTERIOR: 6
5 STRING INTERMEDIATE: 6
5 STRING EDGE: 15
5 STRING INTERIOR: 11
ROW PITCH (E-W): 8.9m
GAP (N-S): 0.5m
GROUND COVER RATIO: 54%
RANGE OF MOTION: ±50°
MODULE TYPE: Trina NEG19RC.20 595Wp / 600Wp
OF MODULES: 3,900pcs / 3,800pcs
DC CAPACITY: 2,320.5kWp / 2,280kWp = 4,600.5kWp
INVERTER TYPE: SMA MSVPS-2200-S2-11
OF INVERTERS: 2 pcs
AC CAPACITY: 4,400kVA
DC/AC RATIO MVPS-1: 1.055
DC/AC RATIO MVPS-1: 1.036
DC/AC RATIO SYSTEM: 1.046
TYPE-B 600W
TYPE-A 595W
OVERALL SITE PLAN
1:500
COPYRIGHT
Sydney WATER
NEMPS CREEK SEWERAGE NETWORK
ST0079 WATER RESOURCE RECOVERY FACILITY – NEMPS CREEK
SITE WIDE
PV ARRAY LAYOUT OVERALL
DRAWING No. ST0079 8020-3
ISSUE 2
SHEET No. 1


TYPICAL SIDE ELEVATION
TYPICAL FRONT ELEVATION
100 MODULE TABLE
N-S ELEVATION VIEW AT MAXIMUM TILT
N-S ELEVATION VIEW AND CLEARANCES
DETAIL A
DETAIL B
KEMPS CREEK SEWERAGE NETWORK
SITE WIDE
SITE ELEVATIONS FTC TABLES
agl

Appendix C Landscape Design Drawings

Appendix D Weed Mapping