STRUCTURE PLAN AMENDMENT

Lot 500 Bertram Road, Wellard

Harley Dykstra®

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DOCUMENT CONTROL

CONTROL VERSION	DATE	STATUS	DISTRIBUTION	COMMENT
A	16.12.2020	Draft	Client	Review
B	21.12.2020	Final	LG	Assessment

Prepared for:	The Kings College	Date:	21 December 2020
Prepared by:	BH	Job No:	HD 21968
Reviewed by:	DM	Ref:	21968 – LSP – Version B

DISCLAIMER

ENDORSEMENT PAGE

This Structure Plan Amendment is prepared under the provisions of the City of Kwinana Local Planning Scheme No.2

IT IS CERTIFIED THAT THIS STRUCTURE PLAN AMENDMENT
WAS APPROVED BY RESOLUTION OF
THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

…… Date

Signed for and on behalf of the Western Australian Planning Commission:

……

An officer of the Commission duly authorised by the Commission pursuant to section 16 of the *Planning and Development Act 2005* for that purpose, in the presence of:

…… Witness

…… Date

…… Date of Expiry

TABLE OF AMENDMENT(S)

AMENDMENT NO.	SUMMARY OF AMENDMENT	AMENDMENT TYPE	DATE APPROVED BY WAPC
1	Introduce Special Use – Educational Establishment over Lot 500 Bertram Road, Wellard and modification to road layout and POS configuration.	Standard	xxx

EXECUTIVE SUMMARY

This submission represents an application for an amendment to the approved Structure Plan for Lots 500 and 501 (No. 202 and 214) Bertram Road, Wellard. The Structure Plan Amendment Area as identified on the Structure Plan Map (**Plan 1**) relates to the 'Urban' zoned portion of Lot 500 Bertram Road, Wellard under the Metropolitan Region Scheme (MRS). This area measures approximately 4.6380ha and is owned by The Kings Educational Ministries Inc ('The Kings College') who operate the The Kings College school currently situated on the adjacent Lot 950 (No. 170) Bertram Road. The Structure Plan Amendment Area is located approximately 33km south of the Perth Central Business District, 2.5km south east of the Kwinana Town Centre, and approximately 1.0km west of the Mortimer Road-Kwinana Freeway intersection.

The proposed Structure Plan Amendment is intended to facilitate the development of Lot 500 for additional education facilities to compliment the existing school on Lot 950 Bertram Road.

The summary table below (**Table 1**) details the nature and key outcomes of the proposed Structure Plan Amendment.

ITEM	DATA	STRUCTURE PLAN REF (SECTION NO.)
Total area covered by the Structure Plan Amendment	4.6380 ha	Part 1 Section 1
Area of each land use proposed: - Special Use – Educational Establishment - Park Recreation and Drainage	 4.1482ha 4,898m2	 Part 2 Section 2.1 Part 2 Section 2.1
Estimated area of Public Open Space: - Park Recreation and Drainage	 0.4898 hectares	 Part 2 Section 4.2

TABLE 1 – STRUCTURE PLAN AMENDMENT SUMMARY TABLE

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PART ONE - IMPLEMENTATION

1 STRUCTURE PLAN AMENDMENT AREA

This Structure Plan Amendment shall apply to the portion of Lot 500 Bertram Road, Wellard zoned 'Urban' under the MRS being the land contained within the inner edge of the line denoting the Structure Plan Amendment Area. The proposed Structure Plan Map is included as **Plan 1**.

2 OPERATION

The date the Structure Plan Amendment comes into effect is the date that the Amendment is approved by the WAPC.

3 STAGING

Development of the Educational Establishment on Lot 500 will be staged. A staging plan has not yet been finalised given this will be dependent on the availability of funding and the level of demand. Infrastructure requirements relevant to specific stages of development can be detailed as part of future development applications.

4 SUBDIVISION AND DEVELOPMENT REQUIREMENTS

4.1	Residential Density	Residential densities applicable to the Structure Plan Amendment Area shall be as shown on the Structure Plan Map.
4.2	Land Use Permissibility	Land use permissibility within the Structure Plan area shall be generally in accordance with the corresponding zone or reserve under Local Planning Scheme No. 2 (LPS 2). 'Educational Establishment' is a preferred use within the area designated as Special Use – Educational Establishment on the Structure Plan Map.
4.3	Masterplan	Development of the site for an Educational Establishment shall generally be in accordance with the Masterplan prepared by Taylor Robinson Chaney Broderick (**Appendix H** of Part 2 of the Structure Plan Amendment Report).
4.4	Bushfire Management	This Structure Plan Amendment is supported by a Bushfire Management Plan ('BMP'). A BMP shall be prepared and implemented as a condition of subdivision and/or development approval.
4.5	Traffic Management	A Transport Impact Statement/Transport Impact Assessment may be required to support future development applications for specific stages of development.
4.6	Stormwater Management	An urban water management plan will be required as a condition of development approval.
4.7	Noise Management	An acoustic report may be required to support specific stages of development. Any requirement for an acoustic report will be determined having regard to more detailed design at the development application stage.
4.8	Other Management Plans	The local authority may, depending on staging, recommend a condition is placed on development and/or subdivision approvals requiring the preparation, approval and implementation of a: - Acid Sulfate Soils & Dewatering Management Plan; - Construction Environmental Management Plan; and - Wetland Management Plan providing for the protection of the adjoining Conservation Category Wetland ('CCW').

4.9	Easement	As a condition of development and/or subdivision approval, an easement in gross shall be provided in the location shown on the Structure Plan Map to provide vehicular access to Lot 501.
4.10	Uniform Fencing	As a condition of development and/or subdivision approval, uniform fencing is to be installed and thereafter maintained in the locations recommended by the relevant Management Plan.

5 OTHER REQUIREMENTS

5.1 DEVELOPER CONTRIBUTIONS

The following developer contribution plan applies to the proposed use of the land under LPS 2:

i. Development Contribution Plan 1 ('DCP 1') for the funding of traditional infrastructure.

Development of Lot 500 for an 'Educational Establishment' will not bring about the need for 'Community Infrastructure' contributions under DCP 7 and DCP 12.

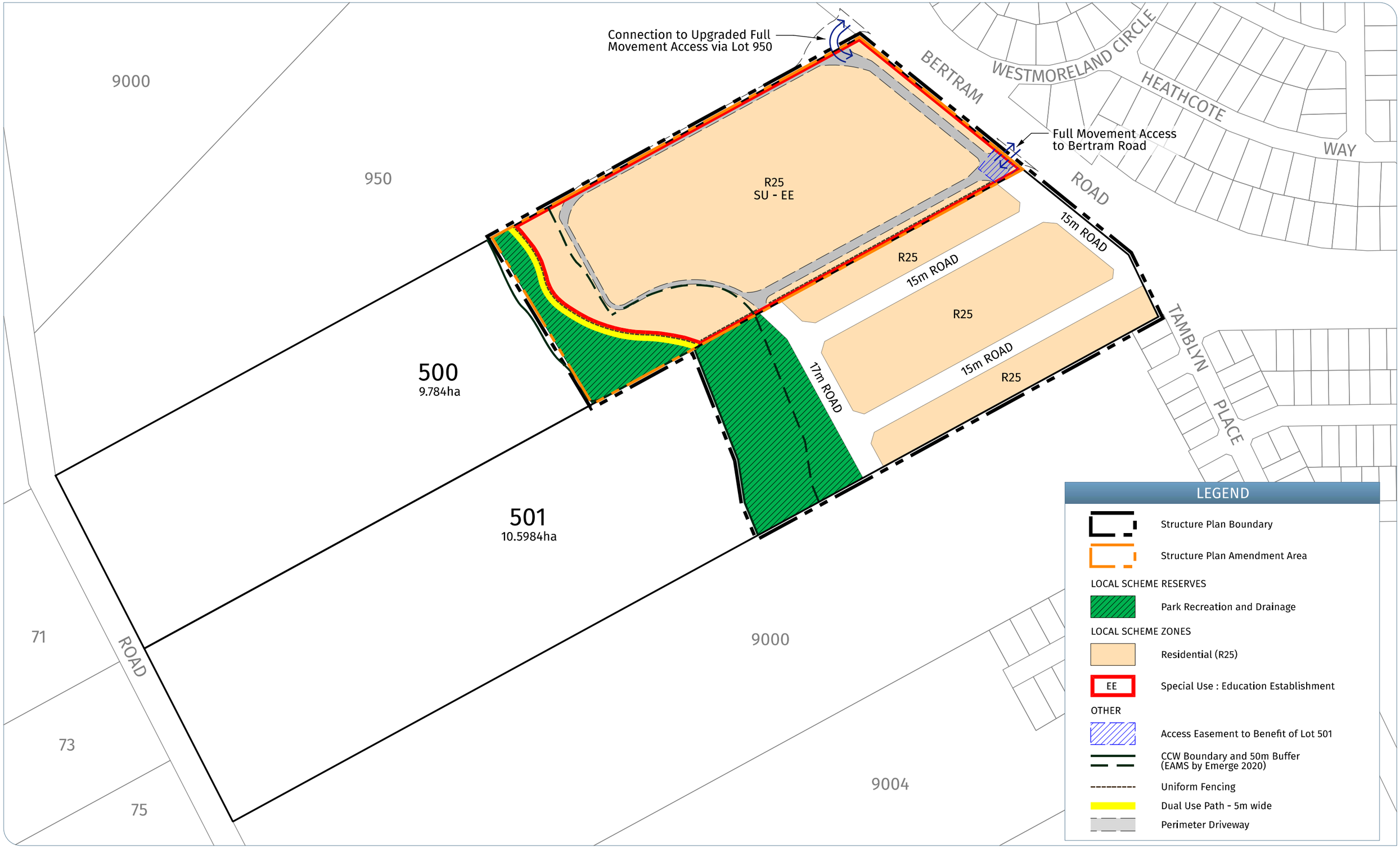
5.2 CONSERVATION CATEGORY WETLAND

The Conservation Category Wetland (CCW) identified within the balance of Lot 500 zoned 'Rural A' under LPS 2 and associated portion of the CCW buffer shown as 'Park Recreation and Drainage' on the Structure Plan Map will be ceded free of cost and vested in the Crown as a condition of the first stage of subdivision/and or development.

5.3 INFRASTRUCTURE UPGRADES

The Structure Plan Amendment Area will require a full movement intersection upgrade to Bertram Road in the location shown on the Structure Plan Map as a condition of development approval as required or referenced by a Transport Impact Assessment prepared in support of an application for development approval at that time.

PLAN 1 – STRUCTURE PLAN MAP



STRUCTURE PLAN

Lots 500 (No. 202) & 501 (No.214) Bertram Road, WELLARD

Plan No.	21968-04	
Date	17/12/20	
Drawn	NP	
Checked	DM	
Revision	B	
Scale	1:2500@A3	0 20m 40m 60m

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NOTE: This plan has been prepared for planning purposes. Areas, Contours and Dimensions shown are subject to survey

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PART TWO - EXPLANATORY REPORT

1 PLANNING BACKGROUND

1.1 Introduction and Purpose

This Structure Plan Amendment has been prepared by Harley Dykstra on behalf of The Kings College (landowner of Lot 500 Bertram Road, Wellard).

The primary objective of this submission is to seek an amendment to the existing Lot 500 & Lot 501 (No. 202 & 214) Bertram Road, Wellard, Local Structure Plan (LSP) to facilitate the development of Lot 500 for the expansion of The Kings College currently operating at the adjacent Lot 950 (No. 170) Bertram Road, Wellard. The Kings College has been operating at the current site in partnership with its founding body, Freeway Church, since 1991. However, due to increased student numbers and associated demand for suitable facilities, expansion over Lot 500 is required. The Structure Plan Amendment Area relates to Lot 500 only given no changes to the approved structure plan are proposed for Lot 501. The Structure Plan Amendment nonetheless will enable subdivision of Lot 501 to proceed in accordance with the approved Local Structure Plan.

The Structure Plan Amendment provides a Statutory Planning Framework to guide the future development of the land, as required by clause 6.15.3 of the City of Kwinana LPS 2 for land zoned 'Development'. The intended land uses within the Proposed Structure Plan Amendment Area include the following:

- Approximately 4.1482ha designated for 'Special Use – Educational Establishment' and underlying 'Residential (R25)' as a Local Scheme Zone;
- Approximately 4,898m^2 of land designated for 'Park Recreation and Drainage' as a Local Scheme Reserve'.

This proposal is accompanied by a Structure Plan Map (**Plan 1**) prepared in accordance with the *Planning and Development (Local Planning Scheme) Regulations, 2015*, which is included at Part One of this Report.

The Explanatory Section of this Structure Plan Amendment Report includes a detailed description of the proposal, provides an evaluation of the relevant town planning, environmental, bushfire management, local water management and traffic considerations applicable to the land, and details the rationale supporting the proposed Structure Plan Amendment.

This Structure Plan Amendment has been formulated by Harley Dykstra in collaboration with specialist consultants, who have provided input in relation to matters as follows:

TOTAL PROJECT MANAGEMENT	- Project Management
TAYLOR ROBINSON CHANEY BRODERICK	- Masterplan
EMERGE	- Bushfire Management Plan - Local Water Management Strategy - Landscape strategy - Environmental Assessment and Management Strategy
TRANSCORE	- Transport Impact Assessment

Copies of the relevant consultant reports and drawings are appended to this submission and key findings incorporated within the body of the report. Previous work undertaken by consultants as part of the approved Local Structure Plan is acknowledged where relied upon.

1.2 LAND DESCRIPTION

1.2.1 Location & Context

The Structure Plan Amendment Area is comprised of the portion of Lot 500 Bertram Road, Wellard zoned 'Urban' under the MRS. This area is situated approximately 33km south of the Perth Central Business District, within 2.5km of the Kwinana Town Centre and approximately 1.0km from the Mortimer Road - Kwinana Freeway intersection. Access to the site is currently obtained via a driveway and crossover onto Bertram Road. An aerial locality plan is included at **Figure 1** below and aerial photograph is included at **Figure 2** (overleaf).

The immediate surrounding locality consists of the following:

- Lot 950 Bertram Road, Wellard currently accommodates the King's College and Freeway Church generally on the northern portion of the site.
- The land abutting the southern boundary is subject to the approved Lot 500 and 501 (No. 202 and 214) Bertram Road, Wellard Structure Plan. The proposed Structure Plan Amendment represents no change to Lot 501.
- The land abutting the Western boundary of Structure Plan Amendment area is identified as part of a Conservation Category Wetland commonly known as the Bollard Bulrush Swamp.
- The land on the opposite side of Bertram Road is zoned 'Urban' and has been primarily developed for residential purposes.

FIGURE 1 – AERIAL LOCALITY PLAN (SUBJECT LAND OUTLINED IN RED)

FIGURE 2 – AERIAL PHOTOGRAPH (SUBJECT LAND OUTLINED IN RED)

1.2.2 Area and Land Use

The overall land area of the parent lot (Lot 500) is 9.784ha while the total land area of the Structure Plan Amendment Area is 4.6380 hectares. Lot 500 has recently been purchased by the Kings College and is generally devoid of development other than an existing dwelling in the norther corner of the site, near its frontage with Bertram Road. The north-eastern half of the site is largely cleared of vegetation, other than a few scattered trees and shrubs located primarily around the dwelling. The south-western half of Lot 500, however, is covered in substantial vegetation contained within a Conservation Category Wetland according to the geomorphic wetlands of the Swan Coastal Plan mapping system administered by the Department of Biodiversity, Conservation and Attractions (DBCA).

Land to the south and north of Lot 500 is being progressively developed for residential purposes, consistent with the current zonings under LPS 2 and approved Structure Plans. Land generally to the north of the site has already been developed for residential purposes.

1.2.3 Legal Description and Ownership

The Structure Plan Amendment Area forms part of Lot 500. **Table 1** provides a summary of the land while a copy of the Certificate of Title is included at **Appendix A**.

LOT NO.	PLAN/ DIAGRAM	VOLUME	FOLIO	REGISTERED PROPRIETOR(S)	AREA (HA)
500	70999	2796	129	The Kings Educational Ministries Inc	9.7840

TABLE 1 – LAND OWNERSHIP DETAILS

1.3 PLANNING FRAMEWORK

1.3.1 Zoning and Reservations

1.3.1.1 Metropolitan Region Scheme

The Metropolitan Region Scheme (MRS), zones Lot 500 partially as Rural (south western portion) and Urban (north eastern portion). The Rural zoning generally correlates with the CCW that is contained in the south western portion of the site. The Structure Plan Amendment Area represents the area of Lot 500 zoned Urban.

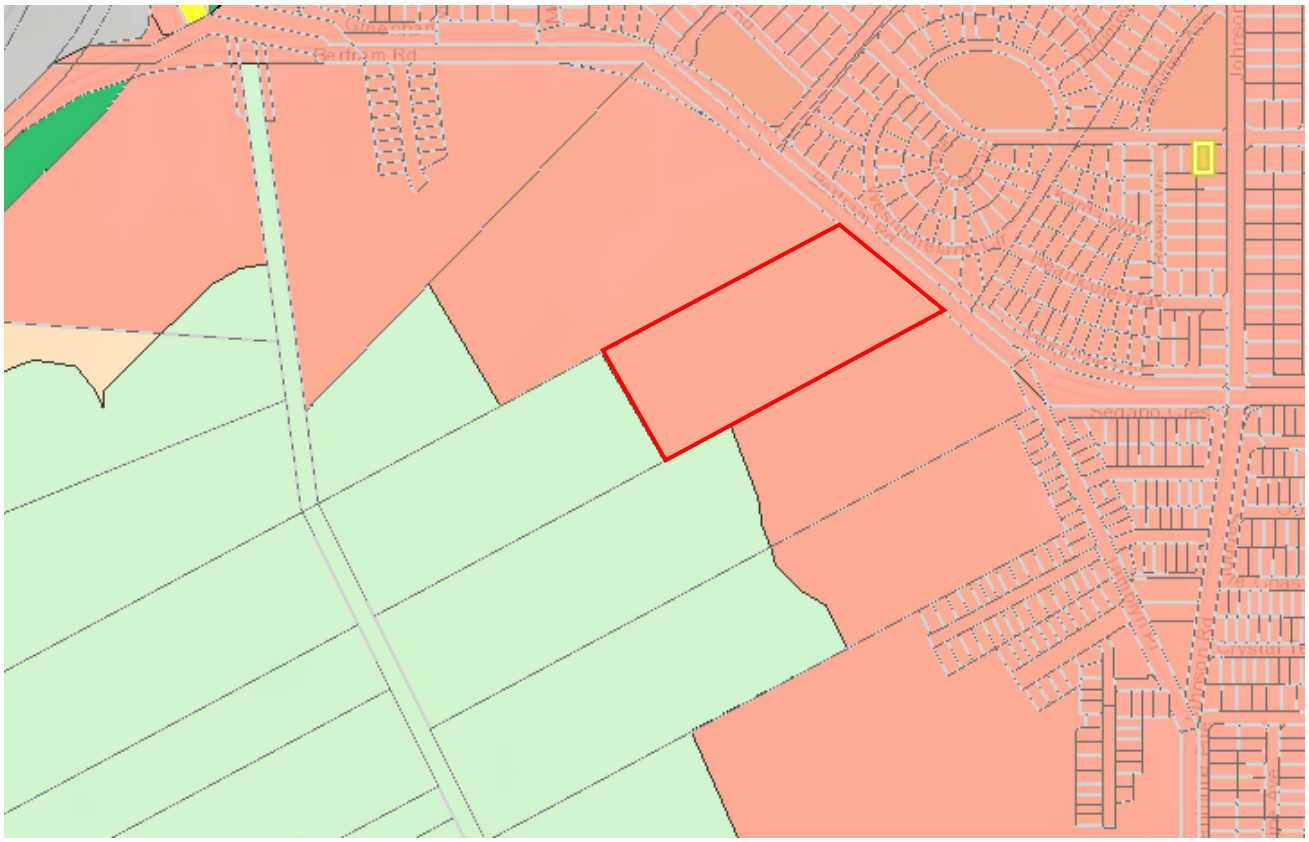

FIGURE 3 – METROPOLITAN REGION SCHEME ZONING

1.3.1.2 City of Kwinana Local Planning Scheme No.2

The City of Kwinana Local Planning Scheme No.2 (LPS 2) zones Lot 500 as Rural Living A (south western portion) and Development (north eastern portion). The zoning respects the MRS in that the Development zone is wholly contained within the portion of the site zoned Urban under the MRS.

Clause 6.17.2.1 of LPS 2 outlines the requirement for a Structure Plan prior to subdivision and/or development within the Development zone. Clause 6.17.2.1 states the following:

"Within the Development Zone, Kwinana Town Centre Zone or Development Area or the relevant portion of the Zone or Area, unless there is an adopted Structure Plan the local government is not to:

(a) consider recommending subdivision; or

(b) Approve an application for Planning Approval."

This Structure Plan Amendment has been prepared to satisfy the above requirement so that development of Lot 500 for an Educational Establishment may occur. It is noted 'Educational Establishment' is an 'SA' use in the 'Residential' zone meaning that Council may approve the use by exercising its discretionary powers and after notice of the application has been given in accordance with Clause 2.3 of LPS 2 – *Advertising of Applications.* This Structure Plan Amendment seeks to identify an Educational Establishment as a preferred use on the site.

The Structure Plan Amendment Area is also contained within a number of Development Contribution Plans as follows:

- Development Contribution Area No. 1 ('DCA 1') – Traditional (hard) infrastructure
- Development Contribution Area No. 7 ('DCA 7') – Traditional (hard) infrastructure
- Development Contribution Area No. 12 ('DCA 12') – Community (soft) infrastructure

Development of Lot 500 for an 'Educational Establishment' will not bring about the need for 'Community Infrastructure' contributions under DCP 7 and DCP 12.

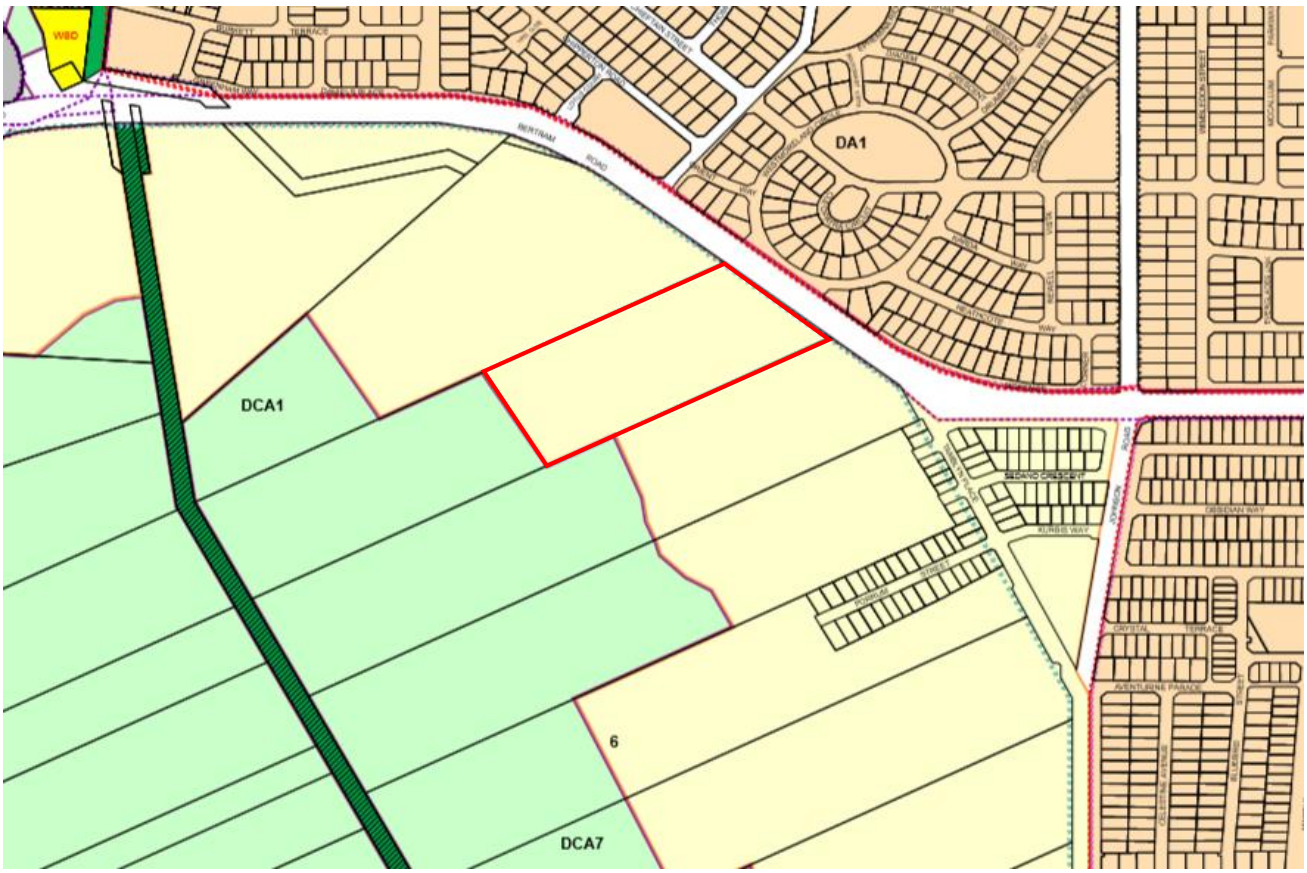

FIGURE 4 – LOCAL PLANNING SCHEME NO.2 ZONING

1.3.2 Regional and Sub-Regional Spatial Frameworks

1.3.2.1 Perth and Peel @ 3.5 Million

Perth and Peel @ 3.5 million is a high-level spatial framework and strategic plan that provides a vision for the future growth of the Perth metropolitan region towards a population of 3.5 million residents.

Consistent with the MRS, the land subject of this Structure Plan Amendment is identified as 'Urban' in the South Metropolitan Peel Sub-Regional Planning Framework whilst the western portion of the parent lot is identified as 'Proposed Open Space – Nature/Passive Recreation'.

Perth and Peel @ 3.5 million recognizes the need for the provision of additional school sites to respond appropriately to increased populations as stated below:

> "*Future infill residential development will place further demand on existing school sites within established urban areas and continued consideration must be given to the number of high school and primary schools required to service this growing demand.*"

The Kings College has experienced rapid student growth in recent years associated with increased residential development in the locality. Therefore, the development of Lot 500 will enable the school to develop to its ultimate capacity of approximately 1,300 students.

1.3.3 Planning Strategies and Structure Plans

1.3.3.1 Jandakot Structure Plan

The proposed Structure Plan Amendment continues to confirm the intentions of the Jandakot Structure Plan, a regional structure plan that was adopted in 2007. The Jandakot Structure Plan was intended to guide strategic planning and development immediately surrounding the Jandakot Underground Water Pollution Control Area, generally comprising the localities of Oakford, Mandogalup, Casuarina, Wellard, Anketell and The Spectacles.

The Structure Plan Amendment Area is identified as 'Short-Term Urban' under the Jandakot Structure Plan and is also identified as an "area subject to further investigations to determine specific areas that may be available for future urban land uses."

These further investigations were undertaken as part of the MRS rezoning which defined the area that is deemed suitable for urban development. Therefore, the proposed amendment is considered to be in accordance with the intent and provisions of the Jandakot Structure Plan.

1.3.3.2 Lot 500 and 501 (No. 202 and 214) Bertram Road, Wellard Local Structure Plan

The subject land is included within the existing Lot 500 and 501 (No. 202 and 214) Bertram Road, Wellard Local Structure Plan, which was endorsed by the WAPC on 6 November 2017. No development on either of the lots has commenced.

The approved Local Structure Plan seeks to facilitate further subdivision and residential development over the Urban zoned portions of Lots 500 and 501 Bertram Road and designates areas for public open space and drainage. This amendment seeks to facilitate the development of Lot 500 for educational uses while future subdivision and development of Lot 501 will remain consistent with the approved Local Structure Plan.

1.3.4 State Planning Policies

1.3.4.1 State Planning Policy 2.1 – Peel Harvey Coastal Plain Catchment

State Planning Policy 2.1 – Peel Harvey Coastal Plain Catchment applies to the Structure Plan Amendment area given that it is located within the Peel-Harvey Coastal Plain Catchment area. The purpose of SPP 2.1 is to prevent environmental damage to the Peel-Harvey Estuarine System. The Policy objectives are outlined in Section 2 of the policy as follows:

- "*To improve the social, economic, ecological, aesthetic, and recreational potential of the Peel-Harvey Coastal Plain Catchment.*
- *To ensure that changes to land use within the Catchment to the Peel-Harvey Estuarine system are controlled so as to avoid and minimize environmental damage.*
- *To balance environmental protection with the economic viability of the primary sector.*
- *To increase high water-using vegetation cover within the Peel-Harvey Coastal Plain Catchment.*
- *To reflect the environmental objectives in the Draft Environmental Protection Policy (Peel-Harvey Estuarine System) 1992.*
- *To prevent land uses likely to result in excessive nutrient export into the drainage system."*

As part of preparing the Local Water Management Strategy for the approved Structure Plan, the abovementioned objectives of SPP 2.1 were addressed by RPS Environmental and Planning Pty Ltd. In support of this Structure Plan Amendment, a LWMS has been prepared by Emerge Associates which confirms that the policy measures of SPP 2.1 can be satisfied. The LWMS is attached at **Appendix B.**

1.3.4.2 State Planning Policy 3.7 – Planning in Bushfire Prone Areas

State Planning Policy 3.7 (SPP 3.7) seeks to guide the implementation of effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure. SPP 3.7 applies to strategic planning proposals, including Structure Plans and Structure Plan Amendments over land designated as bushfire prone by the Map of Bushfire Prone Areas prepared by the Department of Fire and Emergency Services. An extract from the Map of Bushfire Prone Areas Mapping, as it relates to the subject land is included at **Figure 5** below.

Section 6.3 of the Policy states that any strategic planning proposal within a designated bushfire area is to be accompanied by a Bushfire Management Plan or an amended BMP where one has previously been endorsed. Accordingly, a BMP has been prepared by Emerge Associates in accordance with SPP 3.7 and is included at **Appendix C.** Further details are included at Section 3.4 of this report.

FIGURE 5 – BUSHFIRE PRONE AREAS MAPPING

1.3.4.3 Liveable Neighbourhoods

The WAPC's *Liveable Neighbourhoods* is an operational policy that guides the design and assessment of structure plans (regional, district and local) and subdivision for new urban areas in the metropolitan area and country centres, on greenfield and large urban infill sites. Liveable Neighbourhoods states that Structure Plans should address the following (bold text added for emphasis):

- Walkable neighbourhood catchments of approximately 400-450m radius around proposed neighbourhood and town centres, superimposed over the structure plan;
- Density targets expressed as dwellings per site hectare;
- Existing and proposed commercial centres;
- **Proposed natural features to be retained;**
- Proposed street block layout;
- **Proposed street network, including street types and path networks;**
- **Proposed transportation corridors, public transport network and cycle and pedestrian networks;**
- Proposed land uses, including distribution of higher, medium and lower-density residential;
- **Proposed schools and community facilities;**
- **Public parkland; and**
- **Proposed urban water management measures.**

Relevant consideration pertaining to the abovementioned planning elements has been addressed in this report. Therefore, this Structure Plan Amendment is considered to demonstrate compliance with the intent of Liveable Neighbourhoods.

1.3.4.4 Draft Operational Policy 2.4 – Planning for School Sites

Draft Operational Policy 2.4 sets out general locational criteria, configuration requirements and design standards for the provision of government and non-government primary and secondary school sites. The policy is also intended to assist in addressing issues that may arise in residential areas between schools and their surroundings particularly in respect of traffic and noise generating activities, and mitigation of impacts on existing transport network and services. It is noted Clause 3.3.2 sets out the desirable size for school sites. Given The Kings College is a non-government school that has combined Primary and Secondary, 10-12ha is recommended. As it currently stands, the Kings College have approximately 7.8ha available. Expansion onto Lot 500 will provide for a school site that is more consistent with the desirable lot sizes prescribed by Clause 3.3.2. Other design and management considerations applicable to the proposed Structure Plan Amendment are addressed under relevant sections of this report or shall be considered in further detail at development application stage.

1.3.5 City of Kwinana Local Planning Policies

1.3.5.1 Local Planning Policy No.1 – Landscape Feature and Tree Retention

The City's Local Planning Policy No. 1 applies to all land within the City of Kwinana and is to be implemented during the preparation of Structure Plans. The policy seeks to ensure that:

a) *"an appropriate level of information concerning significant trees and landscape features is provided at each stage of the planning framework;*

b) *Retention of significant trees and landscape features are optimized through the strategic and statutory planning framework to retain the character of the area."*

Section 4b) of Local Planning Policy No. 1 states that a Local Landscape Feature and Tree Retention Strategy is to be submitted to the City of Kwinana as part of a local structure plan in accordance with schedule 2 clause 16(1)(c)(i) of the *Planning and Development Regulations 2015* and the relevant requirements of *Liveable Neighborhoods.* Accordingly, a Landscape Strategy has been prepared by Emerge Associates to address Local Planning Policy 1 (**Appendix D**).

1.3.5.2 City of Kwinana Local Planning Policy No. 3 – Bollard Bulrush East Landscape Masterplan

The City's Local Planning Policy No. 3 – *Bollard Bulrush East Landscape Masterplan* applies to all land within the Bollard Bulrush East Urban Cell that is zoned 'Development' under LPS 2. The policy is applied to local structure plans and subdivision applications and is intended to do the following:

a) "Ensure that a range of recreation facilities and activities are provided in a uniform and coordinated manner within the open space situated in the Bollard Bulrush East Urban Cell; and

b) Guide the preparation of landscape plans for the open space in the Bollard Bulrush East Urban Cell."

Pursuant to Section 2 of the policy, a Landscape Strategy has been submitted with this Structure Plan Amendment. A copy of the Landscape Strategy is included at **Appendix D**. The landscape strategy has due regard to the Bollard Bulrush East Landscape Masterplan (see **Appendix E**) and the following points of Local Planning Policy No. 3, where relevant to this site:

- *"a uniform dual use path around the eastern side of Bollard Bulrush Swamp, including pedestrian/cycle connections over the Peel Main Drain;*
- *Uninform playground equipment, fitness equipment, park benches and lighting;*
- *'kick about' spaces;*
- *Uniform conservation fencing;*
- *Stormwater detention areas that do not interfere with the function of public open space (POS);*
- *Fire breaks and fire access tracks; and*

- *Wetland revegetation."*

1.3.6 Pre-Lodgement Consultation

Extensive consultation has been undertaken with the City of Kwinana's Strategic and Statutory Planning officers (along with the City's technical services officers), the Department of Planning Lands and Heritage (DPLH) and the owners of adjoining Lot 501 Bertram Road prior to and during the preparation of this Structure Plan Amendment. This Structure Plan Amendment has been informed by this extensive pre-lodgement consultation.

Preliminary City of Kwinana Meeting – August 2019

- Preliminary introduction of proposal to City of Kwinana and discussion in relation to planning process and requirements.

DPLH Meeting – 10/09/2019

- Project introduced to the DPLH and a general discussion about the process to undergo a Structure Plan Amendment.
- DPLH raised no fundamental issues with the Structure Plan Amendment and indicated that the road network could be revised subject to suitable traffic studies.
- All parties agreed that the 'Conservation Category Wetland 50m buffer' would need to be considered.
- DPLH encouraged a meeting with the City of Kwinana to discuss proposed amendments to the road network.

DPLH Meeting – 25/11/2019

- Project introduced and discussion about the necessity for a Structure Plan Amendment.
- DPLH advised that there are sensitive environmental considerations for land adjacent to Conservation Category Wetlands and that an environmental consultant would likely be required to determine appropriate uses.
- Discussion about various traffic considerations including the fact that initial traffic modelling for the Structure Plan identified the link road as a minor road.

City of Kwinana Meeting – 29/11/2019

- Project introduced to the City of Kwinana and overview of the master planning process.
- City of Kwinana raised the following issues:
    - The planned internal road linking future residential development west and south of the school and church sites.
    - Traffic access in and out of the school site as well as into adjoining development sites.
    - Likely sensitivities associated with the wetlands.
- Discussion about the issues raised with the City.
- City provided with a full set of the masterplan drawings which they indicated they would review.
- Following the 29 November 2019 meeting, the City of Kwinana conducted a review of the Kings College Draft Master Plan and provided a summary of the findings in a letter dated 12 February 2020. This Structure Plan Amendment has been prepared with due regard to the comments made in the letter.

City of Kwinana Meeting – 20/01/2020

- General discussion about the proposed development of Lot 500 and likely timeframes.

- City of Kwinana advised that a Structure Plan Amendment would need to be prepared in the first instance.
- Discussion about the viability of incorporating a linking road.
- City acknowledged their intention to create an eventual ring road around the Bollard Bullrush Swamp but noted this would be challenging due to the existence of numerous landowners.
- Discussion about the idea of constructing a pedestrian path to the edge of the wetland.

DLPH Meeting – 16/03/2020

- Discussion about the connecting road and providing a hard edge to the Conservation Category Wetland Buffer.
- All in attendance acknowledged the need to liaise with the Department of Biodiversity Conservation and Attractions regarding appropriate buffer width and the management of the buffer at an appropriate stage.
- All in attendance agreed that the appointment of a suitable environmental consultant with bushfire management expertise would be a logical next step.

Meeting with Landowners of Lot 501 - 17/06/2020

- Meeting to discuss and clarify intentions of Lot 501 landowners to progress with subdivision of Lot 501, discuss timeframes and potential solutions to achieve shared access from Bertram road.

City of Kwinana Meeting with Lot 500 and 501 Proponents – 02/09/2020

- Meeting with the City of Kwinana to jointly discuss access arrangements and other matters relevant to the Structure Plan Amendment.

Further discussion between City of Kwinana and Total Project Management – 08/09/2020

- Further discussions to clarify intentions of Lot 501 landowners and advise Structure Plan Amendment for Lot 500 was being progressed and would be submitted in due course.

2 SITE CONDITIONS AND CONSTRAINTS

2.1 LANDFORM AND SOILS

2.1.1 Topography

The topography within Lot 500 generally falls from east to west with elevations ranging from approximately 10 metres Australian Height Datum (m AHD) along Bertram Road down to 5 m AHD around the Bollard Bulrush Swamp (BBS) and adjacent to the Peel Main Drain (PMD).

2.1.2 Geology

Regional geology for the site has been mapped by the *Geological Survey of Western Australia* (Gozzard 1986). The site comprises the following soil types:

- Sandy Silt (Ms5). This unit is described as 'dark brownish grey silt, with disseminated fine-grained quartz sand, firm, variable clay content, of lacustrine origin'.

- Sand (S8). This unit is described as 'very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin as relatively thin veneer over C2, M4 and Mc2'.

Geotechnical investigations conducted in March 2015 by Structerre (2015) confirmed that ground conditions beneath the site are comprised of topsoil up to 0.1 m below ground level (BGL), silty sand to sand fill up to 0.3 m BGL, and loose to medium dense natural sand up to 4 m BGL. Permeability was found to be 10.7 m/day within the site (Structerre 2015).

2.1.3 Acid Sulfate Soils

Regional acid sulfate soil (ASS) risk mapping indicates that the entire site is classified as having a high to moderate risk of ASS occurring within 3 m of the natural soil surface (DWER 2020a). It is highly likely that fill will be required to achieve the required separation from groundwater levels and to reduce flooding risk. This will reduce the likelihood of disturbing ASS through reducing the need for dewatering and large-scale excavations.

Once detailed earthworks designs and depths of trenching/excavation are known, and therefore the likelihood of disturbance below 3 m of the natural soil as part of the construction process, an investigation to determine the actual presence of ASS may be undertaken. Dependent on the findings of the ASS investigations, and if ASS are found within the areas that are proposed to be developed or detailed designs indicate that ASS is likely to be disturbed due to excavation for the installation of services, then an appropriate ASS and dewatering management plan (ASSDMP) may need to be prepared to support development.

2.2 HYDROLOGY

2.2.1 Groundwater

The *Perth Groundwater Map* (DWER 2020b) indicates that groundwater levels across the site are a maximum of 8 m AHD (i.e. 2 m BGL), and flow in a south-westerly direction towards the BBS and PMD.

Within the site, groundwater monitoring was undertaken from two bores (BH01 and BH02) from October to November 2015. Measured groundwater levels were found to be between 0-2.2 m BGL. Due to the low clearance to groundwater, coupled with a likely increase in groundwater levels due to development, subsoils will likely be need beneath the site to set a controlled groundwater level (CGL).

2.2.2 Surface Water

A review of the DWER *Hydrography Linea dataset* (2020g) indicates the presence of the perennial BBS, and a 'subject to inundation' buffer that covers the majority of Lot 500. The PMD, which is managed by the Water Corporation (WC) is located along the south-western boundary of Lot 500 and flows in a southerly direction. The PMD eventually discharges to the Serpentine Rive and the Peel-Harvey estuary. The PMD is a trapezoidal in shape and sits within a drainage reserve typically 20-25m wide.

Major event runoff from the Western portion of Lot 500 is expected to sheet flow towards the BBS, eventually discharging to the PMD. This has been considered as part of the Local Water Management Strategy (LWMS) that has been prepared to support the Structure Plan Amendment.

2.2.3 Wetlands

A review of the *Geomorphic Wetlands on the Swan Coastal Plain* dataset (DBCA 2020) indicates that the western portion of the site contains a Multiple Use Wetland (MUW)(UFI 13327) and a portion of Bollard Bulrush Swamp (UFI 15866), which is mapped as a Conservation Category Wetland (CCW).

Bollard Bulrush Swamp comprises a complex series of seasonally inundated or seasonally water-logged areas classified as basins, palusplains and floodplains part of the Beelier Chain of Wetlands. This wetland is one of 19 wetlands that form part of the 'Bibra suite' and therefore is classified as a CCW, the highest conservation category for geomorphic wetlands. CCWs are typically afforded a 50 m wide buffer from surrounding development or incompatible land uses. No Ramsar or listed 'important wetlands' are located within or nearby the site.

The Structure Plan Amendment Area accommodates the CCW 50 m buffer and supporting landscape plans indicate appropriate treatments for the wetland buffer area in accordance with the City of Kwinana's *Local Planning Policy No. 3 Bollard Bulrush East Landscape Masterplan*. On this basis there would be no impacts on the CCW and the proposed land use and associated development appropriately responds to the presence of the CCW.

A site investigation was undertaken by Emerge Associates (2020d) to determine the specific boundary of the CCW. It was determined that the boundary of the intact native plant community **ErMr,** provides an appropriate basis for defining the extent of the CCW, using the existing fence line as a basis for defining the plant community edge. As discussed in the Environmental Assessment and Management Strategy (EAMS), it is noted that the site-specific wetland boundary varies slightly from the MRS zoning based on the extent of intact wetland vegetation. Overall however, the assessment found the MRS zoning is generally consistent with the actual extent of the CCW, within the 'Rural' zoned land.

Surface water and groundwater impacts to the CCW can be managed through engineering and design in the preparation and implementation of future water management plans. The requirement to undertake preparation of more detailed water management plans to support the development is generally imposed as a condition of development.

2.3 BIODIVERSITY AND NATURAL ASSETS

2.3.1 Vegetation and Flora

Historical terrestrial flora and vegetation studies and investigations have been undertaken across the site to support the strategic land use planning process completed to date. As part of MRS Amendment 1188/57, ENV Australia undertook a 'Level 2' targeted flora and vegetation survey over the site and broader area in September 2010. Emerge Associates undertook a further 'reconnaissance' survey flora and vegetation assessment in May 2020 to support the EAMS (**Appendix F**).

One vegetation type was identified as occurring over the entirety of the site; **Parkland Cleared**, described as 'Scattered *Eucalyptus rudis* and *Melaleuca raphiophylla* over non-native grassland or bare ground with scattered native shrubs and forbs'. This was not identified as an intact native plant community due to understory clearing resulting in a predominantly non-native grassy understory.

The vegetation within the site was subject to a high level of historical disturbance through vegetation clearing and stock grazing, resulting in the 'completely degraded' condition. As such, the vegetation is no longer intact and does not represent a listed community. Therefore, no Threatened or Priority Ecological Communities occur within the site (Emerge Associates 2020).

A total of six threatened and two priority flora species were considered to potentially to occur within the site or wider local area based on database searches (DoEE 2019; DBCA 2019). However recent and historical flora and vegetation surveys did not record any threatened or priority flora species within the site (ENV Australia 2011b; Emerge Associates 2020). It was considered unlikely that the site supports flora of conservation significance a result of the reduced condition of the vegetation as well as trampling and grazing by cattle.

As outlined in the survey reports, the methodology, timing and level of effort applied during the flora and vegetation assessments were considered to be suitable for the site and did not limit the survey outcomes. The ENV Australia (2011b) survey was undertaken at the appropriate time of year (spring) and the entire site was adequately searched for species of conservation significance.

Given the limited significant flora or vegetation values within the site, the objective for future management will be principally focused around protecting and rehabilitating the vegetation associated with Bollard Bulrush Swamp CCW (UFI 15866) and the 50 m buffer which extends within the site, through the implementation of a 'Parks Recreation and Drainage' reserve which encapsulates the significant flora and vegetation values of the wetland. In addition, it is intended to opportunistically retain paddock trees (where possible) as part of the future development. The proposed Structure Plan Amendmnet will provide an opportunity to rehabilitate a portion of the 50 m buffer.

Where clearing of remnant native trees within the site is proposed, a clearing permit will need to be attained pursuant to Part V of the *Environmental Protection Act 1986* (unless a valid exemption applies).

On this basis the Structure Plan Amendment has adequately responded to flora and vegetation considerations.

2.3.2 Fauna

As part of MRS Amendment 1188/57, ENV Australia undertook a 'Level 1' fauna assessment over the amendment area and broader Lot 500 in June 2010. Subsequent to this, Emerge Associates undertook a 'Reconnaissance' flora and vegetation assessment in May 2020 to support the EAMS (**Appendix F**).

Based on the results of the fauna assessments, fauna habitat values within the site are generally limited, primarily providing habitat that is suitable for common and widespread native species with non-specific habitat requirements. The site is considered to have overall low biodiversity value from a fauna perspective due to the historical removal of a majority of the original native vegetation and the degraded nature of the existing vegetation (i.e. completely degraded) and associated habitat (ENV Australia 2011a, Emerge Associates 2020e).

The scattered native swamp paperbark and flooded gum trees could provide shelter and foraging opportunities for a number of different species including arboreal reptiles and mammals and the three threatened species of black cockatoo species; Carnaby's black cockatoo (CBC), forest red-tailed black cockatoo (FRTBC) and to a lesser extent Baudin's black cockatoo (BBC) (given the site is located on the edge of the BBCs distribution range). No evidence of black cockatoo nesting was observed during the fauna surveys and the probability of black cockatoo breeding within the site is low. Black cockatoos are highly mobile and have the capacity to move to across wide areas, development is unlikely to impact on local populations (ENV Australia 2010, Emerge Associates 2020). Notwithstanding, the Structure Plan Amendment will provide opportunities for the retention of native Swamp Paperbark and Flooded Gum trees within The Kings College outdoor play and recreation open spaces.

One fauna habitat type; **melaleuca dampland** was identified to the south of the site confined to the CCW wetland vegetation, which supports dense cover of wetland native understorey vegetation. One fauna species of conservation significance; the Quenda, was positively identified as utilising the densely vegetated Bollard Bulrush Swamp (Emerge Associates 2020e). The Structure Plan Amendment provisions will require a wetland reserve to be created and ceded to the State for the protection of the Bollard Bulrush Swamp CCW vegetation, encompassing the entirety of the **melaleuca dampland** fauna habitat. Given the Structure Plan Amendment will incorporate a 50 m buffer to the identified fauna

habitat, it is considered unlikely the proposal would significantly impact on fauna associated with the Bollard Bulrush Swamp.

As part of the future subdivision and development, a Wetland Management Plan (WMP) and Construction Environmental Management Plan (CEMP) will be required to be prepared to manage potential impacts to fauna.

On this basis, the Structure Plan Amendment has adequately responded to the fauna and fauna habitat considerations and would not result in the clearing of any significant fauna habitat.

2.4 BUSHFIRE HAZARD

Bushfire hazards have been identified within and outside the site, associated with the Forest (Class A) vegetation within the portion of the 50 m wetland buffer to be revegetated to a similar standard to the existing wetland vegetation and ceded to the State under a 'Park Recreation and Drainage' reserve, in addition to the existing private landholdings surrounding the site.

A Bushfire Management Plan has been prepared by Emerge Associates to address the requirements of SPP 3.7 – *Planning in Bushfire Prone Areas* and the associated *Guidelines* in support of this application to amend the Structure Plan. The Bushfire Management Plan addresses proposed development within the Structure Plan Amendment Area and is included as **Appendix B**.

From a bushfire hazard management perspective, the key consideration as part of future development within the site is to ensure future development areas will be able to accommodate the separation necessary to ensure built form achieves a bushfire attack level (BAL) rating of BAL-29 or less. This BAL rating will need to be achieved without requiring clearing or modification of vegetation in areas where remnant vegetation is proposed to be retained, and allow for revegetation of the wetland buffer.

This has been achieved through the strategic location of internal driveway reserves and footpaths and the managed recreational open spaces which will be designed and maintained to low threat in order to minimise the hazard to the school development. Vehicle access will accommodate egress to at least two destinations, ensuring the perimeter driveway will connect to the existing public road network, specifically Bertram Road to the north, further connecting onto Mortimer Road to the east and Challenger Avenue to the west. This will be detailed as part of future bushfire management plans supporting subdivision or development approval.

No further environmental impacts (such as clearing of vegetation) beyond those outlined in above, will be required in order to implement the development across the site, consistent with the proposed Structure Plan Amendment.

On this basis the Structure Plan Amendment has adequately responded to the bushfire risk considerations.

2.5 HERITAGE

2.5.1 Indigenous heritage

In accordance with the Aboriginal Heritage Due Diligence Guidelines (DAA 2013), a search of the AHIS online database (DPLH 2020) was undertaken. No Registered Aboriginal Heritage Sites or Other Aboriginal Heritage Places have been identified within the site, however one Other Heritage Place (Bellway Sand Quarry, Wellard, Site ID: 3646) was identified approximately 185 m east of the site. This site will not be impacted upon by future development of Lot 500 as provided for by the Structure Plan Amendment.

2.5.2 Non-Indigenous heritage

A desktop review of the Australian Heritage Database (Department of the Environment 2019), the State Heritage Office database (Heritage Council 2019) and the City of Kwinana Local Government Inventory (City of Kwinana 2016) indicates

that one registered heritage site, 'Wellard Swamp / Bollard Bullrush Swamp' (Place Number: 12107) is located within the western portion of the site.

2.6 OTHER LAND USE CONSTRAINTS AND OPPORTUNITIES

2.6.1 Site Contamination

A review of the Department of Water and Environmental Regulation (DWER) Contaminated Sites Database (DWER 2018) concluded that no known contaminated sites are located within the vicinity of the subject site.

Historic agricultural land uses, primarily low-intensity activities such as cattle grazing are considered unlikely to raise any significant contamination risk concerns for the site.

2.6.2 Sewage Sensitive Areas

The entirety of the site is classified as a sewage sensitive area by the *Government Sewerage Policy* (DPLH 2019), due to its proximity (1 km) to a significant wetland. However, as the site will be connected to the Water Corporation's reticulated sewer network, no further management actions in relation to the policy will be required.

3 LAND USE AND DEVELOPMENT REQUIREMENTS

3.1 LAND USE

3.1.1 Design Overview

The primary design driver for the proposed Structure Plan Amendment is to facilitate the future development and use of Lot 500 Bertram Road for a Special Use – Educational Establishment associated with The Kings College currently operating at Lot 950 Bertram Road. Since 1991 the College has been located on Lot 950 with current student numbers being approximately 550. Rapid growth in recent years means that the College must now expand with projected numbers being 1,300 once development on Lot 500 is completed. As a result, this proposal seeks to amend the Structure Plan to facilitate the future development of Lot 500 for this purpose. Other amendments include modification to the previously approved POS configuration and road layout to better reflect the proposed use of the site.

The indicative design of the school site on Lot 500 is illustrated in the Masterplan by Project Architect Taylor Robinson Chaney Broderick attached at **Appendix H.** The Masterplan has been informed by integrated environmental, bushfire management, planning, architectural, and traffic inputs. The design of the site is intended to integrate with the Bertram Road streetscape and adjoining development on Lot 950 as well as provide a suitably managed interface with future residential subdivision and development on Lot 501. A significant amount of landscaping throughout the site will also enhance the natural amenity of the area and its relationship with the Conservation Category Wetland. These integrated specialist inputs are reflected on the Opportunities and Constraints Plan at **Appendix I** and in turn have been accommodated within the Structure Plan Map (**Plan 1**).

Further details relating to the relevant design opportunities and constraints are provided below.

3.1.2 Integration with Adjoining Lots

The Structure Plan Amendment Area is bound by Lot 501 to the south east and Lot 950 to the north west. The proposed amendment recognises the need for The Kings College currently operating at Lot 950 to expand. Therefore, this Structure Plan Amendment seeks to facilitate future development of the site for Special Use – Educational Establishment. Whilst Lot 950 does not form part of the Structure Plan Amendment Area, the Traffic Impact Assessment at **Appendix G**, guided by the Masterplan at **Appendix H** nonetheless considers and provides an analysis of the traffic and access requirements for the overall College campus, once fully developed. The TIA recommends a connection to an upgraded full movement

access to the north west part of the Structure Plan Amendment Area via Lot 950 to achieve efficient and consolidated access to the College (and Church).

The future Educational Establishment will abut Lot 501 which will be subdivided and developed for Residential (R25) purposes in accordance with the approved Local Structure Plan. It is considered the proposed land uses are compatible with one another given Educational Establishment is an 'SA' use in the 'Residential' zone under the City of Kwinana LPS 2. Further, the Structure Plan over Lot 670 to the west of The Kings College campus on Lot 950 was approved on the basis the interface between residential land use and an Educational Establishment could be appropriately managed. Specific stages of development on Lot 500 may be subject to acoustic studies to ensure the interface between the Educational Establishment and future residential development is appropriately managed, including via the provision of uniform fencing. Consistent with the general arrangements proposed for Lots 950 and Lot 500, a consolidated full movement access to Bertram Road has been recommended by the Transport Impact Assessment as depicted on the Structure Plan Map (**Plan 1**).

3.2 PUBLIC OPEN SPACE (POS)

The Landscape Master Plan prepared by Emerge Associates provides a concept design of the open space areas that will be provided following the development of Lot 500 for an 'Educational Establishment'. The plan provides connections between the school, adjacent landowners, and natural assets. A continuous pedestrian/cycling path will link along the wetland in accordance with the Bollard Bulrush East Landscape Masterplan prepared by Emerge on behalf of the City of Kwinana (**Appendix E**). The path will allow local residents to interact with the wetland while also serving the function as a secondary fire access.

The wetland buffer will provide a balance of passive recreation open spaces within the Educational Establishment grounds incorporating planting to achieve a 'low threat' bushfire classification. A roadside drainage swale will be provided at the edge of the buffer parallel to the alignment of the private internal driveway. Uniform fencing will be used to separate the school from the dual use path and public recreation area.

Further details regarding the design and planting of landscaped areas is included in the Landscape Strategy prepared by Emerge as attached at **Appendix D.**

Lot 500 will not generate a Public Open Space requirement given schools are specifically to be treated as a deduction under Liveable Neighbourhoods (2009). While the provision of Public Open Space on Lot 501 will not strictly meet the minimum required Public Open Space percentage prescribed by Liveable Neighbourhoods (2009) as shown in the table below, the development of Lot 500 will effectively make up for this minor shortfall by providing for connections to and integration with the POS area designated over Lot 501 on the approved Local Structure Plan.

Calculation of Required POS Provision (Lot 501)	
Total Site Area (ha)	4.93
Deductions	
Other	
Surplus Restricted Public Open Space (Wetland Buffer)	0.63
Total Deductions	0.63
Gross Subdivisible Area (total area minus deductions)	4.3
Required Public Open Space (10%)	0.43
Break Down of POS Provided	
Restricted Public Open Space	
Wetland Buffer	0.72
Total Restricted POS	
Total Restricted POS Credited to a maximum of 20%	0.09
Surplus Restricted POS Not Credited i.e. over maximum 20%	0.63
Total Unrestricted POS	0.30
Total POS	0.39
POS Provision as Percentage of Gross Subdivisible Area	8.9%

3.3 MOVEMENT NETWORKS

3.3.1 Traffic Generation

The proposed subdivisional road network within the approved Local Structure Plan has been designed to service future residential subdivision and development at a density of R25 while the proposed private driveways on Lot 500 will service The Kings College.

The anticipated increase to traffic volumes has been estimated by Transcore in the Traffic Impact Assessment attached at **Appendix G**. Overall, it is concluded that the proposed road network is able to satisfactorily cater for the projected number of vehicle movements. Therefore, the Structure Plan Amendment Area will have no adverse impact on traffic operations.

3.3.2 Proposed Movement Network

A Transport Assessment has been prepared by Transcore in support of this Structure Plan Amendment as attached at **Appendix G**. The transport Assessment further considers and justifies the movement network proposed as part of this Structure Plan Amendment.

The proposed public road network shall remain generally consistent with the adopted Structure Plan but does not include a road linking the development to Lot 950 and the interim secondary access point previously proposed has been deleted. An easement over Lot 500 will provide access for the residential lots on Lot 501 to Bertram Road via a full movement intersection to Bertram Road. Development on Lot 500 will have a second access to Bertram Road via Lot 950.

Deletion of the linking roads reflected on the approved Local Structure Plan over Lot 500 (fronting Bertram Road and adjoining BBS) will of itself have no impact on the ability to provide a contiguous link to residential development on Lot 670 in the future, given The Kings College have no need or intention of constructing these roads across Lot 950. The proposed access arrangements appropriately provide for the development of the site for an Educational Establishment which supersedes the previous consideration of Lot 500 for conventional residential subdivision.

3.3.3 Public Transport

Existing bus route 543 runs on Bertram Road adjacent to the Structure Plan Amendment area, as shown in Figure 9 of the Transport Impact Assessment. It provides 20 to 30 minute service frequency during weekday peak periods and hourly during the day and on Saturdays, and at two hour intervals on Sundays and public holidays. Bus stops are available on both sides of Bertram Road within walking distance of the Structure Plan Amendment area.

3.3.4 Pedestrian and Cyclist Facilities

Shared paths are currently located along the eastern side of Bertram Road. A dual use path is also proposed as part of this Structure Plan Amendment to provide a hard edge to the Conservation Category Wetland Buffer which will connect to the dual use path network around BBS envisaged by the approved Structure Plan framework.

3.4 RESIDENTIAL

While the underlying zoning of the 'Educational Establishment' on Lot 500 will be 'Residential R25', any future residential development over the land will be subject to a separate structure plan amendment.

3.5 STORMWATER MANAGEMENT

A Local Water Management Strategy (LWMS) has been prepared to address the relevant water management considerations for the LSP. The LWMS is in accordance with Better Urban Water management (BUWM) (WAPC 2008), and in compliance with the design objectives contained within the District Water Management Strategy ('DWMS'). The LWMS outlines strategies and management techniques to address the following:

- Water Conservation and efficiency of use
- Stormwater management
- Protection and management of the BBS
- Management of groundwater levels and quality
- Monitoring requirements
- Implementation (i.e. roles and responsibilities).

Implementation of the LWMS will be facilitated by an urban water management plan required as a condition of development approval.

3.6 BUSHFIRE MANAGEMENT

The design of the Structure Plan Amendment Area has been informed by the Bushfire Management Plan (BMP), prepared by Emerge Associates at **Appendix C**. The BMP complies with *SPP 3.7 – Planning in Bushfire Prone Areas* and the associated Guidelines.

Provision of appropriate separation distances between future built form and bushfire hazards will need to be accommodated as part of future design work at development application stage. Landscaped areas and access ways will be designed and maintained to a low threat standard. Vehicle access will accommodate egress to at least two destinations. This will be implemented through future subdivision and/or development approval.

3.7 SERVICING

A servicing report was prepared as part of the approved Local Structure Plan in support of 'Residential' development over Lot 500 (and Lot 501). Accordingly, there are no servicing capacity issues anticipated as a result of developing the 'Educational Establishment' on Lot 500. Further details relating to available services is included in the below sections.

3.7.1 Roads

The proposed road hierarchy servicing the Structure Plan Amendment Area is included in Figure 12 of the Transport Impact Assessment prepared by Transcore consisting of the following:

Integrator A – Bertram Road
Access Street – Road network within Lot 501
Perimeter Driveway – Road network within Lot 500

The access streets shown over Lot 501 on the Structure Plan Map (**Plan 1**) are entirely consistent with the road layout approved as part of the previous structure plan. These roads will feature 15m wide road reserves appropriate for low volumes of vehicles per day.

The proposed road network within the Structure Plan Amendment Area will consist solely of perimeter driveways. These driveways will be privately owned for the purpose of the proposed 'Educational Establishment.'

With regard to access onto Bertram Road, a new full movement T-intersection is proposed at the boundary of Lots 500 and 501. The intersection will feature a right turn lane in the median on Bertram Road and a left turn lane in the southwest verge of Bertram Road. A second means of access and egress will provided via Lot 950 and the existing intersection currently used by The Kings College. This intersection is a full movement T-intersection on Bertram Road featuring a right turn in the median and a left turn in the southwest verge of Bertram Road.

The Transport Impact Assessment prepared by Transcore concludes that the proposed road network will provide for satisfactory intersection operation under the forecast full development traffic flows in 2031.

3.7.2 Paths

It is likely footpaths will continue to be required along the internal roads throughout the Residential development on Lot 501. With regard to the Structure Plan Amendment Area, a dual use path is proposed along the Public Open Space and Bollard Bullrush Swamp as shown within the Landscape Plan prepared by Emerge Associates on behalf of the City (**Appendix E**) and the Landscape Strategy prepared on behalf of The Kings College (**Appendix D**).

3.7.3 Wastewater Disposal

A reticulated sewer main is located within the Bertram Road reserve. At development and/or subdivision stage, a connection to reticulated sewer could be provided. More detailed design will be undertaken at the development and subdivision stage.

3.7.4 Water Supply

While the Structure Plan Amendment Area is not yet connected to a reticulated water supply, a connection is able to be established via infrastructure found within the surrounding road reserves at the time of development.

3.7.5 Underground Power

The proposed development within the Structure Plan Amendment Area is able to be supplied with a power connection via the existing network. Confirmation of this and detailed designs will be obtained from Western Power at the time of development.

3.7.6 Telecommunications

Design for a connection to telecommunications infrastructure will be required at the time of development. Overall, the Structure Plan Amendment Area is able to be serviced by a suitable telecommunications supplier.

3.7.7 Natural Gas

Currently there is no existing gas mains along Bertram Road in close proximity to the Structure Plan Amendment Area. At the time of development, further investigation will be undertaken to determine whether a gas supply connection can be established.

3.7.8 Summary

As also concluded by the approved Structure Plan, no significant factors have been identified that would preclude the development of Lot 500 or subdivision of Lot 501. The Structure Plan area has good road connections and access to existing infrastructure and services.

3.8 DEVELOPER CONTRIBUTION ARRANGEMENTS

As referenced in this Structure Plan Amendment report, the Structure Plan Amendment area is contained within the following Development Contribution Areas:

i. Development Contribution Plan 1 ('DCP 1') for the funding of traditional infrastructure.

ii. Development Contribution Plan 7 ('DCP 7') for the funding of traditional infrastructure (including the land for a district sporting ground); and

iii. Development Contribution Plan 12 for the funding of community infrastructure.

Payment of contributions under DCP 1 may be required by the City of Kwinana given that the development of Lot 500 for the 'Education Establishment' will result in increased traffic on the local road system. Development of Lot 500 for an 'Educational Establishment' will not bring about the need for 'Community Infrastructure' contributions under DCP 7 and DCP 12.

3.9 IMPLEMENTATION

The proposed Structure Plan Amendment has been prepared in accordance with the requirements of the *Planning and Development (Local Planning Schemes) Regulations 2015*. Further, the Structure Plan Amendment complies with the applicable State and Local Planning Policy Framework as set out in Section 1.3 of this Report.

The *Planning and Development (Local Planning Schemes) Regulations 2015* stipulates the manner by which the Structure Plan Amendment will be processed by the City of Kwinana and thereafter, the Western Australian Planning Commission to enable final approval. Once the Structure Plan Amendment is sufficiently progressed, development and/or subdivision applications can be considered and approved where they comply with the Structure Plan. Development Approvals subject to appropriate conditions can then enable the staged expansion of The Kings College to cater for increasing student numbers within the College's catchment area.

APPENDICES INDEX

APPENDIX NO.	NATURE OF DOCUMENT
A	Certificate of Title
B	Local Water Management Strategy
C	Bushfire Management Plan
D	Landscape Strategy
E	Bollard Bullrush East Landscape Masterplan
F	Environmental Assessment and Management Strategy
G	Transport Impact Assessment
H	Masterplan
I	Opportunities and Constraints Plan

APPENDIX A | CERTIFICATE OF TITLE

WESTERN AUSTRALIA

REGISTER NUMBER	
500/DP70999	
DUPLICATE EDITION **1**	DATE DUPLICATE ISSUED **3/9/2012**

VOLUME **2796** FOLIO **129**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 500 ON DEPOSITED PLAN 70999

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

THE KING'S EDUCATIONAL MINISTRIES INC OF 170 BERTRAM ROAD WELLARD WA 6170
(T O261875) REGISTERED 18/10/2019

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. *O261876 MORTGAGE TO MINISTER FOR EDUCATION OF CARE OF DEPARTMENT OF EDUCATION 151 ROYAL ST, EAST PERTH WA 6004 REGISTERED 18/10/2019.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP70999
PREVIOUS TITLE:	1281-799
PROPERTY STREET ADDRESS:	202 BERTRAM RD, WELLARD.
LOCAL GOVERNMENT AUTHORITY:	CITY OF KWINANA

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING N804019

APPENDIX B | LOCAL WATER MANAGEMENT STRATEGY

Local Water Management Strategy

Lot 500 Bertram Road, Wellard

Project No: EP20-047(07)

Prepared for the King's College
December 2020

Document Control

Doc name:	Local Water Management Strategy Lot 500 Bertram Road, Wellard				
Doc no.:	**EP20-047(07)—003A**				
Version	**Date**	**Author**		**Reviewer**	
1	December 2020	Tessa McAllister	TEM	Dave Coremans	DPC
	For client review				
A	December 2020	Tessa McAllister	TEM	Dave Coremans	DPC
	Updated Landscape plans provided in Appendix C - For client review				

Executive Summary

The King's College (the 'proponent') is progressing with a Local Structure Plan (LSP) amendment over part Lot 500 Bertram Road, Wellard (referred to herein as the 'site') to allow for the expansion of a primary and secondary school. The site is located within the City of Kwinana (CoK), approximately 40 km south of Perth. The expansion will be located within the north-eastern portion of Lot 500. Located within the south-western portion of the lot is the Bollard Bulrush Swamp (BBS). The site is approximately 5 hectares (ha) in size.

This local water management strategy (LWMS) details the water management approach to support the development of the site, and is intended to satisfy the requirement to prepare an LWMS in accordance with *Better Urban Water Management* (WAPC 2008), and expectations of the Department of Water and Environmental Management (DWER) and CoK.

The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving waters and their ecosystems. Characteristics of the existing environment within the site have been investigated. In summary, the environmental investigations conducted to date indicate that:

- The site receives an annual average rainfall of 820 mm.
- Average maximum temperatures throughout the site range from 18^{o}C to 31.6^{o}C and average minimum temperatures range from 7^{o}C to 17.2^{o}C.
- Topography throughout Lot 500 ranges from 10 m Australian height datum (AHD) in the east to 5 m AHD in the west.
- Regional geological mapping shows the site is underlain by sandy silt.
- Geotechnical investigations within the site found ground conditions comprised of topsoil up to 0.1 m below ground level (BGL), silty sand to sand fill up to 0.3 m BGL, and loose to medium dense natural sand up to 4 m BGL
- Infiltration testing at one location within the site found permeability to be 10.7 m/day.
- The site is classified as having a 'high to moderate' of acid sulfate soil (ASS) occurring within 3 m of the natural soil surface.
- The site comprises of parkland cleared vegetation community characterised by scattered stands of native trees including *Eucalyptus rudis subsp. rudis* and *Melaleuca preissiana.*
- No conservation significant fauna were recorded within the site during the field surveys.
- A conservation category wetland (CCW) associated with the BBS is located within the southern half of Lot 500, and is surrounded by a multiple use wetland (MUW).
- The Peel Main Drain (PMD) runs along the south-western boundary of Lot 500.
- Major event runoff from within the site is expected to sheet flow towards the BBS and eventually discharge to the PMD.
- The major event post development water levels within the BBS were modelled to be a maximum of 5.65 m AHD.
- Modelling completed by GHD (2010) indicated that peak flow rates discharging from the site into the BBS should be maintained at a rate of 0.007 m^3/s in a 1% annual exceedance probability (AEP) event post development.

- Surface runoff modelling undertaken by Emerge Assocaites indicates that the pre-development peak flow rate from the developable portion of Lot 500 is 0.24 m^3/s in a 1% AEP event.
- One surface water monitoring location within Lot 500 has been sampled and indicates that the average total nitrogen (TN) and average total phosphorous (TP) were 0.134 mg/L and 1.03 mg/L, respectively.
- Groundwater beneath the site is a multi-layered system comprised of the Perth Superficial Swan aquifer, the Leederville aquifer and the Perth-Yarragadee North aquifer.
- Regional groundwater level mapping indicates that groundwater is a maximum of 8 m AHD (i.e. 2 m BGL), and flows in a south-westerly directly towards the BBS.
- Measured maximum groundwater levels from the developable portion of Lot 500 were indicated to be between 6.8 and 4.2 m AHD (i.e. 0-2.2 m BGL).
- Groundwater quality sampling found both bores had elevated TP between 0.16-0.17 mg/L and one bore had elevated TN levels at 1.9 mg/L.

The overall objective for integrated water cycle management for the development is to mimic the existing hydrological regime of the site. The design objectives seek to deliver best practice outcomes using a water sensitive urban design (WSUD) approach, including management approaches for:

- Water conservation
- Stormwater quality management
- Flood mitigation
- Groundwater management.

The overall approach to water conservation is to reduce the amount of scheme water required. Within education buildings, potable water consumption has the potential to be reduced by utilising water efficient fixtures. The wider development can utilise waterwise landscaping principles within landscaped areas and groundwater for irrigation.

Surface water management focuses on treating small event runoff (i.e. first 15 mm) within bio-retention swales and soakwells, and directing runoff from major events from the site via overland flow paths, mimicking natural flows to the adjacent BBS, and eventually the PMD.

Groundwater level management focuses on maintaining the existing hydrology across the site and recharging the superficial aquifer. Groundwater quality management focuses on maintaining or improving the existing groundwater quality. This will be achieved by reducing total nutrient loads originating from the development and treating surface water runoff as close to source as possible and using high nutrient uptake soils and vegetation within bio-retention swales.

The proposed criteria and the manner in which they are proposed to be achieved are presented in **Table E1**. This table provides a readily auditable summary of the required outcomes which can be used in the future detailed design stage to demonstrate that the agreed objectives for water management across the site have actually been achieved.

This LWMS demonstrates that by following the recommendations detailed in the report the site is capable of being developed for the intended use.

Table E2 Water management criteria and compliance summary

Management Aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	When implemented
Water Conservation	WC 1	Use fit for purpose water sources.	A reticulated potable water supply will provide potable water	Proponent	Detailed civil designs
			Groundwater will be utilised to irrigate open space areas	Proponent	Landscape implementation
	WC 2	Open space areas will be limited to an average water use of 7,500 kL/ha/year.	Landscape design will adopt waterwise approach and ongoing management practices	Proponent	Landscape implementation
Stormwater management	SW1	Retain and treat small rainfall event (initial 15 mm) runoff as close to source as possible	Small rainfall event runoff will be treated via soakwells and bioretention swales	Proponent	Detailed drainage design
	SW2	Runoff discharged to the PMD in a major (1% AEP) event should not exceed agreed or pre-development peak flow rates.	The pre-development peak flow rate discharging towards the PMD was modelled to be 0.007 m^3/s . Utilising localised treatment infrastructure and overland flow the post-development peak flow rate discharging towards the PMD will be 0.006 m^3/s.	Proponent	Detailed drainage design
				Proponent	Detailed drainage design
				Proponent	Detailed drainage design
	SW3	Major event stormwater runoff to be discharged from the developable area via overland flow paths.	The road network, footpaths and opens space areas will be graded towards bio-retention swales and eventually overflow via overland flow towards the BBS	Proponent	Detailed drainage design

Table E3 Water management criteria and compliance summary (continued)

Management Aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	When implemented
Stormwater management	SW4	Floor levels will be at least 0.5 m above the 1% AEP flood levels in the BBS.	The finished flood levels for the 1% AEP within the BBS are 5.65 m AHD, therefore finished floor levels for the development will be at least 6.15 m AHD	Proponent	Detailed drainage design
	SW5	Surface runoff treatment areas to be sized to at least 2% of the total connected impervious area	Bio-retention swales are sized to at least 2% of the connected impervious area of the associated contributing catchment	Proponent	Detailed drainage design
	SW6	Design infiltration areas to avoid creating mosquito habitat.	Stormwater infrastructure will be designed to ensure all runoff is infiltrated within 96 hours	Proponent	Detailed drainage design
	SW7	Apply non-structural measures to reduce nutrient loads.	Utilise WWG practices in open space areas and bioretention swales	Proponent	Landscape implementation
			Maintenance of opens space areas and drainage assets	Proponent	Landscaping/ ongoing use by the proponent
Groundwater management	GW1	Use subsoil drainage where maximum groundwater level (MGL), or the clay layer is within 1.2 m of the natural surface.	Subsoil drainage will be investigated during detailed design when final earthworks and fill requirements have been determined.	Proponent	Detailed drainage design
	GW2	Where subsoil drainage are utilised, ensure they have a free outfall.	If subsoil drains are utilised within the site, they will discharge to the buffer which is lower than the minimum fill levels and the future design will ensure a free draining outfall.	Proponent	Detailed drainage design

Table E4 Water management criteria and compliance summary (continued)

Management Aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	When implemented
Groundwater management	GW3	Finished earthworks levels must be 1.2 m above the subsoil drain invert where used, otherwise 1.2 m above MGL.	Finished earthworks levels will be confirmed during detailed design, however will be at least 1.2 m above subsoil drains or the MGL	Proponent	Detailed drainage design
	GW4	Maintain or improve groundwater quality onsite.	Direct small event runoff to soakwells and bio-retention swales. Treatment is provided through interaction with vegetation and adsorption of nutrients to soil particles through infiltration	Proponent	Detailed drainage design
			Minimise fertiliser use in open space areas and road verges	Proponent	Landscape implementation
			Use roll-on, drought-tolerant turf species	Proponent	Landscape implementation

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Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
ABS	Australian Bureau of Statistics
ANZECC	Australian and New Zealand Environment and Conservation Council
BoM	Bureau of Meteorology
CoK	City of Kwinana
DBCA	Department of Biodiversity and Conservation
DoW	Department of Water
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
JDWMP	Jandakot Drainage and Water Management Plan
WAPC	Western Australian Planning Commission
WALIA	Western Australian Land Information Authority
WC	Water Corporation of Western Australia (Water Corp)

Table A2: Abbreviations – General terms

General terms	
MGL	Maximum groundwater level
AEP	Annual exceedance probability
ASS	Acid sulfate soils
BBS	Bollard Bulrush Swap
CCW	Conservation category wetland
CGL	Controlled groundwater level
LWMS	Local water management strategy
MUW	Multiple use wetland
NO_X	Nitrate and nitrite
PRI	Phosphorus retention index
TN	Total nitrogen
TP	Total phosphorous
TWL	Top water level
UFI	Unique feature identifier
WMP	Water management plan

General terms	
WSUD	Water sensitive urban design

Table A3: Abbreviations – units of measurement

Units of measurement	
cm	Centimetre
ha	Hectare
m	Metre
m^2	square metre
m AHD	m in relation to the Australian height datum
mm	Millimetre

Terminology Tables

Table A4: AEP – ARI equivalence

Rainfall event	Annual exceedance probability (AEP)	Annual recurrence interval (ARI)	Depth (mm)
Small	-	1	15
Minor	20 %	5	-
	10 %	10	-
Major	1 %	100	-

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1 Introduction

1.1 Background

The King's College (the 'proponent') is progressing with a Local Structure Plan (LSP) amendment over part Lot 500 Bertram Road, Wellard (referred to herein as the 'site') to allow for the expansion of a primary and secondary school. The site is located within the City of Kwinana (CoK), approximately 40 km south of Perth. The expansion will be located within the northern portion of Lot 500. Located within the south-western portion of the lot is the Bollard Bulrush Swamp (BBS). The site is approximately 5 hectares (ha) in size, and is shown in **Figure 1**.

1.2 Planning context

The site is currently zoned as 'Urban' under the *Metropolitan Region Scheme* (MRS) and 'Development' under the CoK *Local Planning Scheme (LPS) No. 2* (DPLH 2019). The south-western portion of Lot 500, which contains the BBS is currently zoned as 'Rural' under the MRS and 'Park Recreation and Drainage' under the CoK *LPS No. 2* (DPLH 2019).

The extent of the current zoning is due to MRS Amendment 1188/57 in 2014 for the Wellard Urban East Precinct which rezoned approximately 70 ha of land, including the site, from 'Rural' to 'Urban deferred', retaining the important wetland values of the BBS in the 'Rural' zone.

The intent is for the proponent to cede the area reserved for 'Parks Recreation and Drainage' as development progresses for the protection of the BBS vegetation (including a portion of the proposed 50 m buffer). Future development within the site will be confined within a 'Special Use: Education Establishment' zone, noting expectation around how the portion that falls within the wetland buffer is treated.

1.3 Purpose

It is important that the manner in which water will be managed is clearly documented early in the planning process, and this should be in a manner which avoids flooding and protects the environment. This approach provides the framework for actions and measures to achieve the desired outcomes during development.

This local water management strategy (LWMS) details the water management approach to support the development of the site, and is intended to satisfy the requirement to prepare an LWMS in accordance with *Better Urban Water Management* (WAPC 2008), and expectations of the Department of Water and Environmental Management (DWER) and CoK.

1.4 Policy framework

There are a number of Local and State Government policies of relevance to the development. These policies include:

- *A State Water Strategy for Western Australia* (Government of WA 2003)
- *State Planning Policy 2.9 Water Resources* (WAPC 2006)
- *State Water Plan* (Government of WA 2007)
- *Guidance Statement No. 33: Environmental Guidance for Planning and Development* (EPA 2008)
- *Liveable Neighbourhoods Edition 4 (Update 2)* (WAPC 2009a)
- *Planning Bulletin No. 64: Acid Sulfate Soils* (WAPC 2009b)
- *Water Wise Perth-Two Year action plan* (Government of WA 2019).

In addition to the above policies, there are a number of published guidelines and standards available that provide direction regarding the water discharge characteristics that developments should aim to achieve. These are key inputs that relate either directly or indirectly to the development and include:

- *Australian Rainfall and Runoff* (Ball J et al. 2019)
- *Australian Runoff Quality* (Engineers Australia 2006)
- *Better Urban Water Management* (WAPC 2008)
- *Developing a Local Water Management Strategy* (DoW 2008a)
- *Decision Process for Stormwater Management in Western Australia* (DWER 2017)
- *National Water Quality Management Strategy* (NWQMS) (ANZECC and ARMCANZ 2000a)
- *Stormwater Management Manual for Western Australia* (DoW 2007)
- *Jandakot District Water Management Plan* (DoW 2009).

1.5 Previous studies

1.5.1 District Water Management Strategy

A *District Water Management Strategy* (DWMS) was prepared (Emerge Associates 2014) to facilitate the re-zoning of the Wellard urban precinct east from 'Urban Deferred' to 'Urban' under the MRS. The DMWS provided the framework for water management criteria and includes the following key principles and design criteria:

- Water conservation
  - Utilise fit for purpose water sources throughout the development.
  - Consumption target for water of 100 kL/person/year, including not more than 40-60 kL/person/year scheme water.
- Stormwater management
  - Maintain the pre-development 5, 10 and 100 year average recurrence interval (ARI) event peak flow rates leaving the site.
  - Maintain 500 mm clearance between habitable floor levels and the 100 year ARI top water levels (TWL) within the Peel Main Drain (PMD) and onsite storage areas.
  - Minor roads must remain passable in the 5 year ARI rainfall event.
  - Retain and treat the 1 year 1 hour ARI event as close to source as possible.

  - Bio-retention areas to be sized to at least 2% of the total connected impervious area.
  - Utilise appropriate structural and non-structural measures to reduce nutrient loads.
  - Surface water quality leaving the site should be the same, or better, than that entering the site.
- Groundwater management
  - Maintain clearance between habitable floor levels and maximum groundwater levels (MGL) of at least 1.2 m.
  - Maintain a clearance between stormwater management feature inverts to MGL of at least 500 mm.
  - Groundwater quality leaving the site should be the same, or better, than that entering the site.

It is noted that the criteria proposed in the DWMS were in the overtall context of residential development. While this did not preclude land developed for educational purposes it preimarily envisaged developing land for residential purposes. The design criteria may therefore not all be directly applicable to the proposed development within Lot 500.

1.5.2 Local Water Management Strategy

A *Local Water Management Strategy* was prepared for lots 500 and 501 by RPS (2017) to facilitate residential development. The key design and management objectives detailed in the LWMS are congruent with the objectives detailed in the DWMS, with the exception of the following objectives that were further refined:

- Stormwater management
  - Provide 1% annual exceedance probability (AEP) floodways for safe passage of regional flood flows adjacent to the development area.
  - Provide flood paths for overland flows with the development area that exceeds the capacity of piped drainage.
  - Outflow from the site will occur as sheet flow across a vegetated surface to the wetland buffer, and subsequently BBS and the PMD, in order to replicate the pre-development environment.
- Groundwater management
  - Provide subsoil drainage where required to control any post-development groundwater level rise.

1.6 LWMS objectives

This LWMS has been developed in consideration of the objectives and principles detailed in *Better Urban Water Management* (WAPC 2008). It is intended to support the development within the site and is based on the following major objectives:

- Maintain the established hydrological regime to the BBS.
- Provide a broad level stormwater management framework to support future development.
- Develop a water conservation strategy for the site that will ensure the efficient use of all water resources.
- Incorporate appropriate Water Sensitvie Urban Design (WSUD) best management practices (BMPs) into the drainage system that address the environmental and water management issues identified.

- Ensure that sufficient land area is available to manage runoff.
- Minimise ongoing operation and maintenance costs for the land owners.
- Gain support from DWER and CoK for the proposed method to manage stormwater within the site.

Detailed objectives for water management within the site are further discussed in **Section 4**.

2 Proposed Development

The King's College proposes to expand its existing school (on Lot 905) to the eastern portion of the adjacent Lot 500 (approximately 5 ha). The proposed LSP has been prepared for the site by Harley Dykstra, and is provided in **Appendix A**. The LSP proposes the following land uses:

- The Kings College primary and secondary educational establishment buildings
- Café and kitchen facilities, gym, hardcourts and aquatic centre
- Retention of BBS riparian vegetation and accommodation of the necessary bushfire setbacks
- Retention of the BBS, which is a conservation category wetland (CCW) and establishment of a wetland buffer
- Passive recreation areas incorporating drainage and the opportunity to retain mature trees
- A park recreation and drainage reserve incorporating rehabilitation planting at the interface of the BBS, which includes a dual use pathway.

The masterplan and landscaping masterplan for the site is provided in **Appendix B** and **Appendix C**, respectively.

3 Existing Environment

3.1 Sources of information

The following sources of information were used to provide a broad regional environmental context to the site:

- *Weather and Climate Statistics (*BoM 2020*)*
- *LIDAR elevation dataset, Swan Coastal Plain* (DWER 2020b)
- *Geological survey of Western Australia* (Gozzard 1986)
- *Acid sulfate soils (ASS) risk mapping* (DWER 2020c)
- *Geomorphic wetlands of the Swan Coastal Plain database* (DBCA 2020)
- *Perth groundwater map* (DWER 2020b)
- *Water register* (DWER 2020e)
- *LWMS – Lots 500 and 501 Bertram Road Wellard* (RPS 2017)
- *Preliminary Geotechnical Investigation - Lot 502 Tambly Place and Lots 500 & 501 Bertram Road, Wellard* (Structerre 2015)
- *Environmental Assessment and Management Strategy* (Emerge Associates 2020a).

3.2 Existing and historical land use

Review of publicly available aerial photography (WALIA 2020), shows the site contained remnant wetland vegetation in the western portion circa 1953 in the centre-eastern portion of the site there are some signs of cleared land for low-intensive agricultural purposes and in the far eastern portion of the site scattered remnant trees were present . Between 1974 – 1989, residential development became evident in the far eastern portion of the site involving some clearing of trees. At present, the wetland vegetation in the western portion of the site has remained relatively untouched .

3.3 Climate

The site experiences a Mediterranean climate of hot dry summers and cool wet winters. Long term climatic averages indicate that average maximum temperatures range from 18 °C in July through to 31.6 °C in February, while the average minimum temperatures range from 7 °C in July through to 17.2 °C in February (BoM 2020). The site is located in an area of moderate to high rainfall, receiving 820 mm annually on average with approximately half of the rainfall received between June and August (BoM 2020).

3.4 Geotechnical conditions

3.4.1 Topography

The topography within Lot 500 generally falls from east to west with elevations ranging from approximately 10 metres Australian height datum (m AHD) along Bertram Road down to 5 m AHD around the BBS and adjacent to the Peel Main Drain (PMD) . Topographic contours across the site are shown in **Figure 2**.

3.4.2 Regional geology

Environmental geology for the site has been mapped by the *Geological Survey of Western Australia* (Gozzard 1986). The site consists of:

- Ms5 – Sandy Silt - dark brownish grey silt, with disseminated fine-grained quartz sand, firm, variable clay content, of lacustrine origin.
- S8 – Sand - very light grey at surface, yellow at depth, fine to medium-grained, subrounded quartz, moderately well sorted, of eolian origin as relatively thin veneer over C2, M4 and Mc2.

Regional geology across the site is shown in **Figure 3**.

3.4.3 Local geology and soils

Geotechnical investigations were conducted in 2015 by Structerre (2015) at ten test pit locations within and in close proximity to the site, as shown in **Figure 3**. Holes were dug up to 4 m below ground level (BGL). Ground conditions beneath the site comprised of topsoil up to 0.1 m BGL, silty sand to sandy fill up to 0.3 m BGL, and loose to medium dense natural sand up to 4 m BGL. Ground conditions within an adjacent lot to the site were comprised of topsoil up to 0.1 m BGL, loose to medium dense silty sand up to 0.5 m BGL, sandy clay with organics up to 2.5 m BGL, and medium dense natural sand up to 4 m BGL.

The site was classified as a class 'P' in accordance with AS2870-2011 however could be updated to a class 'A' with appropriate earthworks (Structerre 2015).

The geotechnical investigation and bore logs are provided in **Appendix D**.

3.4.3.1 Infiltration testing

Infiltration testing was conducted during geotechnical investigations at one location within the site, and two locations within proximity to the site as shown in **Figure 3**. Permeability was found to be 10.7 m/day within the site and 5.4 m/day and 7.1 m/day within the adjacent Lot 501.

3.4.4 Acid sulfate soil

Regional acid sulfate soil (ASS) risk mapping indicates that the entire site is classified as having a high to moderate risk of ASS occurring within 3 m of the natural soil surface, as shown in **Figure 4**. Final fill levels and subsequent excavation will determine whether dewatering is required, however due to the shallow depth to groundwater, it is considered likely.

3.5 Environmental assets

3.5.1 Flora and vegetation

A number of historical terrestrial flora and vegetation studies and investigations have occurred across the site and the broader BBS, including a *Level 2 Targeted Flora and Vegetation Survey* by ENV Australia (2011) and a reconnaissance flora and vegetation survey was undertaken by Emerge Assocaites in 2020. The findings documented one native plant community **ErMr** identified within Lot 500, associated with the BBS, extending over 5.07 ha**.**

The remainder of Lot 500 (4.72 ha) comprises of parkland cleared community characterised by scattered stands of native trees including *Eucalyptus rudis subsp. rudis* and *Melaleuca preissiana*. Recent and historical flora and vegetation surveys did not record any threatened or priority flora species within the site. A description of the vegetation communities identified within the site is provided in **Table 1.**

Table 1: Vegetation communities identified within the site (Emerge Associates 2020e).

Plant community	Description	Area (ha)
ErMr	Low closed forest of *Eucalyptus rudis* and *Melaleuca raphiophylla* (with occasional *B. littoralis*) over tall rushland of *Baumea articulata* and *Typha* spp. or bare ground or open grassland and herb land of **Cynodon dactylon*, **Ehrharta longifolia*, *Atriplex prostrata in degraded parts.	5.07
Parkland Cleared	Scattered Eucalyptus rudis and Melaleuca raphiophylla over non-native grassland or bare ground with scattered native shrubs and forbs.	4.72

The cleared parkland was recorded in 'completely degraded' condition due to the low number and cover of native species. Plant communities and regional vegetation complex mapping is shown in **Figure 5** and vegetaion condition is shown in **Figure 6**.

3.5.2 Fauna

A total of 13 fauna species were recorded within Lot 500 encompassing, the majority of which were common, widespread bird species. No conservation significant fauna was recorded during the field surveys. In addition, the likelihood that the site would provide important habitat for any fauna species of conservation significance is low, given the site primarily comprises cleared areas and non-native vegetation which support low fauna habitat values.

3.6 Surface water

3.6.1 Geomorphic wetlands

Review of the *Geomorphic Wetland Database* (DBCA 2020) shows the BBS (UFI 15866) is located within the western portion of Lot 500 and is a CCW. Surrounding the CCW is a multiple-use wetland (MUW) as shown in **Figure 5**. The mapped MUW and CCW extending into the site have experienced a high level of disturbance that has reduced the ecological values of the wetland and now supports vegetation in 'Completely Degraded' condition. Therefore the mapped extent of the CCW shown in **Figure 5** does not accurately represent the actual extent of the CCW values.

As part of their assessment of the MRS Amendment 1188/57 (described in **Section 1.2**), the Environmental Protection Authority (EPA) considered the extent of the BBS CCW, and the potential impacts arising from the proposed land uses, and recommended that a buffer of 50 m was required to adequately protect the CCW. Based on this assessment, the approapriate boundary of the CCW and the 50 m buffer is presented in **Figure 5.** No formal stormwater management features will be located within the BBS or its corresponding 50 m buffer (as is described further in **Section 6**).

3.6.2 Existing hydrological features

Review of the DWER *Hydrography Linear dataset* (2020g) indicates the presence of the perennial BBS, and a 'subject to inundation' buffer that covers the majority of Lot 500.

The PMD , which is managed by the Water Corporation (WC) is located along the south-western boundary of Lot 500 and flows in a southerly direction. The PMD eventually discharges to the Serpentine River and the Peel-Harvey estuary. The PMD is trapezoidal in shape and sits within a drainage reserve typically 20-25 m wide. Existing hydrological features are presented in **Figure 6**.

Major event runoff from the western portion of Lot 500 is expected to sheet flow towards the BBS, eventually discharging to the PMD.

Pre-development flood levels within the BBS and the PMD were provided in the *Jandakot Drainage and Water Management Plan* (JDWMP) (DoW 2009). Additional flood modelling was completed by GHD (2010) which included the potential development land immediately surrounding the BBS to determine post-development flood levels within the BBS.. The maximum water levels for the BBS for the minor (10% AEP) and major (1% AEP) events from are presented in **Table 2** These elevations are relevant to the site as they will guide the minimum floor levels of developments adjacent to the BBS and PMD.

Table 2: Maximum water levels within the Bollard Bulrush Swamp for the minor and major rainfall events.

	Top water level (m AHD)	
	Minor event (10% AEP)	Major event (1% AEP)
Pre-development - JDWMP (DoW 2009)		
Bollard Bulrush Swamp	4.81	5.61
Post-development - (GHD 2010)		
Bollard Bulrush Swamp	5.61	5.65

The GHD (2010) modelling identified a nominal storage volume that would be required by developments surrounding the BBS to ensure the flood levels identified in the *JDWMP* are maintained. It also provided nominal peak flow rates that could enter the PMD and still maintain the flood levels and flow rates within the PMD. The peak flow rates identified in the GHD modelling have been used to establish initial estimates rates in the 1% AEP rainfall event based on a pro-rata approach. According to the results of the GHD modelling, the peak flow rates in the 1% AEP rainfall event entering the BBS were identified as 0.007 m^3/s.

Emerge Associates has subsequently undertaken finer scale pre-development modelling of Lot 500 to determine the likely pre-development peak flow rates contributing to the PMD from the developable portion of Lot 500. The pre-development modelling was undertaken using XPSWMM software, and determined that the pre-devleopment peak flow leaving the developable portion of Lot 500 would be 0.24m^3/s in a 1% AEP event. The adoption of the peak flow rates from the GHD modelling therefore represents a very conservative approach to managing peak flow rates leaving the developable portion of Lot 500.

3.6.3 Surface water quality

Review of the *Water information reporting database* (DWER 2020a) shows a surface water quality monitoring location within Lot 500 (ID: 6140843), as shown in **Figure 6**. Five samples were taken between 2000 to 2004 and are presented in **Table 3**.

Table 3: Surface water quality results downstream of the site from 2000 2004 (DWER 2020e)

Surface water wite	Year	pH	EC (µs/cm)	TN (mg/L)	TP (mg/L)
6140843	2000	7.61	890	0.05	0.92
6140843	2000	6.83	890	0.05	0.92
6140843	2000	7.55	800	0.1	2.46
6140843	2000	6.71	1170	0.02	0.75
6140843	2004	-	790	0.02	0.09

The average total nitrogen (TN) and average total phosphorous (TP) from **Table 3** were found to be 0.13 mg/L and 1.03 mg/L, respectively. The long-term targets for nutrient concentrations in the PMD proposed in the JDWMP (DoW 2009) are 1.0 mg/L for TN and 0.1 mg/L for TP.

3.7 Groundwater

3.7.1 Groundwater resources

The *Water Register* (DWER 2020c) indicates that the site is located within the Jandakot groundwater area. Aquifers beneath the site comprise of the following:

- Superficial Swan (unconfined)
- Leederville (confined)
- Yarragadee North (confined).

3.7.2 Groundwater levels

The *Perth Groundwater Map* (DWER 2020b) indicates that groundwater levels across the site are a maximum of 8 m AHD (i.e. 2 m BGL), and flow in a south-westerly direction towards the BBS and PMD. Regional groundwater level contours are shown in **Figure 2**.

During geotechnical investigations conducted by Structerre (2015) in March 2015, groundwater was encountered at depths of between 1.1 m to 1.5 m BGL. Groundwater monitoring was also undertaken from October to November 2015 from two bores (BH01 and BH02) shown in **Figure 6**. Measured groundwater levels contours were generated by RPS (2017) using a range of monitoring data both within and in proximity to the site. Generated MGLs are shown in **Figure 2** and were found to be between 0-2.2 m BGL, and RPS subsequently concluded that subsoil drains would likely to be utilised to set a controlled groundwater level (CGL) (discussed further in **Section 7**).

3.7.3 Groundwater quality

Groundwater quality sampling was undertaken twice in 2015 from bores BH01 and BH02. Monitoring was also completed from two bores within proximity to the site (MW2E, MW5E) from 2010 to 2011 (RPS 2017). Although MW2E and MW5E are not located within Lot 500, these monitoring results provide historical upstream and downstream nutrient concentrations, which provides a comparison to monitoring results from within Lot 500. TN concentrations were found to be elevated above the ANZECC guidelines in all sampling locations except for BH02.

TP results were also above the *Peel Harvey Water Quality Improvement Plan* of 0.1 mg/L in all samples. Sampling results are summarised in **Table 4**. Monitoring locations are presented in **Figure 6**.

Table 4: Groundwater quality monitoring results (RPS 2017)

		Field Parameters					Nutrients					
Bore ID	Date	Temperature	Redox	DO	pH	EC	Ammonia	NOX	Total kjeldahl total	Total nitrogen	Total phosphorus	Filtered reactive phosphorus
			mV	Ppm	-	(µs/cm)	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ANZECC	-	-	-	-	7-8.5	300-1,500	-	0 01	-	1.50	0 01	0.005
MW1E	2010 -2011	-	-	-	*7.6*	*763*	-	-	*2.25*	*3.2*	*1.02*	*0.21*
MW5E	2010 -2011	-	-	-	*7.5*	*1606*	-	-	*4.5*	*4.6*	*0.29*	*0.02*
BH01	14/05/2015	17.3	91	0.92	5.4	524	-	-	-	-	-	-
	16/11/2015	20.7	-107	0.06	5.4	426	0.31	0.01	1.9	1.9	0.16	<0.01
BH02	14/05/2015	18.1	647	0.91	6.12	647	-	-	-	-	-	-
	16/11/2015	20.1	-5	1.3	6.27	383	0.16	0.02	0.8	0.8	0.17	0.11

**Note: Results in italics are an average*

3.8 Sewage sensitive area

The entirety of Lot 500 is classified as a sewage sensitive area by the *Government Sewerage Policy* (DPLH 2019), due to its proximity (1 km) to a significant wetland. However, as the site will be connected to reticulated sewer, no management actions in relation to the policy will be required.

3.9 Summary of existing environment

- The site receives an annual average rainfall of 820 mm.
- Average maximum temperatures throughout the site range from 18°C to 31.6°C and average minimum temperatures range from 7°C to 17.2°C.
- Topography throughout the lot ranges from 10 m AHD in the east to 5 m AHD in the west.
- Regional geological mapping shows the site is underlain by sandy silt.
- Geotechnical investigations within the site found ground conditions comprised of topsoil up to 0.1 m below ground level (BGL), silty sand to sand fill up to 0.3 m BGL, and loose to medium dense natural sand up to 4 m BGL
- Infiltration testing at one location within the site found permeability to be 10.7 m/day.
- The site is classified as having a 'high to moderate' of ASS occurring within 3 m of the natural soil surface.
- The site comprises of parkland cleared vegetation community characterised by scattered stands of native trees including *Eucalyptus rudis subsp. rudis* and *Melaleuca preissiana.*
- No conservation significant fauna were recorded within the site during the field surveys.
- A CCW associated with the BBS is located within the southern half of Lot 500, and is surrounded by a MUW.
- The PMD runs along the south-western boundary of Lot 500.
- Major event runoff from within the site is expected to sheet flow towards the BBS and eventually discharging to the PMD.
- The major event post development water levels within the BBS were modelled to be a maximum of 5.65 m AHD.
- Modelling completed by GHD (2010) indicated that peak flow rates discharging from the site into the BBS should be maintained at a rate of 0.007 m^3/s in a 1% AEP event post development.
- Surface runoff modelling undertaken by Emerge Assocaites indicates that the pre-development peak flow rate from the developable portion of Lot 500 is 0.24 m^3/s in a 1% AEP event.
- One surface water monitoring location within Lot 500 has been sampled Indicating that the average TN and averageTP were 0.134 mg/L and 1.03 mg/L, respectively.
- Groundwater beneath the site is a multi-layered system comprised of the Perth Superficial Swan aquifer, the Leederville aquifer and the Perth-Yarragadee North aquifer.
- Regional groundwater level mapping indicates that groundwater is a maximum of 8 m AHD (i.e. 2 m BGL), and flows in a south-westerly directly towards the BBS.
- Groundwater investigations within the site showed groundwater is close to the natural surface (i.e. within 0.5 m BGL).
- Groundwater quality sampling found both bores had elevated TP between 0.16-0.17 mg/L and one bore had elevated TNP levels at 1.9 mg/L.

4 Design Criteria and Objectives

This section outlines the objectives and design criteria that this LWMS and future management plans must achieve, and is generally consistent with the DWMS (Emerge Associates 2014), however has been updated to reflect the change in LSP. The water management strategy includes water conservation, stormwater management, groundwater management and wetland management.

4.1 Integrated water cycle management

The *State Water Strategy* (Government of WA 2003) and *Better Urban Water Management* (WAPC 2008) endorses integrated water cycle management approach and application of WSUD principles.

The key principles of integrated water cycle management include:

- Considering all water sources, including wastewater, stormwater and groundwater.
- Integrating water and land use planning.
- Allocating and using water sustainably and equitably.
- Integrating water use with natural water processes.
- Adopting a whole catchment integration of natural resource use and management.

Integrated water cycle management addresses not only physical and environmental aspects of water resource use and planning, but also integrates other social and economic concerns. Water management design objectives should therefore seek to deliver better outcomes in terms of:

- Potable water consumption
- Flood mitigation
- Stormwater quality management
- Groundwater management.

The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving environments. The existing environmental context of the site has been discussed in **Section 3** of this document. Guidance regarding environmental values and criteria is provided by a number of national and state policies and guidelines and site-specific studies undertaken in and around the site. These were detailed in **Section 1.4** and **Section 1.5**, respectively.

4.2 Water conservation

Water conservation management criteria include:

Criteria WC1 Use fit for purpose water sources.

Criteria WC2 Irrigation of open space areas will be limited to an average water use of 7,500 kL/ha/year.

The manner in which these objectives will be achieved is further detailed in **Section 5**.

4.3 Stormwater management

Stormwater management criteria include:

Criteria SW1 The small rainfall event (i.e. the first 15 mm) to be treated on site.

Criteria SW2 Runoff discharged to the PMD in a major (1% AEP) event should not exceed agreed or pre-development peak flow rates.

Criteria SW3 Major event stormwater runoff to be discharged from the developable area via overland flow paths.

Criteria SW4 Finished floor levels will be at least 0.5 m above the 1% AEP flood levels in the BBS and PMD.

Criteria SW5 Surface runoff treatment areas to be sized to at least 2% of the total connected impervious area.

Criteria SW6 Design infiltration areas to avoid creating mosquito habitat.

Criteria SW7 Apply non-structural measures to reduce nutrient loads.

The manner in which these objectives will be achieved is further detailed in **Section 7**.

4.4 Groundwater management

The groundwater management criteria for the site include:

Criteria GW1 Use subsoil drainage where MGL is within 1.2 m of the natural surface.

Criteria GW2 Subsoil drainage to have a free draining outfall 150 mm above the discharge location.

Criteria GW3 Finished floor levels to be 1.2 m above the subsoil drain invert where utlised.

Criteria GW4 Maintain or improve groundwater quality beneath the site.

The manner in which the groundwater management objectives will be achieved is further detailed in **Section 9.**

4.5 Wetland management

The principles behind wetland management are to maintain the existing hydrological regime and ensure the protection of water quality within the BBS. Design criteria presented above are also relevant to the successful management of the wetland (specifically **Criteria SW1, SW2**, **SW3,** and **GW4**).

The manner in which the criteria detailed for stormwater and groundwater management are achieved relevant to wetland management is detailed in **Section 8**.

5 Water Conservation Strategy

5.1 Fit for purpose water use

Conservation of water through fit-for-purpose use and best management practices is encouraged so that scheme water is not wasted. Fit-for-purpose principles have been utilised in the water conservation strategy for the site and will achieve **Criteria WC1**.

5.1.1 Scheme water supply

The site will be supplied with potable by via connection to the WC Integrated Water Supply Scheme (IWSS).

5.1.2 Groundwater supply

Groundwater can be used for irrigation of the open space areas instead of utilising scheme water. Turf areas typically require 7,500 kL/ha/year, therefore approximately 7, 900 m^2 of open space will require a maximum of 5,925 kL/ha/year.

At the time of preparing this report (October 2020), allocation is available within the Superficial Swan aquifer, however the Leederville aquifer is over-allocated. A non-potable sourc is currently being investigated by the proponent and will be confirmed in future water management documentation.

5.2 Water conservation measures

The landscaping approach will utilise water wise gardeningprinciples , and water efficient fittings across the school to ensure that the use of scheme water is minimised. These measures are further discussed in the following Sections.

5.2.1 Water efficient fixtures

Significant reductions can be achieved with the use of ater efficient fittings. The water conservation strategy proposes that all buildings within the school use water efficient fittings.

5.2.2 Water wise landscaping

Water use for irrigation (by employing water efficiency measures) can significantly reduce total water usage. The following water efficiency measures will be used within landscaping:

- The adoption of xeriscaped gardens (garden beds are landscaped using 'waterwise plants', which are local native species that require less water).
- Where required, soil shall be improved with soil conditioner certified to Australian Standard AS4454 to a minimum depth of 150 mm where turf is to be planted and a minimum depth of 300 mm for garden beds.
- Garden beds to be mulched to 75 mm with a product certified to Australian Standard AS4454.
- Implementation of hydrozoning design practices, which will group plant species with similar/ same irrigation requirements.

- Irrigation systems will have emitters which disperse coarse droplets to minimise losses to evaporation.
- Irrigation will not be utilised during winter months and rain sensors will be utilised.

The above measures will assist in achieving **Criteria WC3**.

5.3 Water conservation criteria compliance summary

A summary of the proposed water conservation design criteria and how these will be addressed within the site is provided in **Table 1** below.

Table 5: Water conservation compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
WC1	Use fit for purpose water sources	A reticulated potable water supply will provide potable water
		Groundwater will be utilised to irrigate open space areas
WC3	Open space areas will be limited to an average water use of 7,500 kL/ha/year	Landscape design will adopt waterwisw approach and ongoing management practices

6 Stormwater Management

The principle behind the stormwater management strategy for the site is to retain and treat the small (i.e. first 15 mm) rainfall event runoff on-site and to direct runoff from larger events to natural flow pathways towards the BBS and PMD. WSUD measures that may be utilised in the stormwater management strategy include:

- Soakwells
- Bio-retention swales

The WSUD measures that will be implemented as a part of the LSP are described in the following sections.

6.1 Development drainage

6.1.1 Education buildings

Education buildings will retain and treat the small rainfall event (i.e. first 15 mm) within soakwells as per advice from geotechnical investigations (Structerre 2015). Runoff from roof areas will therefore infiltrate into the underlying soil profile and ultimately to groundwater. If some or all of the first 15 mm of runoff cannot be accommodated within soakwells, these volumes will need to be added to the design requiremetns for bio-rention swales.

Education locations of building are shown in **Figure 7**. The use of soakwells will assist in achieving **Criteria SW1** and **SW2**.

6.1.2 Bio-retention swales

Bio-retention swales are proposed to be utilised across the development to capture and treat the small event runoff (i.e. first 15 mm) from other impervious areas (e.g. road pavement/footpaths). Indicative locations of swales are shown in **Figure 7**. Runoff from rainfall events greater than the capacity of the swales will be conveyed via overland flow through the buffer to the downstream BBS. The southern bio-retention swale will be trapezoid in shape, and will be designed to have a maximum depth of 500 mm and 1 in 3 side slopes. All other swales will be designed with a maximum depth of 300 mm and 1 in 3 side. The base width of the swales will vary to suit the location but is nominally expected to vary from zero to 2 m. A clearance of at least 300 mm will be maintained between the invert of the swales and the MGL.

Swales should be planted with native vegetation to encourage biological nutrient uptake of nitrogen species (Monash University 2014) and should be lined with 300 mm of an appropriate soil medium with a high phosphorous retention index (PRI) (>10) to increase phosphorous removal from runoff during infiltration.

The discharge points from the swales to the buffer will need sutiable erosion control, such as rock spawl or jute matting. This detail will be resolved in the future detailed civil design stage.

The use of swales will assist in achieving **Criteria SW1**, **SW2**, **SW5** and **GW4**. Storage required capacities of the swales are presented in **Table 5** and is the nominal locations of these are illustrated in **Figure 7**.

Table 6: Small event treatment storage

Catchment	Total area of connected impervious surface (m^2)	Treatment	Total volume (m^3)	Total area (m^2)	Percentage of connected impervious area (%)
Ct01	14,000	Bio-retention Swale	210	608	4.3

Table 6 shows the swales will exceed the minimum of 2% of the impervious surface across the site is treatment, which achieves **Criteria SW5**.

6.1.3 Discharge from site

The site grades towards the BBS and runoff following a major rainfall event will discharge via overland flow to the PMD in the existing environment. The existing hydrology should be maintained, and therefore, the major event stormwater runoff will be directed towards the BBS and PMD as overland flow from the bio-retneiton swale.

Emerge Assocaites have prepared a post-development surface runoff model to confirm that the flow rates determined by previous studies and the pre-development modelling as being required to maintain the pre-development peak flow regime.

The bio-retnetion swales will become inundated during the small rainfall event (i.e. first 15 mm), and runoff exceeding this will be conveyed via overland flow towards the BBS and eventually the PMD. Discharge flow pathways are shown in **Figure 7**.

Table 7 shows the pre-development peak flow rates discharging into the BBS (discussed in **Section 3.6.2**) and that the post-development peak flow rates being directed to the PMD, and these confirm that **Criteria SW2** can be acheived.

Table 7: Pre and post development peak flow rates discharging to the PMD

Scenario	Major event peak flow rate (m^3/s)
Pre-development	0.007
Post-development	0.006

6.2 Non-structural measures

A number of non-structural measures will be implemented across the site to help reduce nutrient loads within stormwater runoff. These measures include:

- Minimising fertiliser use to establish and maintain vegetation and turfed areas.
- Use of drought tolerant turf species that require minimal water and nutrients.

The above measures will assist in achieving **Criteria SW7** and **GW4**.

6.3 Stormwater design criteria compliance

A summary of the proposed water conservation design criteria and how these are addressed within LSP is provided is **Table 8**.

Table 8: Stormwater management compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
SW1	The small rainfall event (i.e. the first 15 mm) to be treated on site	Education buildings will retain and treat runoff within soakwells
		Runoff in the small event from road pavement and footpaths will be treated within bio-retention swales
SW2	Runoff discharged to the PMD ina major (1% AEP) event should not exceed agreed or pre-development peak flow rates	The pre-development peak flow rate discharging towards the PMD was modelled to be 0.007 m^3/s (see **Section 3.6.2**). Utilising localised treatment infrastructure the post-development peak flow rate discharging towards the PMD will be 0.006 m^3/s.
SW3	Major event stormwater runoff to be discharged from the developable area via overland flow paths	The road network, footpaths and opens space areas will be graded towards swales and eventually overflow as sheet flow via the discharge flow pathways into the BBS
SW4	Floor levels will be at least 0.5 m above the 1% AEP flood levels in the BBS and PMD	The finished flood levels for the 1% AEP within the BBS are 5.65 m AHD, therefore finished floor levels for the development will be at least 6.15 m AHD
SW5	Surface runoff treatment areas to be sized to at least 2% of the connected impervious area	Bio-retention are sized to at least 2% of the connected impervious area of the contributing catchment
SW6	Design infiltration areas to avoid creating mosquito habitat	Stormwater infrastructure will be designed to ensure all runoff is infiltrated within 96 hours but providing adequate clearance above groundwater
SW7	Apply non-structural measures to reduce nutrient loads	Utilise waterwise landscaping practices in open space areas and bio-retention swales
		Maintenance of opens space areas and drainage assets

7 Groundwater Management

The principles behind groundwater management are to maintain the existing hydrology across the site, recharge the superficial aquifer and maintain the existing groundwater quality.

7.1 Groundwater level management

Earthworks levels for the site are yet to be confirmed. However, finished floor levels will need to meet a minimum elevation of 6.15 mAHD. Further, the finished floor levels should also aim to achieve a minimum 1.2 m of clearance above the measured MGL. This will ikely be achieved by the use of imported (sand) fill.

Subsoil drains have previously been proposed to be installed in the road network and beneath swales to assist in infiltrating run-off post-development and provide a CGL (RPS 2017). This was proposed to be set at the MGL. It has not been determined whether subsoil drains will be required to facilitate development of the site and to promote longevity of the road pavement. They may also be required to ensure that the swales and soakwells drain in an appropriate time. The use of subsoil drains within the site will be investigated during detailed design in conjunction with earthworks levels.

7.2 Groundwater quality management

The main groundwater quality objective is to maintain or improve the existing groundwater quality beneath the site. This can be achieved by reducing the total nutrient load to groundwater from sources within the development and by improving the groundwater via treatment of surface runoff prior to infiltrating to groundwater.

The reduction of nutrient loads to groundwater will be achieved through the following measures:

- Treatment of stormwater within bio-retention swales, designed to retain and treat the small event (15 mm) runoff, consistent with best management practices.
- Minimising fertiliser use to establish and maintain vegetation/turf.
- Utilising drought tolerant turf species that require minimal water and nutrients.
- Roll-on turf will be used within open space areas (where turf is to be used) to prevent the high nutrient input requirement during establishment of turf.

The above measures will help to maintain the quality of water prior to infiltration into the underlying groundwater and will assist in achieving **Criteria GW4**.

7.3 Groundwater design criteria compliance

Table 9: Groundwater management compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
GW1	Use subsoil drainage where MGL, or the clay layer is within 1.2 m of the natural surface	Subsoil drainage will be investigated during detailed design when final earthworks and fill requirements have been outlined.
GW2	Where subsoil drains are utilised, ensure they have a free outfall	If subsoil drains are utilised within the site, they will discharge to the buffer which is lower than the minimum fill levels and the future design will ensure a free draining outfall.
GW3	Finished earthworks levels must be 1.2 m above the subsoil drain invert where used, otherwise 1.2 m above MGL	Finished earthworks levels will be determined during detailed design, however will be at least 1.2 m above subsoil drains or the MGL.
GW4	Maintain groundwater quality onsite	Direct small event runoff to soakwells and bio-retention swales. Treatment is provided through interaction with vegetation and adsorption of nutrients to soil particles through infiltration.
		Minimise fertiliser use in open space areas and road verges.
		Use roll-on, drought-tolerant turf species.

8 Wetland Management

Due to close proximity to the CCW, measures will be required to protect the wetland, which will be primarily through a 50 m wetland buffer. The wetland buffer will protect the wetland vegetation and minimise the migration of non-native species. No drainage from the site will be directly connected or piped into the wetland, and any runoff will be conveyed towards the BBS and PMD via overland flow.

Details of the wetland management proposed (e.g fencing, weed management, revegetation and rehabilitation) will be detailed in a site-specific wetland management plan (WMP) or similar. The WMP will be prepared to manage the impacts of the proposed development on the wetland and will outline the interface treatments and management strategies adjacent to the wetlands including the parties responsible for the management of these areas.

As described in **Section 4.5**, the principles behind wetland management are to maintain the existing hydrological regime and ensure protection of water quality within the BBS. The management strategies proposed to protect water quality within the BBS are consistent with the actions required to comply with **Criteria WC2**, **SW1**, **SW2**, **SW3**, **SW5**, **SW7** and **GW5**, and includes:

- Minimising pollutant loads within stormwater runoff and infiltrating to shallow groundwater
- Treating the small event stormwater runoff within the developable portion of the site.

9 Future Water Management Planning

The requirement to undertake preparation of more detailed water management plans to support the development is generally imposed as a condition of development. The development of any future water management plan (WMP) should follow the guidance provided in *Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions (DoW 2008b).*

While strategies have been provided within this LWMS that address planning for water management within the site, it is a logical progression that future designs and the supportive WMP will clarify details not provided within the LWMS. The main areas that will require further clarification within future WMPs may include:

- Earthworks and fill strategy
- Modelling and configuration of drainage structures
- Implementation of water conservation strategies
- Confirmation of irrigation source
- Non-structural water quality improvement measures
- Management and maintenance requirements
- Construction period management strategy
- Monitoring and evaluation program.

These are further detailed in the following sections.

9.1 Earthwork and fill strategy

As discussed in **Section 7.1**, the use of sand fill may be required to ensure **Criteria GW1**, **GW3** and **GW3** are achieved. Suitable fill levels for the development will be determined by detailed site investigations in conjunction with earthworks.

Soils beneath bio-retneiton swales would ideally have high PRI to ensure at-source nutrient retention leading to the protection of the underlying aquifer.

9.2 Modelling and configuration of drainage structures

It is acknowledged that the drainage strategies documented in this LWMS are to some extent based upon broad-scale assumptions and regional data. These assumptions are considered adequate for development of the proposed stormwater management structure sizing and are of a conceptual but appropriate level of detail.

The exact location and shape of stormwater management assets structures will therefore need to be specified and presented within the future WMP.

For example, if aqequate clearance between groundwater and the soakwells cannot be met, additional retention may be required within in the swales. It is expected that the civil drainage designs will be progressed to a level that provides detailed cross-sections, sizes of storage areas, subsoil pipe sizes, inverts, etc.

The exception to the requirement to revise the surface runoff modelling is if the catchment details and WSUD structure designs are consistent with the assumptions made in this LWMS. If this were the case it would be acceptable to provide design calculations for the drainage network and WSUD structures to demonstrate compliance with the LWMS.

9.3 Implementation of water conservation strategies

A number of potential measures to conserve water have been presented within this LWMS (see **Section 5.2**). These water conservation strategies will be incorporated into the design and the ongoing maintenance of all open space areas. Landscape design measures that will be incorporated into the water conservation strategy will be further detailed within the future WMP.

9.4 Confirmation of irrigation source

It is expected that where any irrigation is proposed, future the WMP will demonstrate that an adequate water source has been obtained to meet irrigation requirements, or that an appropriate contingency plan has been established.

The use of groundwater as an irrigation/construction source is currently being arranged by the proponent. Any groundwater licences obtained for use in irrigation of landscaping and construction, along with the location of bores will be confirmed in the future WMP.

9.5 Non-Structural water quality improvement measures

Guidance for the development and implementation of non-structural water quality improvement measures is provided within the *Stormwater Management Manual for Western Australia* (DoW 2007). It is expected that the future WMP will provide a list of appropriate non-structural measures including timing and responsible parties.

9.6 Management and maintenance requirements

The measures to be implemented to address surface water management (i.e. bio-retention swales) will require ongoing maintenance. Therefore, the future WMP will provide detailed management and maintenance plans that will set out maintenance actions (e.g. gross pollutant removal), timing (e.g. how often it will occur), locations (e.g. exactly where it will occur) and responsibilities (e.g. who will be responsible for carrying out the actions).

9.7 Construction period management strategy

It is anticipated that the construction stage will require some management of various aspects (e.g. dust, surface runoff, noise, traffic etc.). The management measures undertaken for construction management will be addressed either in the future WMP or a separate Construction Management Plan (CMP).

9.8 Monitoring and evaluation program

It will be necessary to confirm that the management measures that are implemented are able to fulfil their intended management purpose.

A post-development monitoring program will be developed to provide this confirmation, and it will include details of objectives of monitoring, relevant issues and information, proposed methodology, monitoring frequency and reporting obligations.

These monitoring programs are detailed in **Section 10** of this LWMS and will be further detailed at the WMP stage.

10 Monitoring and Maintenance

The intent of the below monitoring programs and maintenance requirements are to ensure the stormwater and groundwater management functions of bioretention swales are achieved.

10.1 Surface water monitoring

Given that there will be no surface water discharge from the site during small events (the first 15 mm) it will be very difficult to collect a water quality sample for treated surface runoff. Post-development surface water monitoring is therefore not proposed.

Post-development monitoring within the wetland is not proposed as the wetland complex is influenced by a wider catchment area than the site itself. Any changes to water quality within the wetland would not be directly identifiable to practices within the proposed development which is the purpose of any post-development monitoring.

10.2 Groundwater monitoring

Pre-development groundwater sampling was conducted at two locations within the site as detailed in **Section 3.7.3**. The pre-development groundwater quality monitoring provides some measure of baseline data that will assist in verification of future detailed designs at the subdivision stage. Additional monitoring of groundwater levels (spatially and temporally) is recommended to occur prior to detail earthworks and civil design to ensure that the appropriate clearance to groundwater can be achieved.

Post-development groundwater monitoring aims to provide a site-specific understanding of impacts to the wetland through comparison of flows from the site itself which will then inform on-site management practices as necessary.

Given the variability in the observed water quality data, it is proposed that post-development monitoring will reference both a derived water quality target, and an upstream/downstream comparison of water quality at key locations within the development site. Indicative post-development monitoring bore locations are presented in **Figure 7** and will assist in understanding the quality of groundwater discharge to the wetland. Given that the locations of bio-retention swales are nominally shown, these locations should be revised at WMP stage to ensure that an upstream/downstream comparison is available.

A summary of the post-development monitoring program is shown in **Table 10**. Post-development monitoring will be conducted for two years, post construction of the detention storage and treatment measures, and any landscaping.

Table 10: Monitoring program summary

Monitoring Type	Locations	Frequency	Parameters
Groundwater	Bores upstream and downstream of the site	Quarterly (typically Jan, April, July, Oct).	In situ pH, EC, temperature. Sample TSS, TN, TKN, NH4, NOX, TP, FRP

10.2.1.1 Post development trigger values

Interim water quality targets have been derived from background levels measured during monitoring prior to development, provided in **Section 3.7.3**. Trigger values have also been established in consideration of the NWQMS (ANZECC and ARMCANZ 2000a) and the *Peel Harvey Water Quality Improvement Plan* trigger values. The trigger criteria derived from pre development monitoring is proposed in **Table 11.**

Table 11: Groundwater quality trigger values

Trigger Values	pH	EC (µs/cm)	TP (mg/L)	TN (mg/L)
Average	5.8	495	0.17	1.4

10.3 Contingency action plan

A contingency action plan (CAP) has been proposed in this LWMS (in the following section). Where relevant, it should also be further detailed and implemented as a part of each WMP. The CAP is effectively a plan of steps that will be undertaken should certain water quality criteria be reached.

10.3.1 Contingency actions

If the results from the initial monitoring occasion indicate that nutrient concentrations exceed the nominated trigger values, a number of contingency measures may be employed.

The first action that should be undertaken if trigger criteria are exceeded is to repeat the monitoring to remove the potential for sampling error. If the repeat monitoring still shows results which breach the trigger value, the next action will be to compare groundwater monitoring results for the upstream (incoming) nutrient concentrations with the downstream (outgoing) nutrient concentrations.

If the downstream nutrient concentrations are >20% higher than the upstream nutrient concentrations, the following actions should be undertaken:

1. Review nutrient application practices to identify source if possible.
2. Remove source if possible (e.g. fertiliser input, etc)
3. Thinning of vegetated treatment areas to ensure removal of accumulated nutrients (i.e. within plants) from the system where observations indicated excessive plant growth.
4. Supplementary planting of vegetated treatment areas where plant density is low (e.g. <4 plants/m^2).

If the downstream nutrient concentrations are found to be generally consistent with the upstream concentrations the next action will be to conduct a site-specific comparison of background data collected. There is some amount of variability (both spatially and temporally) in nutrient concentrations experienced across the site and the trigger values may need to be modified following additional monitoring. This information should then be used as a management tool to determine if the trigger values should be revised.

Following the implementation of the above contingency measures the water quality will be re-sampled. If the results of the analysis still show water quality characteristics which breach the trigger values an additional set of upstream/downstream monitoring bores should be installed at another key representative area (e.g. additional bores upstream and downstream of the site). The additional bores will be sampled as per the ongoing sampling regime already being undertaken. If the results from the second area demonstrate results consistent with the first area, the proponent will work with CoK to determine if the results are representative of a broader catchment management issue, and whether any additional contingency actions need to be implemented.

10.4 Reporting

A post-development monitoring report should be prepared annually. These should be reviewed to determine any changes that should be made to the ongoing management of drainage assets and open space areas.

11 Implementation

The LWMS is a key supportive document for the LSP. The LWMS has been prepared with the intention of providing a structure within which subsequent development can occur consistent with an integrated water cycle management approach. It is also intended to provide overall guidance to the general stormwater management principles for the area and to guide the future WMP.

11.1 Roles and Responsibility

The LWMS provides a framework that the proponent can utilise to assist in establishing stormwater management methods that have been based upon site-specific investigations, are consistent with relevant State and local government policies and have been endorsed by CoK. The responsibility for working within the framework established within the LWMS rests with the proponent.

11.2 Funding

As the site constitutes a single landholding, the management strategies outlined in this LWMS will be borne solely by the proponent.

11.3 Review

It is not anticipated that this LWMS will be reviewed, unless the LSP undergoes significant change post-lodgement of the LWMS. If the LSP is substantially modified, surface runoff calculations undertaken for this LWMS will need to be reviewed and the criteria proposed revised to ensure that all are still appropriate.

The WMP is largely an extension of the LWMS, as it should provide detail to the designs proposed within this LWMS, and will demonstrate compliance with the criteria proposed in **Section 4**.

In addition to the issues detailed in **Section 9**, the WMP will address:

- Compliance with design objectives within the LWMS
- Detailed stormwater management design
- Specific structural and non-structural methods to be implemented and their manner of implementation
- Details of proposed roles and responsibilities for the above measures.

12 References

12.1 General references

The references listed below have been considered as part of preparing this document:

Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC and ARMCANZ) 2000a, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, National Water Quality Management Strategy, Commonwealth of Australia, Canberra.

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Figures

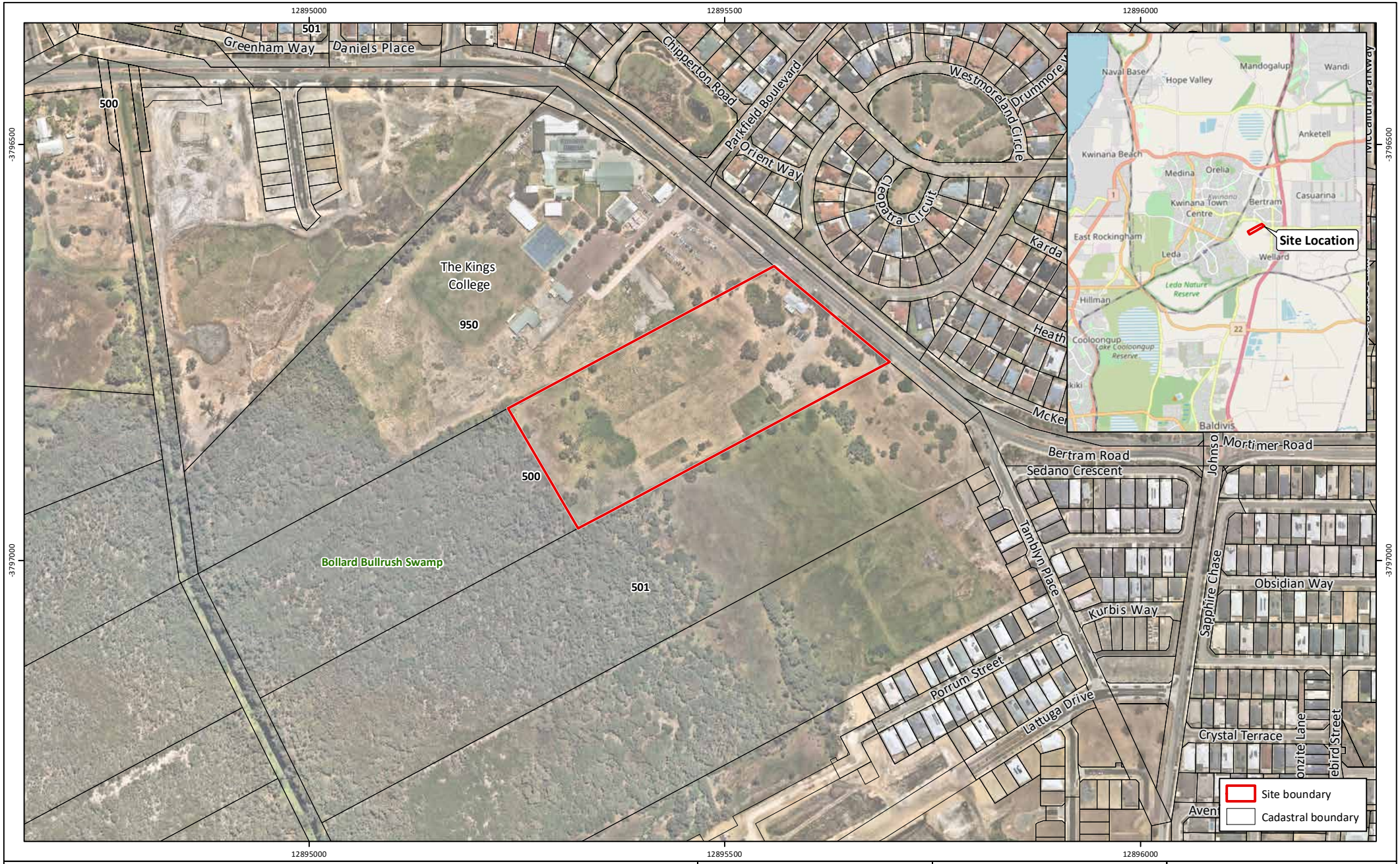

Figure 1: Site Location

Project: Local Water Management Strategy
Lot 500 Bertram Road, Wellard Local Structure Plan Amendment

Client: The Kings College

Plan Number:
EP20-047(07)--F23

Drawn:	GAR
Date:	06/11/2020
Checked:	TEM
Approved:	DPC
Date:	04/12/2020

N

0 100 200
Metres

Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

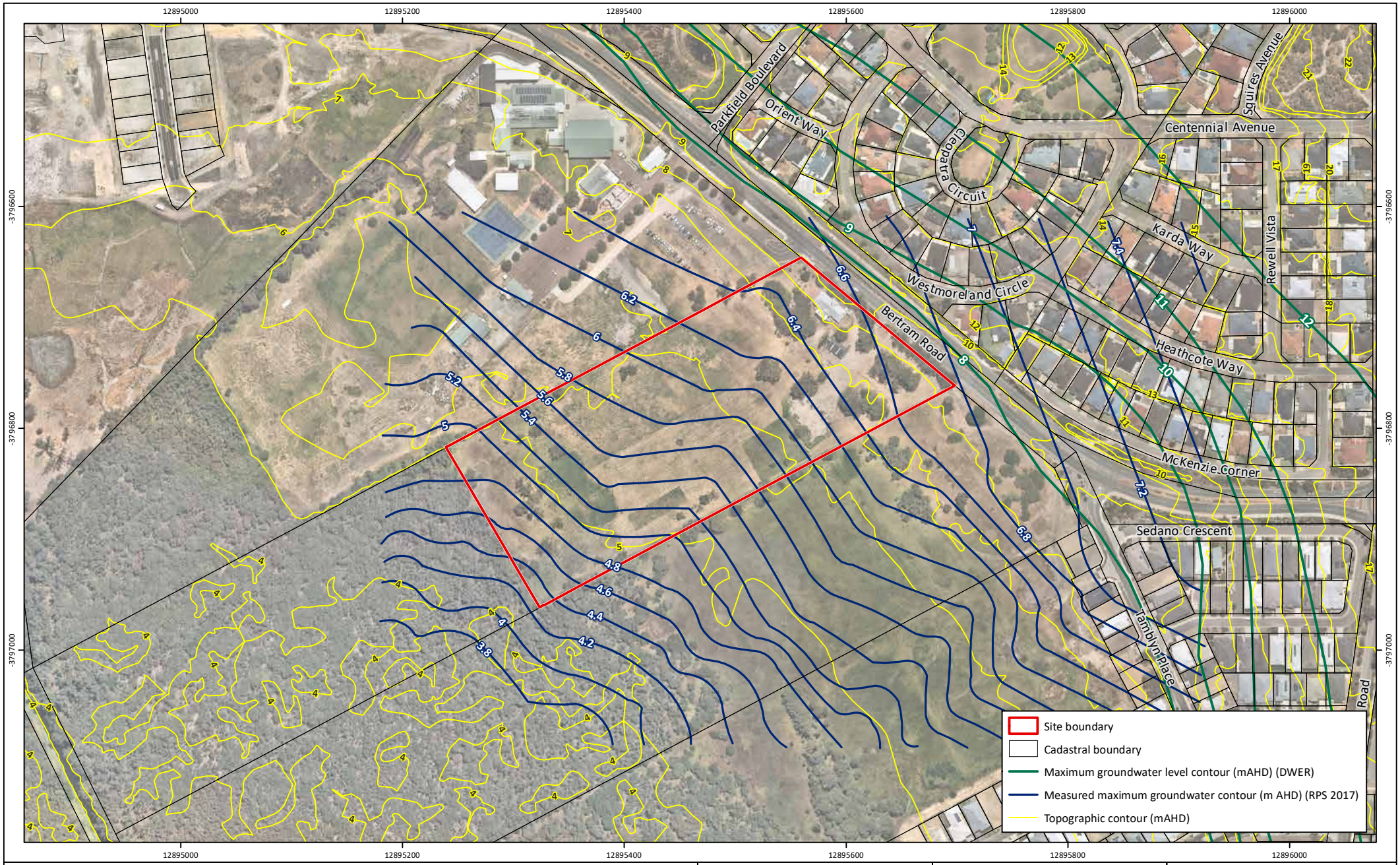

Figure 2: Topographic Contours and Maximum Groundwater Level Contours

Project:	Local Water Management Strategy Lot 500 Bertram Road, Wellard Local Structure Plan Amendment
Client:	The Kings College

Plan Number:
EP20-047(07)--F24

Drawn:	GAR
Date:	06/11/2020
Checked:	TEM
Approved:	DPC
Date:	04/12/2020

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0 50 100 150
Metres

Scale: 1:4,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

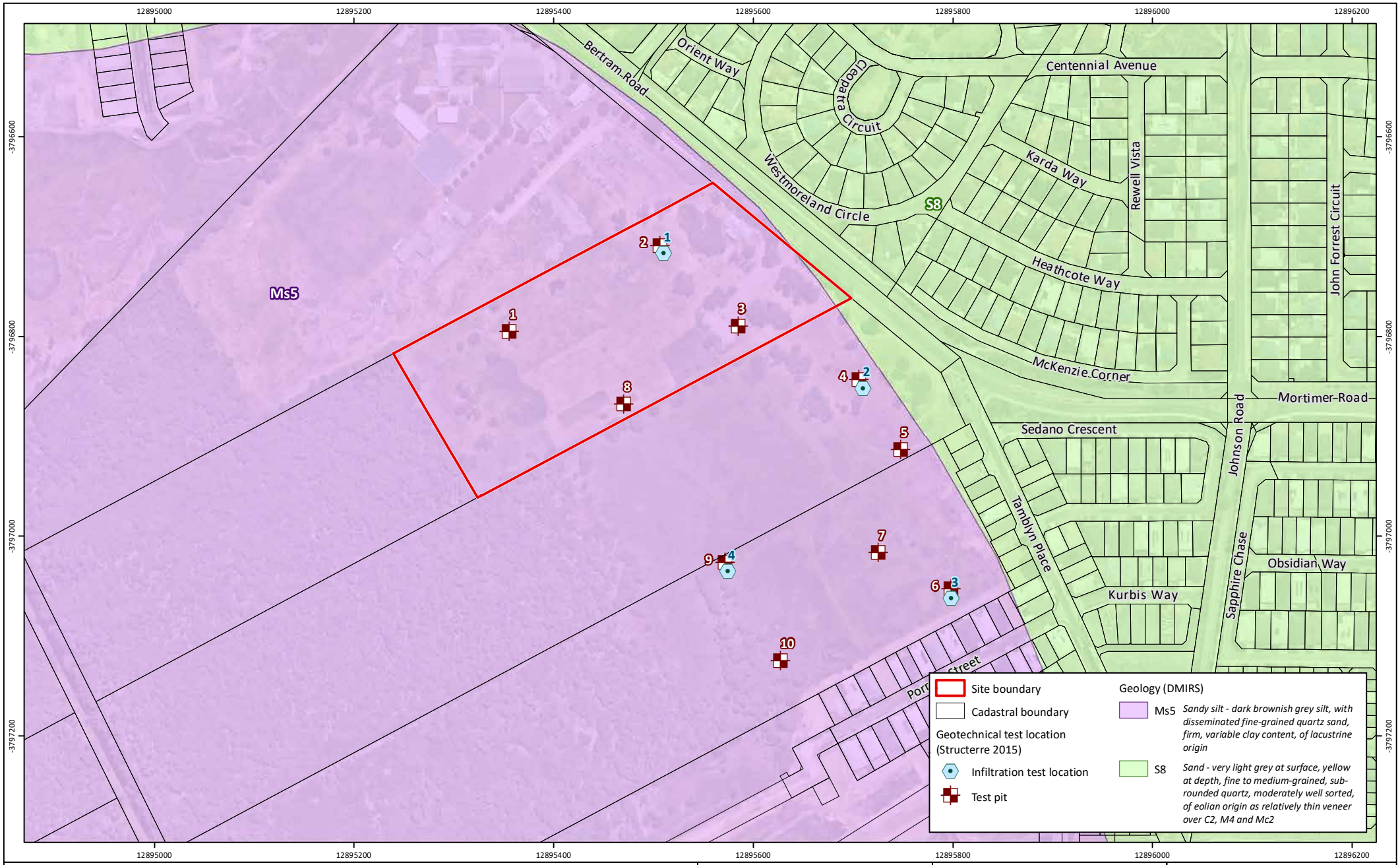

Figure 3: Geological Mapping

Project: Local Water Management Strategy
Lot 500 Bertram Road, Wellard Local Structure Plan Amendment

Client: The Kings College

Plan Number:
EP20-047(07)--F25

Drawn:	GAR
Date:	06/11/2020
Checked:	TEM
Approved:	DPC
Date:	04/12/2020

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Metres

Scale: 1:5,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

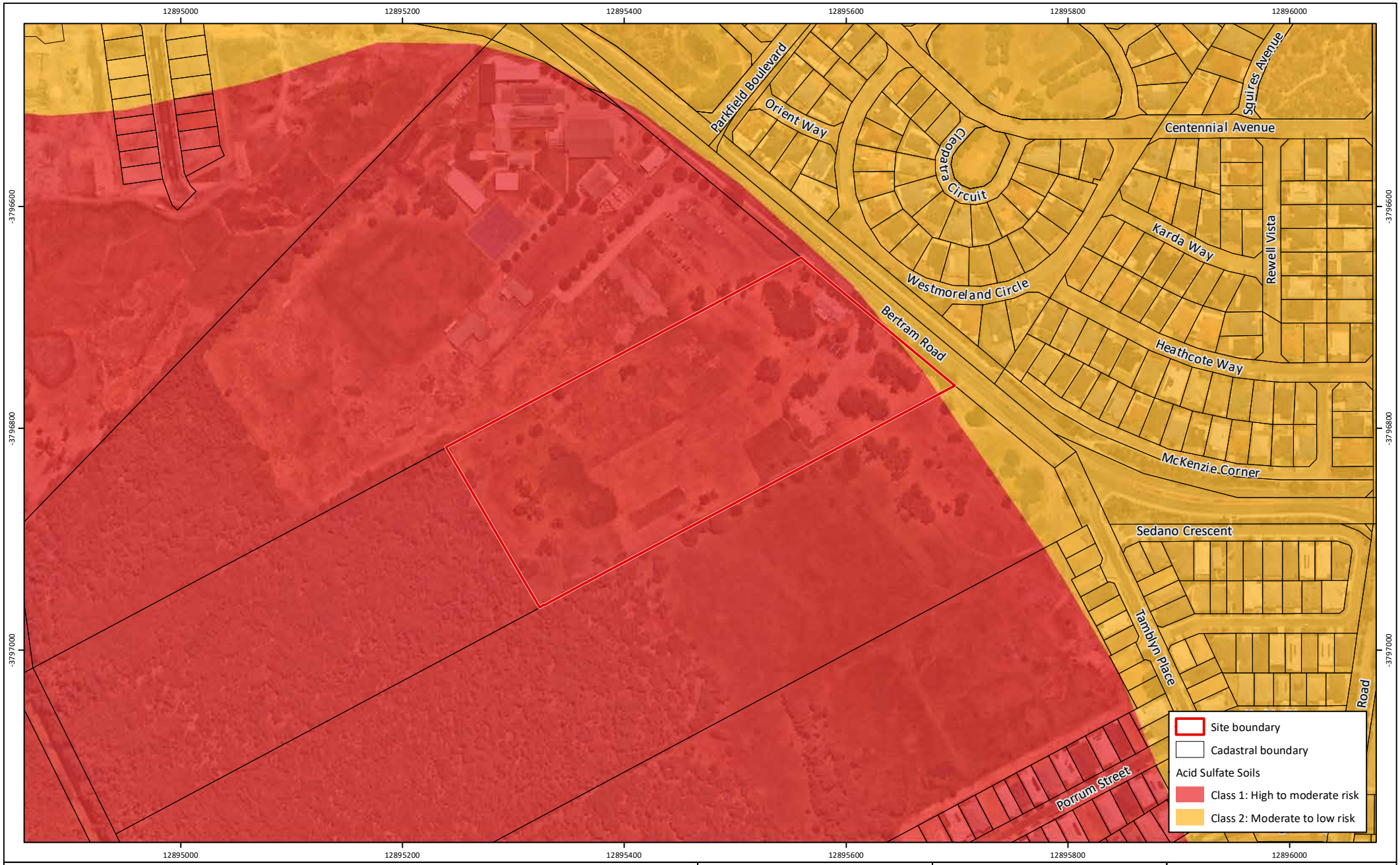

Figure 4: Acid Sulfate Soil Mapping

Project: Local Water Management Strategy
Lot 500 Bertram Road, Wellard Local Structure Plan Amendment

Client: The Kings College

Plan Number:
EP20-047(07)--F26

Drawn:	GAR
Date:	06/11/2020
Checked:	TEM
Approved:	DPC
Date:	04/12/2020

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Metres

Scale: 1:4,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

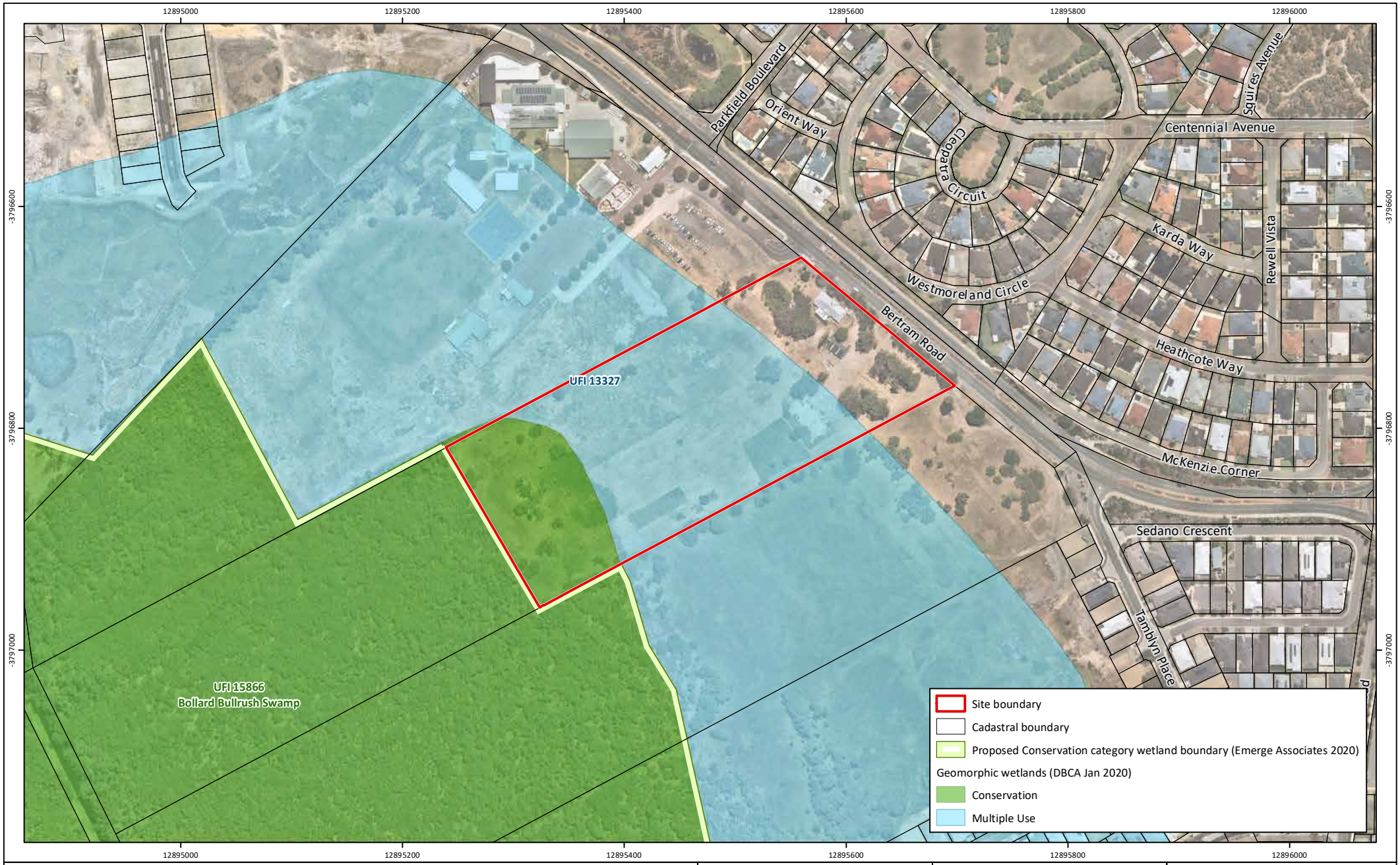

Figure 5: Geomorphic Wetlands

Project:	Local Water Management Strategy Lot 500 Bertram Road, Wellard Local Structure Plan Amendment
Client:	The Kings College

Plan Number:
EP20-047(07)--F27

Drawn:	GAR
Date:	06/11/2020
Checked:	TEM
Approved:	DPC
Date:	04/12/2020

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Metres

Scale: 1:4,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

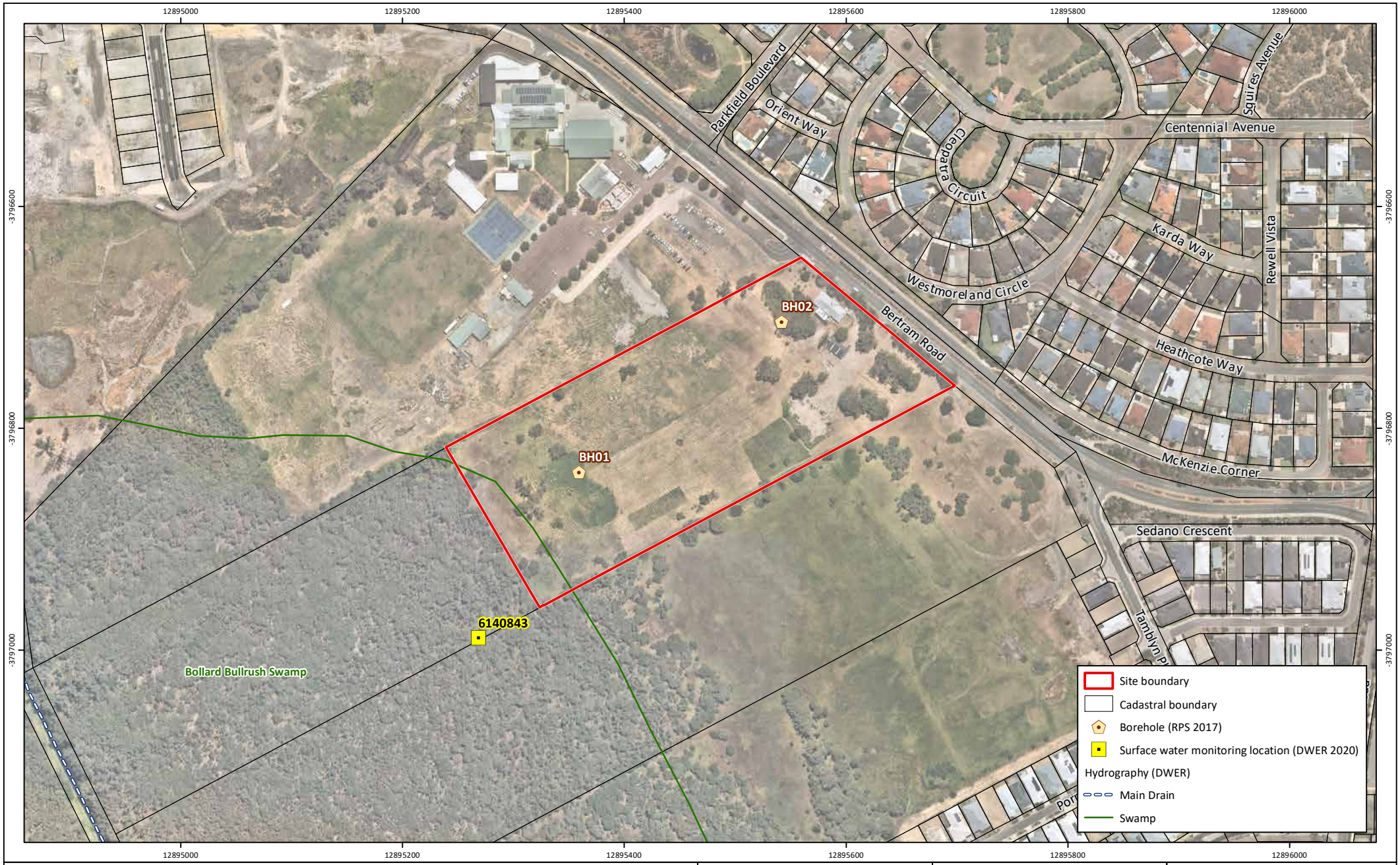

Figure 6: Existing Hydrological Features

Project: Local Water Management Strategy
Lot 500 Bertram Road, Wellard Local Structure Plan Amendment

Client: The Kings College

Plan Number:
EP20-047(07)--F28

Drawn:	GAR
Date:	06/11/2020
Checked:	TEM
Approved:	DPC
Date:	04/12/2020

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Metres

Scale: 1:4,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

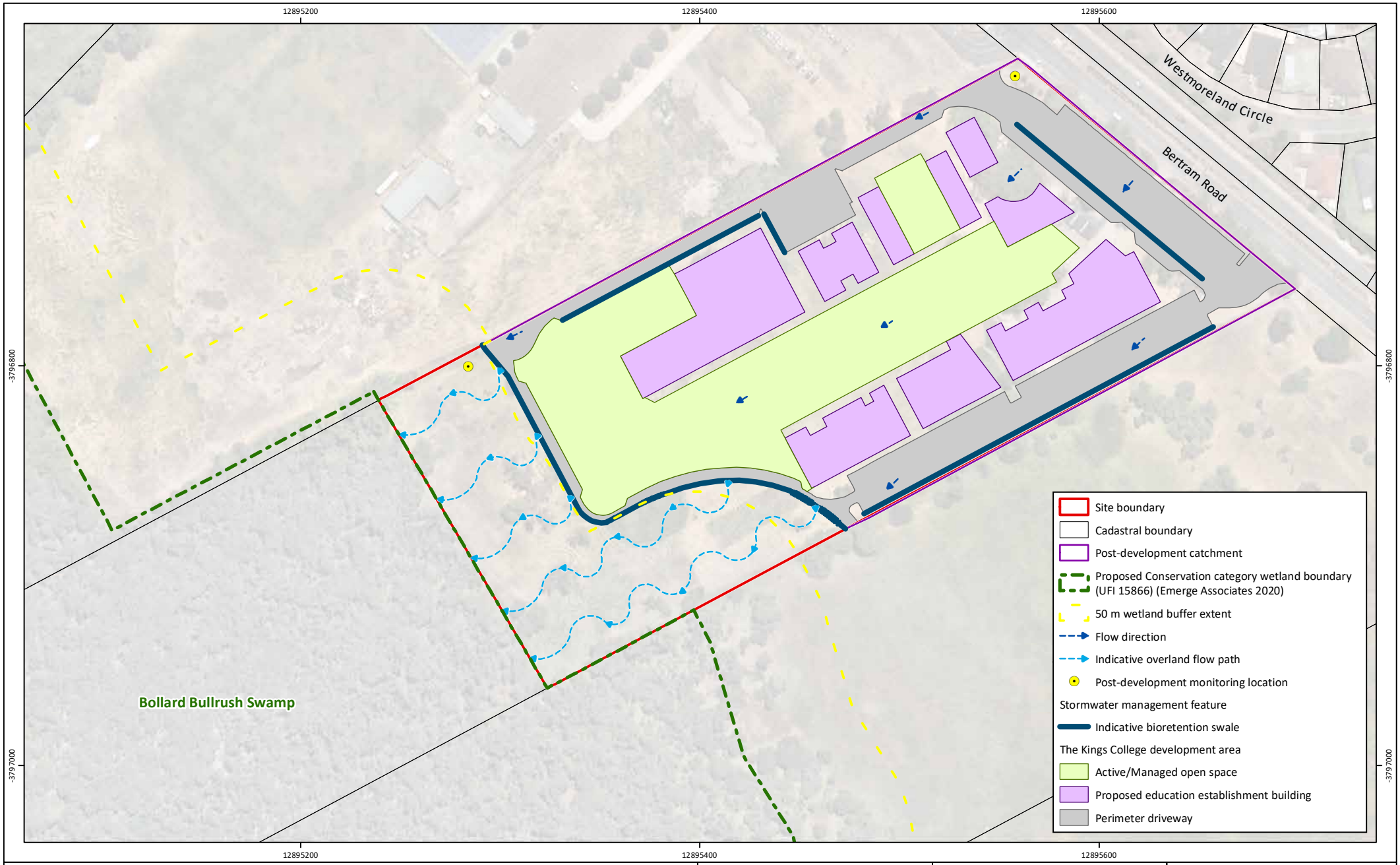


Figure 7: Stormwater Management Plan

Project: Local Water Management Strategy
Lot 500 Bertram Road, Wellard Local Structure Plan Amendment

Client: The Kings College

Plan Number:
EP20-047(07)--F31

Drawn:	GAR
Date:	19/11/2020
Checked:	TEM
Approved:	DPC
Date:	04/12/2020

N

0 25 50 75
Metres

Scale: 1:2,500@A4

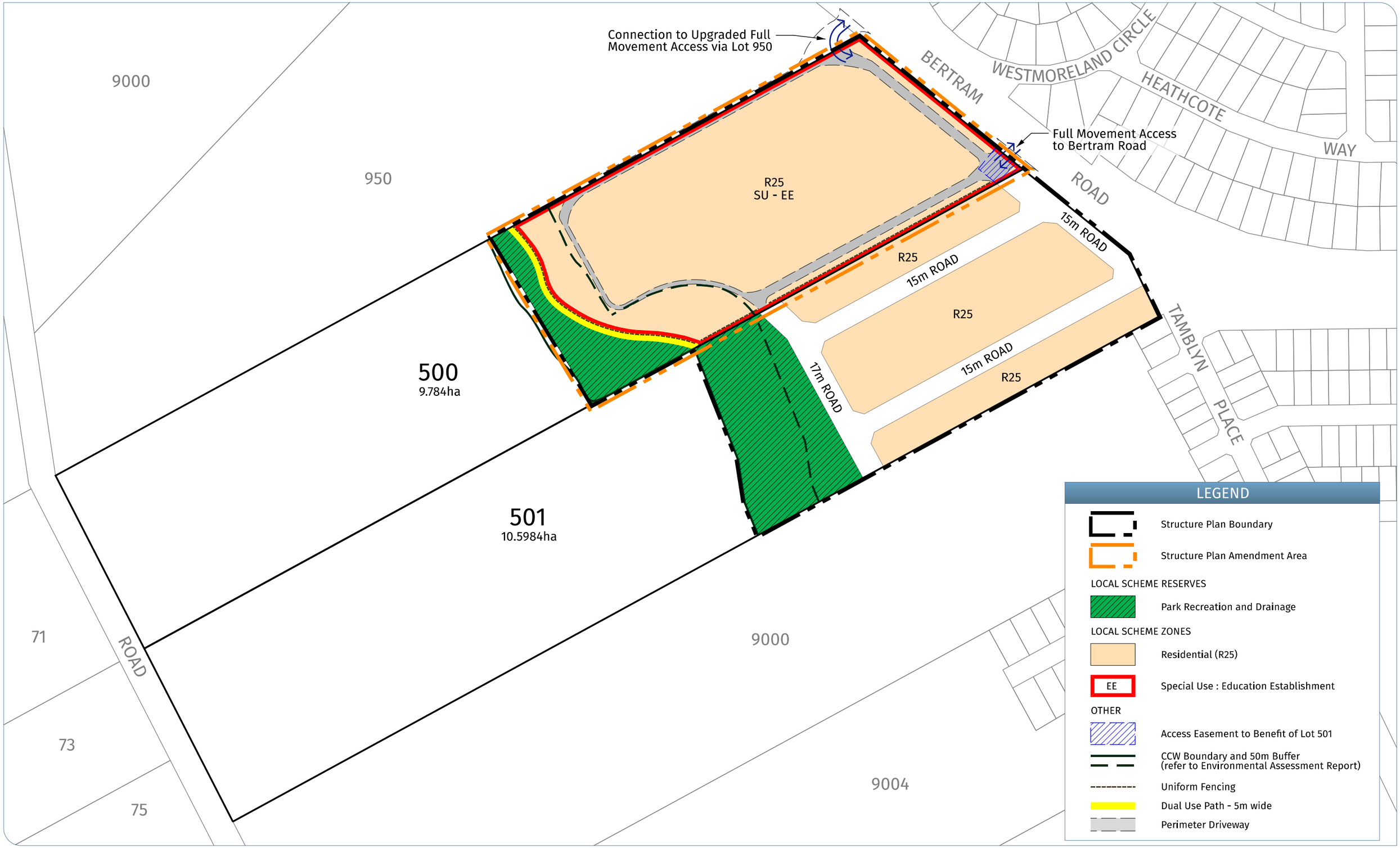
GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix A

Local structure plan

Prepared by Harley Dykstra (2020)



LEGEND

- Structure Plan Boundary
- Structure Plan Amendment Area

LOCAL SCHEME RESERVES

- Park Recreation and Drainage

LOCAL SCHEME ZONES

- Residential (R25)
- EE — Special Use : Education Establishment

OTHER

- Access Easement to Benefit of Lot 501
- CCW Boundary and 50m Buffer (refer to Environmental Assessment Report)
- Uniform Fencing
- Dual Use Path - 5m wide
- Perimeter Driveway

STRUCTURE PLAN

Lots 500 (No. 202) & 501 (No.214) Bertram Road, WELLARD

Plan No.	21968-04	
Date	27/10/20	
Drawn	NP	
Checked	DM	
Revision	A	
Scale	1:2500@A3	0 20m 40m 60m

PERTH & FORRESTDALE:
Lvl 1, 252 Fitzgerald St
PERTH WA 6000
15/2 Hensbrook Loop,
FORRESTDALE WA 6112
T: 08 9495 1947
E: metro@harleydykstra.com.au
ALBANY | BUNBURY | BUSSELTON | FORRESTDALE | PERTH

NOTE: This plan has been prepared for planning purposes. Areas, Contours and Dimensions shown are subject to survey

Harley Dykstra®
PLANNING & SURVEY SOLUTIONS

Appendix B

Masterplan

Prepared by Taylor Robinson Chaney Broderick (2020)

TAYLOR
ROBINSON
CHANEY
BRODERICK

The King's College 20020
Masterplan - Revised

The King's College
September 17, 2020

LEGEND

- SITE BOUNDARY
- REVEGETATED PLANTING 'A' TO WETLAND SIDE
- REVEGETATED PLANTING 'B' TO BUFFER SIDE
- DUAL USE PATH
- FIRE BREAK
- ADMIN
- CAFE / ALFRESCO
- PRIMARY CLASSROOMS
- GYM
- SWIMMING FACILITIES
- PERFORMING ARTS
- SCIENCE
- CANTEEN
- COOKING
- WORKSHOPS/ART
- PLACE OF WORSHIP

The King's College

Proposed Ground Floor Masterplan

Masterplan

1:1000 @ A3

20020

SK2

TAYLOR ROBINSON CHANEY BRODERICK

LEGEND

- SITE BOUNDARY
- REVEGETATED PLANTING 'A' TO WETLAND SIDE
- REVEGETATED PLANTING 'B' TO BUFFER SIDE
- DUAL USE PATH
- FIRE BREAK

- PRIMARY CLASSROOMS
- GYM
- LIBRARY
- SECONDARY CLASSROOMS
- PLACE OF WORSHIP
- DRAMA / MUSIC
- PERFORMING ARTS
- HUB

The King's College

Proposed First Floor Masterplan

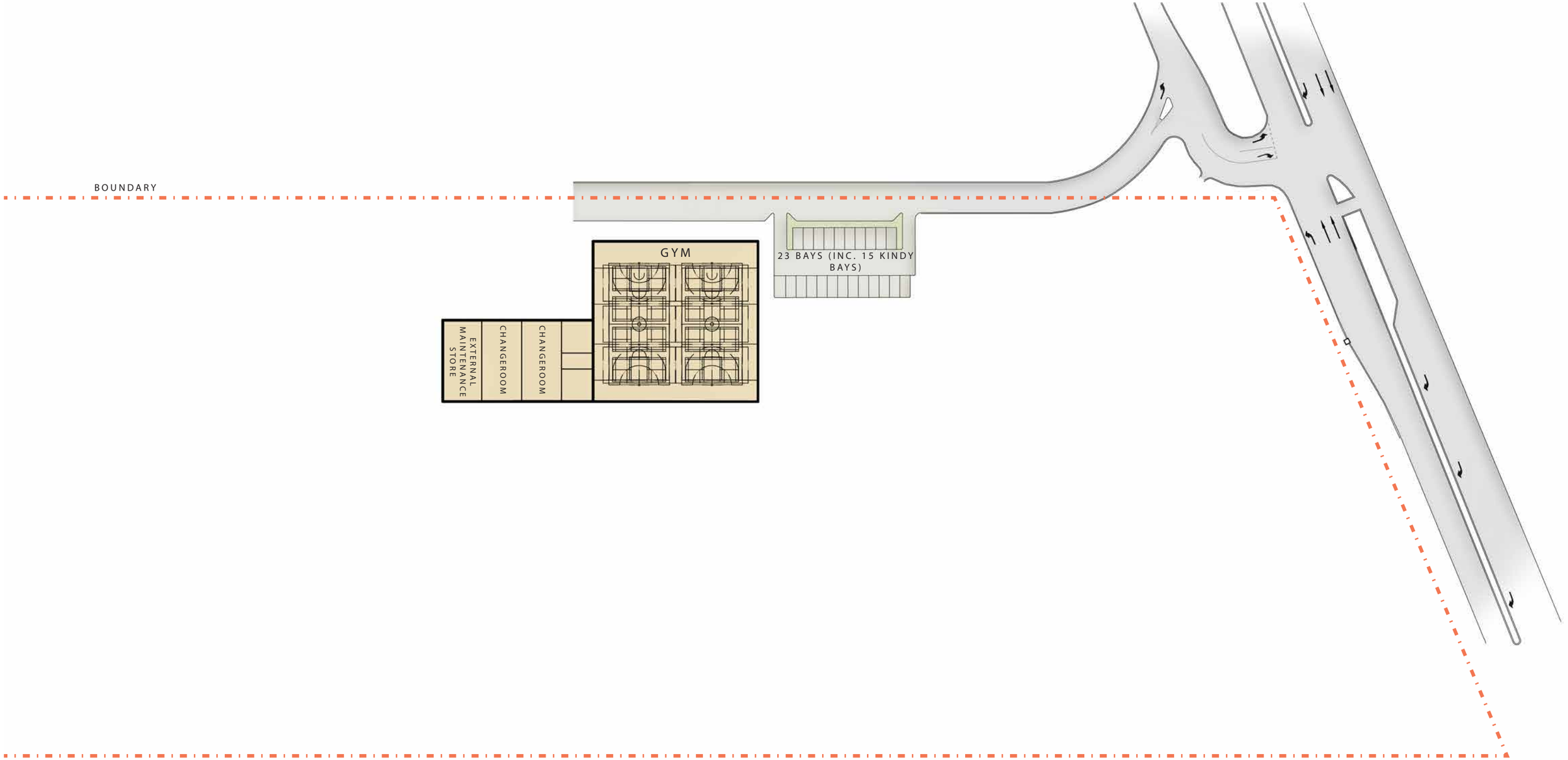
Masterplan

1:1000 @ A3

20020

SK3

TAYLOR ROBINSON CHANEY BRODERICK



The King's College

Proposed Stage One Masterplan

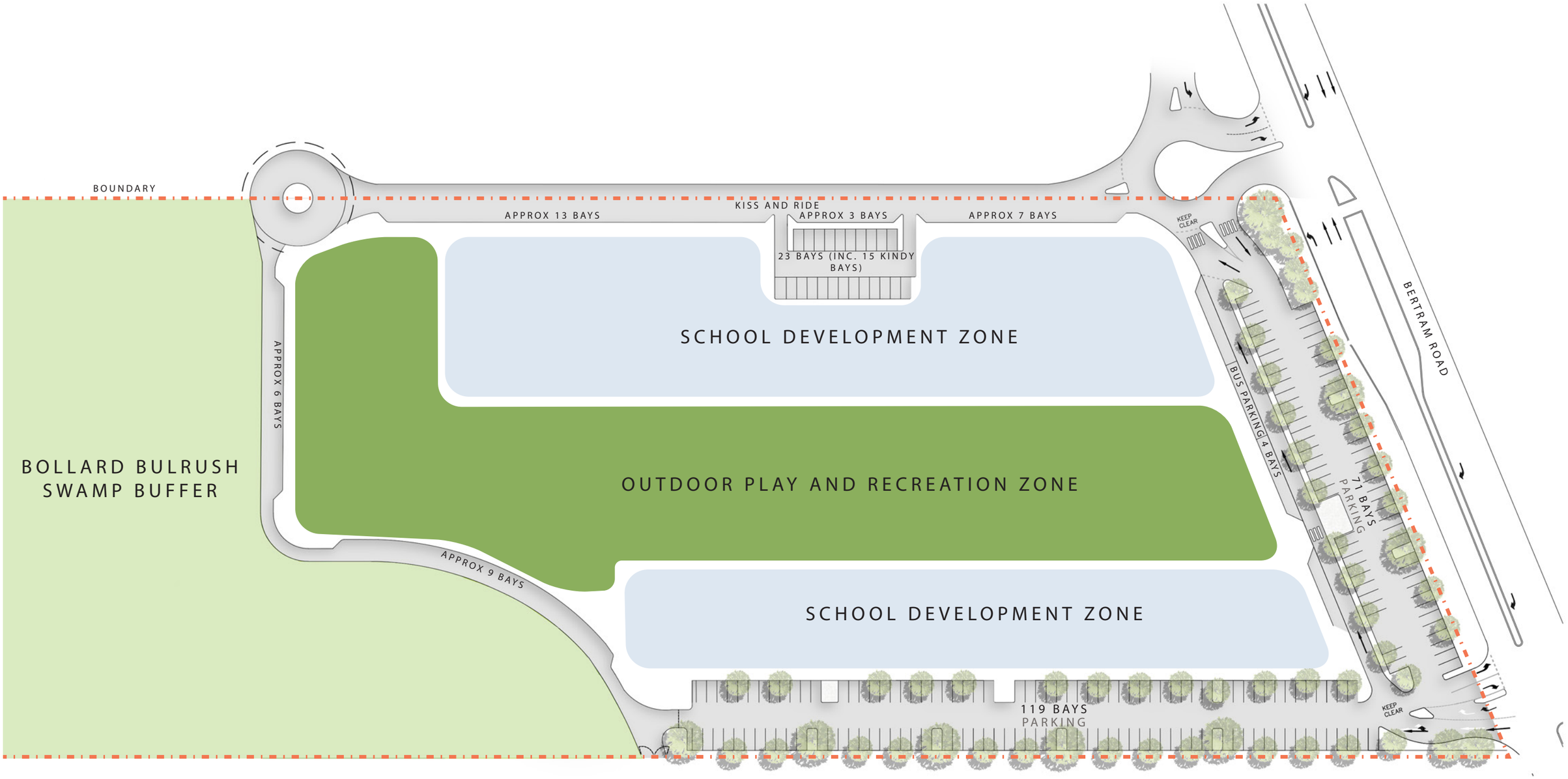
Masterplan

1:1000 @ A3

20020

SK4

TAYLOR ROBINSON CHANEY BRODERICK



The King's College

Proposed Masterplan for Structure Plan. Lot 500 Bertram Road, Wellard.

Masterplan

1:1000 @ A3

20020

SK5

TAYLOR ROBINSON CHANEY BRODERICK

Appendix C

Landscape Masterplan

Prepared by Emerge Associates (2020)

THE KINGS COLLEGE, BERTRAM ROAD, WELLARD

December 2020

Site Structure Plan Amendment

emerge ASSOCIATES

LOCATION PLAN

BACKGROUND:

The Kings College (the proponent) are progressing with an amendment to the existing Local Structure Plan over Lot 500 Bertram Road, Wellard to facilitate the development of The Kings College primary and secondary school. The existing Structure Plan for Lot 500 and 501, Bertram Road, Wellard, approved in 2017 was prepared in anticipation of the site being developed as for residential development, which will require an amendment to enable the proposed land use. The expansion of The Kings College will occur over the northern portion of Lot 500 Bertram Road, Wellard (the site).

The site is 5.00 hectares (ha) in size and is located approximately 32 km south of the Perth Central Business District, within the City of Kwinana. The site is located within a mixed urban and rural-residential area, with Bertram Road and urban development to the north, large rural-residential lots to the east, the Bollard Bulrush Swamp Conservation Category Wetland (CCW) (UFI 15866) and Peel Main Drain to the south, The Kings College buildings and sporting ovals and the Freeway Church to the west. The site is currently zoned 'Urban' under the Metropolitan Region Scheme (MRS), and 'Development', under the City of Kwinana Town Planning Scheme (TPS) No.2.

PURPOSE OF THIS REPORT:

The purpose of the Landscape Report is to provide a synthesis of information regarding the landscape values and attributes of the site. Specifically, this report:

- Identifies the landscape uses and attributes of the site
- Discusses the land use for the structure plan area.
- Discusses how the structure plan layout responds to the existing environmental features and values, and future landscape management requirements as part of the future planning and development process.
- Addresses the interface of the site with the adjacent wetland

LANDSCAPE MASTER PLAN:

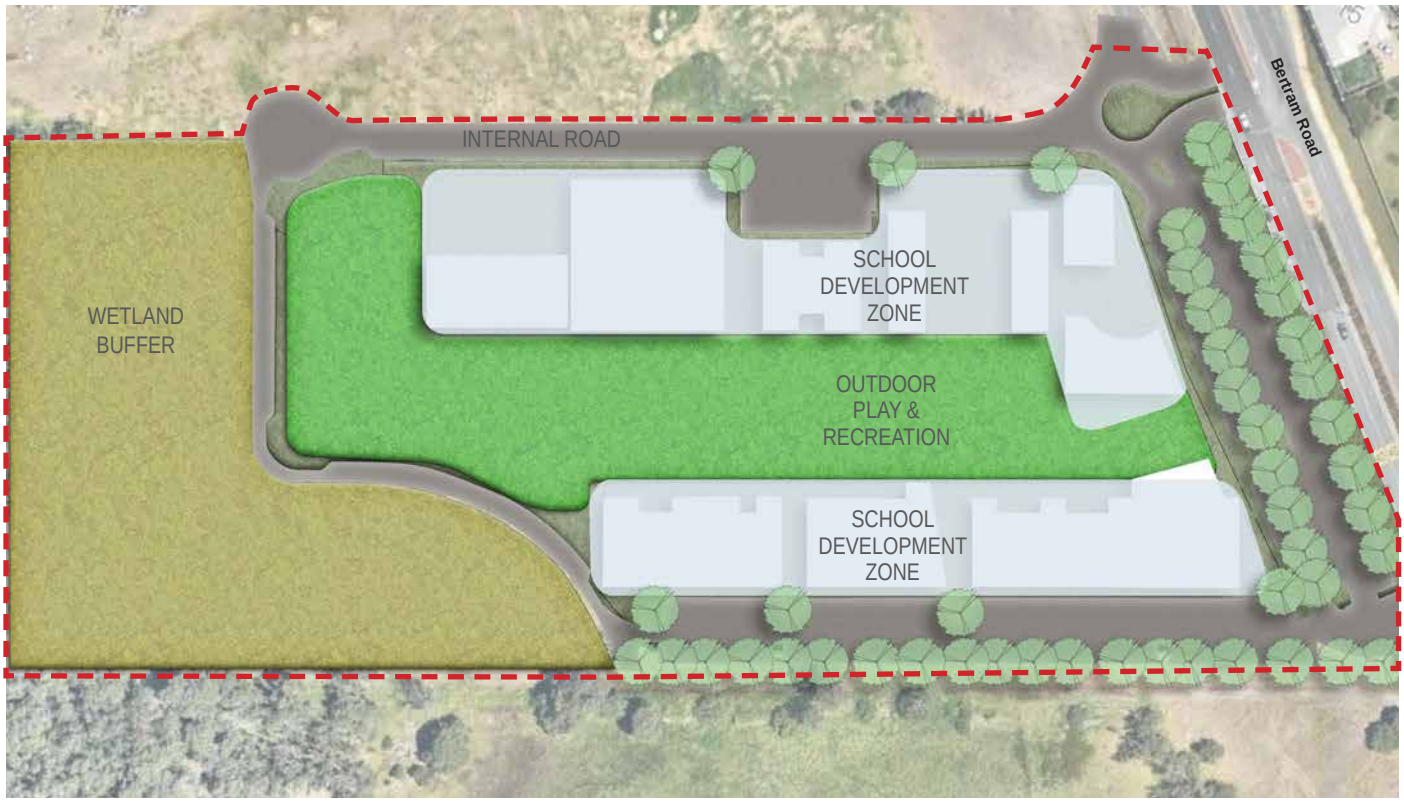
The landscape master plan offers a range of active and passive opportunities for the students of The Kings College, providing accessibility and connectivity throughout the site whilst also playing an important role in protecting the sites adjacent natural assets.

The plan provides connections both externally and internally to key nodes from the school, adjacent landowners and natural assets. Continuous pedestrian/cycling paths will link along the wetland in accordance with the Bollard Bulrush Wetland Masterplan and will include appropriate planting, amenities in the form of passive recreation opportunities and seating.

The plan identifies the requirement for a balanced approach to ensure the social and recreational requirements of the future students and users of Bollard Bulrush Wetland are balanced with the ecological and engineering constraints imposed by the site.

DWG ENVIRO-73
REV D
DATE DEC 2020

LANDSCAPE STRATEGY PLAN



LEGEND

- EXTENT OF WORKS
- INDICATIVE TREES

KINGS COLLEGE SUMMARY

SCHOOL DEVELOPMENT LANDSCAPE
- Turf area for active recreation
- Hard courts for play and active recreation
- Gathering spaces for students to congregate
- Play space and picnic facilities
- Pedestrian/Cycle Path network links to adjacent development.
- Planting appropriate to Education Department specification.

OUTDOOR PLAY & RECREATION
- Balance of native planted pockets and open turf areas
- Large gathering spaces beneath trees
- Informal seating spaces on walls or boulders
- Informal active recreation space

STREETSCAPE
- Predominantly native planted
- Trees planted in rows to provide shade for carparks
- Primary focus on providing shade and heavy green infrastructure

WETLAND BUFFER - 50m
- Balance of passive recreation areas incorporating native planting to comply with the requirements for low threat vegetation and the opportunity to retain mature trees.
- Revegetation of native plant species to a portion of the 50 m buffer at the Bollard Bulrush Swamp interface.

SITE STRUCTURE PLAN

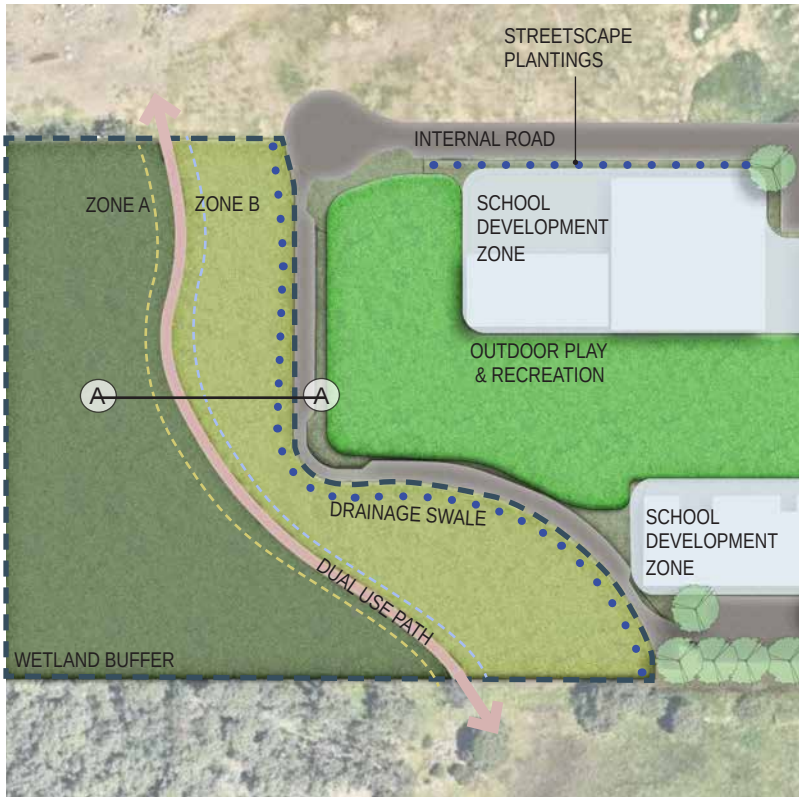
THE KINGS COLLEGE, BERTRAM ROAD WELLARD

DWG **ENVIRO-73**
REV **D**
DATE **DEC 2020**
0 25 50 75 100 m
SCALE **1 : 2000 @ A4**

emerge ASSOCIATES

CONNECTION BETWEEN SCHOOL AND BOLLARD BULLRUSH SWAMP

SWALE AND WETLAND BUFFER INTERFACE



CONCEPT

- Maintain and enhance the existing vegetation within a portion of the wetalnd buffer.
- Meandering dual use path runs the length of the wetland buffer and links to greater path networks
- Native seed planting within passive recreational open spaces between The Kings College and the wetland rehabilitation area, designed to achieve a low threat vegetation standard in accordance with AS3959
- Restricted access to wetland

FUNCTIONS

- Strategic revegetation
- Dual use path
- Provide linkages to pedestrian networks within and outside the development
- Drainage swale

ENVIRONMENTAL CONSIDERATIONS

- No irrigation
- Revegetation of native plant communities to a portion of the 50 m buffer (Zone A) at the Bollard Bulrush Swamp interface
- Removal of weed species
- A portion of the 50 m buffer (Zone B) will be landscaped to provide a managed interface to the wetland reserve. This area will be designed to achieve 'low threat' vegetation in accordance with Section 2.2.3.2 of AS 3959.

BOLLARD BULLRUSH SWAMP BUFFER

WETLAND BUFFER - 50m

- Balance of passive recreation open spaces incorporating planting to achieve a 'low threat' bushfire classification, in addition to rehabilitation planting at the interface of the Bollard Bullrush Swamp.
- Clearance provided for fire vehicle access
- Creating a connection from the school to the wetland, turning open spaces in to unique and welcoming places

DUAL USE PATH

- Provides secondary fire access between buffer and the school. Access points to core firebreak to be provided every 400m. DUP to align where possible with developers approved LSP plans.

ROADSIDE DRAINAGE SWALE

CONSERVATION FENCE AND LIMESTONE TRACK

SCHOOL BOUNDARY FENCE

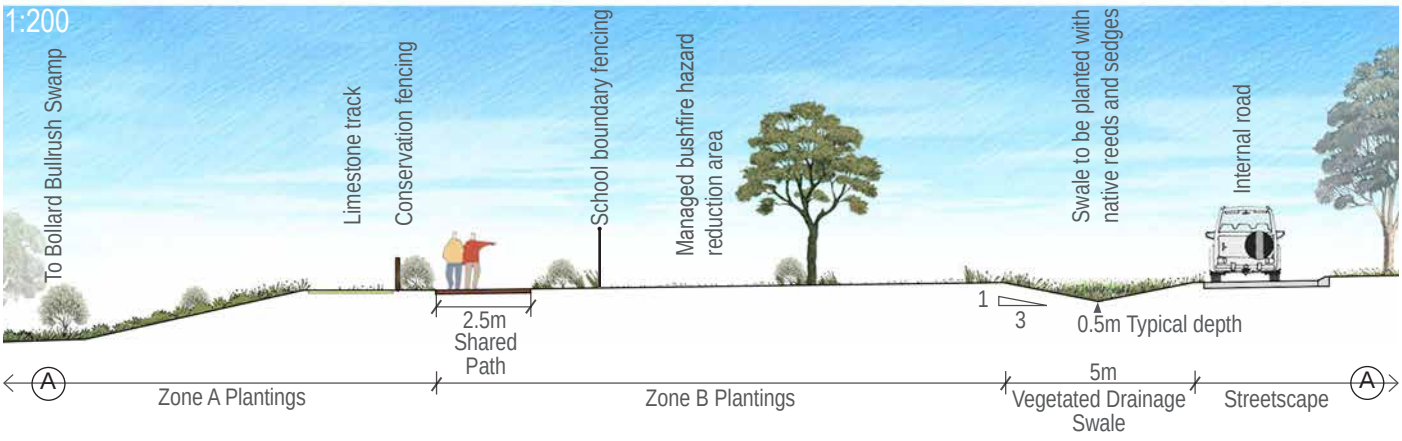
ZONE A

- Revegetation planting to wetland side
- Density of 1 plant mer m^2

ZONE B

- A passive recreation area between The Kings College and Bollard Bulrush Swamp (and the associated Wetland rehabilitation area), incorporating drainage and the opportunity to retain mature trees.
- Will be landscaped and maintained to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959.
- Average density of 1 plant per 2 m^2 but clumped around retained mature trees interspersed with areas of thick woodchip to suppress weeds.

INDICATIVE SECTION



SECTION A - INDICATIVE SECTION WHERE PATH IS LOCATED AT EDGE OF WETLAND BUFFER ZONE

- Sections are conceptual and are subject to change during the detailed design process
- Levels provided are indicative and subject to change during the detail design process

SITE STRUCTURE PLAN

THE KINGS COLLEGE, BERTRAM ROAD WELLARD

DWG ENVIRO-73
REV D
DATE DEC 2020
SCALE 1 : 2000 @ A4

emerge ASSOCIATES

PLANTING CONSIDERATIONS

- A range of native plant species that complement the surroundings have been selected.
- Plants chosen range from low, dense groundcovers to strappy leafed plants, grasses and small to medium sized shrubs.
- Plants native to the local area will provide colourful floral displays throughout the year and attract native birds to the area.
- The use of native plants will minimise maintenance and irrigation requirements and ensure long term plant survival.
- A portion of the 50 m buffer (Zone B) will be designed to achieve 'low threat' vegetation in accordance with Section 2.2.3.2 of AS 3959. and cross referenced with Councils preferred environmental planting suggestions.
- Clear views to the existing wetland trees will be maintained.

Groundcovers

Adenanthos cuneatus

Casuarina glauca

Calothamnus quadrifidus 'Little Ripper'

Calothamnus hirsutus

Convolvulus Moroccan

Erempohila glabra 'Kalbarri Carpet'

Grevillea Gingin Gem

Juniperus conferta

Eremophila glabra

Scaevola 'Purple Passion'

Shrubs

Adenanthos sericea dwarf

Olearia axillaris 'Little Smokie'

Calothamnus quadrifidus 'One-sided Bottlebrush'

Grevillea olivacea

Westringia grey box

Dianella revoluta 'Variegated'

Dianella 'Tas Red'

Melaleuca 'Little Nessie'

Lomandra Tanika

Lomandra wingarra

Trees

Agonis flexuosa

Eucalyptus sideroxylon

Eucalyptus torquata

Melaleuca quinquenervia

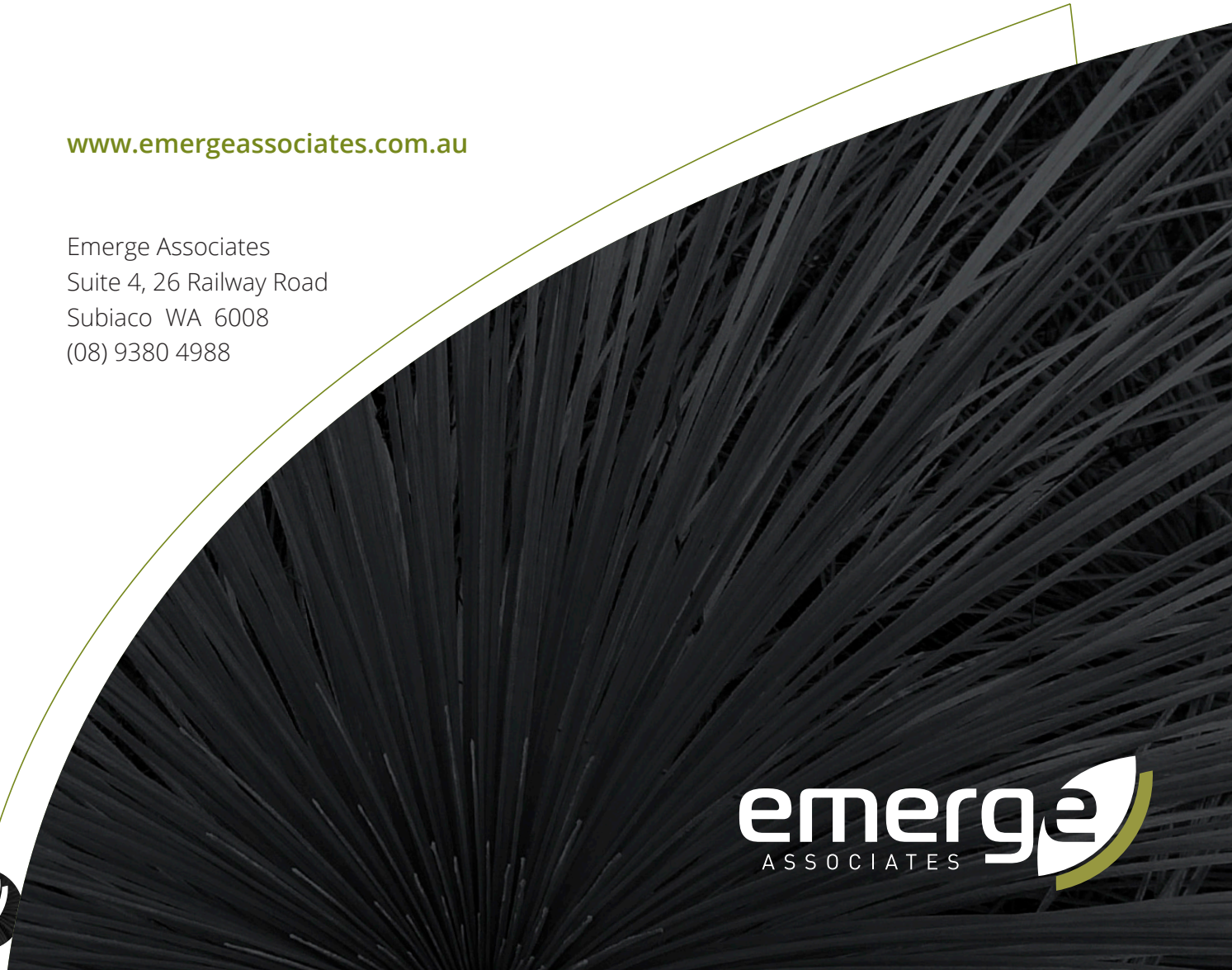
VTipuana tipu

DWG ENVIRO-73
REV D
DATE DEC 2020 SCALE NOT TO SCALE

emerge ASSOCIATES

www.emergeassociates.com.au

Emerge Associates
Suite 4, 26 Railway Road
Subiaco WA 6008
(08) 9380 4988



Appendix D

Geotechnical report

Prepared by Structerre (2015) and RPS (2017)

Doc: GE:2.3.001

PRELIMINARY GEOTECHNICAL INVESTIGATION

For: Bollard WA c/- EKS Solutions

Project Address:

Lot 502 Tamblyn Place and Lots 500 & 501 Bertram Road, Wellard

Project Number: D105651

Job Number: J153793

Revision Number: 0

Author: Amy Yates

Date: 16 March 2015

TABLE OF CONTENTS

1. PROJECT DETAILS

1.1. Introduction

At the request of Chris Sultana, Structerre Consulting Engineers (Structerre) have conducted a Preliminary Geotechnical Investigation at Lot 502 Tamblyn Place and Lots 500 & 501 Bertram Road, Wellard. The purpose of the investigation was to provide:

- A review of historical photographs;
- A desktop study on the potential of Acid Sulfate Soils (ASS);
- An assessment of the subsurface soil profile and groundwater conditions across the proposed area;
- The measurement of the depth of groundwater, if encountered;
- The site classification in accordance with AS 2870-2011 Residential slabs and footings;
- An assessment of the permeability rates across the site for the purposes of stormwater disposal design and provide recommendations on appropriate stormwater disposal system; and
- Preliminary recommendations on earthworks and site preparation.

This report details the scope of the preliminary geotechnical investigation, presents an interpretation of ground conditions and material properties across the site, provides geotechnical design parameters for the design of the proposed infrastructure, and evaluates the suitability of materials for use in earthworks. Interpretation of site conditions is based on the subsurface lithology revealed during the investigation programme, visual assessments of the in situ materials and the results of in situ field tests.

Terms of reference for this investigation were presented in a Structerre Consulting Engineers proposal reference Q53075 Rev 1 (dated 26 February 2015), which was submitted to and accepted by Chris Sultana on behalf of Bollard WA c/- EKS Solutions.

1.2. Site Description & Proposed Development

The site is located at Lot 502 Tamblyn Place and Lot 500 & 501 Bertram Road, Wellard, City of Kwinana. Bertram Place lies to the northeast of Lots 500 and 501 and Tamblyn Place lies to the northeast of Lot 502. Directly to the north of Lot 500 lies a church. To the southeast of Lot 502 lies a partially occupied site. To the southwest of the lots lies an area of dense vegetation. The site slopes downwards to the southwest.

At the time of field investigation, the east and south eastern part of Lot 501 was covered in tall grass, which prevented access.

We understand that the site is to be subdivided for residential purposes.

3. RESULTS OF THE INVESTIGATION

3.1. Subsurface Soil Profile Area 1

The subsurface soil profile for Area 1 was determined from the ground conditions encountered within SRP boreholes 3, 4, 5, 6, 7 and through the interpretation of DCP test results. The subsurface soil profile for Area1 is presented below:

Table 1 – Subsurface Soil Profile Area 1

Depth to Base of Strata (m)	Material Description
0.1 (Ave. 0.1)	FILL: Topsoil
0.0 – 0.4 (Ave. 0.3)	FILL: Silty SAND / SAND, non-plastic, trace organic material (fine roots)
Not Penetrated (>4.0m)	NATURAL: SAND, (fine to medium grained), trace silt, loose to medium dense

3.2. Subsurface Soil Profile Area 2

The subsurface soil profile for Area 2 was determined from the ground conditions encountered within SRP boreholes 1, 2, 8, 9, 10 and through the interpretation of DCP test results. The subsurface soil profile for Area 2 is presented below:

Table 2 – Subsurface Soil Profile Area 2

Depth to Base of Strata (m)	Material Description
0.1 (Ave. 0.1)	FILL: Topsoil
0.3 – 1.6 (Ave. 0.7)	FILL: Silty SAND, trace to with organic material (fine roots), loose to medium dense. (Possible Swamp Deposit)
0.3 – 1.6 (Ave. 0.7)	FILL: Silty SAND, trace to with organic material (fine roots), loose to medium dense. (Possible Swamp Deposit)
2.5 (Ave. 2.5)	Sandy CLAY, (fine to medium grained), with organic material (8.1%), loose (SRP1 only)
Not Penetrated (>4.0m)	SAND, (fine to medium grained), trace to with silt, medium dense

The soils encountered are consistent with the expected site conditions as predicted from the Environmental Geology Map. It is important to note that there may be pockets of fill on site that are deeper than that encountered by the investigation boreholes. The subsurface soil conditions encountered are presented in the bore logs, within Appendix 3.

3.3. Groundwater

Groundwater was encountered at depths of 0.8m to 1.5m below the existing ground surface level.

3.4. Laboratory Test Results

Selected soil samples were tested for Atterberg Limits and organic content, by Structerre's in-house NATA accredited laboratory. A copy of the results are presented in Appendix 3 and summarised below.

3.4.1. Atterberg Limits

The results of the testing are summarised below:

Table 3 – Atterberg Limit Test Results

Sample	Test Hole	Depth (m)	Soil Description	Liquid Limit % AS1289 3.1.2	Plastic Limit % AS1289 3.2.1	Plasticity Index % AS1289 3.3.1	Linear Shrinkage % AS1289 3.4.1
1	SRP1	1.6 – 2.3	Sandy CLAY	113	24	88	21

Test results indicate that the natural sandy CLAY has high shrink swell capacity or degree of expansion.

3.4.2. Organic Content

Sample	Test Hole	Depth (m)	Average Organic Content %	Moisture Content %
1	SRP1	1.6 – 2.3	8.1	55.9

3.4 Percolation Testing

Percolation testing of the in situ soils was undertaken in two locations. Results of the testing are summarised below:

Table 4 – In Situ Percolation Test Results

Test Location	Testing Depth	Soil Type	Permeability
PERC1	0.75m +	Silty SAND / SAND	10.7m/day
PERC2	0.75m +	SAND	7.1m/day
PERC3	0.75m +	Silty SAND / SAND	5.4m/day
PERC4	0.75m +	Silty SAND / SAND	*Test abandoned due to slow percolation rate

4. GEOTECHNICAL CONSTRUCTION CONSIDERATIONS

4.1. Site Classification

AS 2870-2011 Residential Slabs and Footings provides guidance on site classification for residential slabs and footing design based on the expected ground surface movement and depth of expected moisture changes.

Based on results of this investigation, in general Area 1 of the site can be classified as Class "A" provided that all unsuitable materials are removed and replaced with engineer-controlled sand fill materials in accordance with earthwork recommendations outlined in Section 4.3 in this report. However, Area 2 of the site would be classified as Class "P" which could be upgraded to a Class "S" providing the site is remediated as outlined in Section 4.3.

4.2. Drainage

The site is suitable for limited on-site disposal of stormwater runoff subject to the proposed development. For on-site disposal of stormwater runoff, soakwells of sufficient sizes are required, and should be positioned a minimum of 1.2m or the depth of soakwell (whichever is greater) from any proposed or existing foundations (including those beyond the boundaries of the site) to reduce the risk of differential settlement.

To aid with the design of on-site stormwater drainage, groundwater levels and field permeability results are presented in Section 3 of this report.

4.3. Earthworks

The ground conditions encountered during this preliminary investigation shows that Area 1 of the site will require standard earthworks, and Area 2 will require a more in depth approach.

4.3.1. Area 1 - Standard Earthworks

All earthworks shall be undertaken in accordance with AS 3798-2007 Guidelines on Earthworks For Commercial and Residential Developments and are to include the following:

- All unsuitable materials to be stripped and removed from the site. Unsuitable materials include topsoil, deleterious and organic materials.
- It is considered that the near surface potentially uncontrolled sand FILL requires improvement. Therefore, it is proposed to excavate and stockpile the materials for reuse, provided it is free from deleterious / organic materials. The depth of excavation may very depending on conditions encountered and is subject to inspection.
- Excavations should not exceed 2.0m and / or undermine surrounding structures. A 1V:2H slope should be maintained for temporary excavations. If excavation is required closer than the 1V:2H slope would allow, it is recommended that this office be contacted for retaining design.
- Proof compact the exposed base. The compaction requirements are set out in the table below, as per AS 3798-2007:

Table 5 – Compaction Requirements

Item	Application	Minimum relative compaction, %	
		Minimum density ratio (Standard Compaction Effort) (Cohesive soils)	Minimum density index (Cohesionless soils)
1	Residential - lot, fill, house, sites	95	70
2	Commercial – fills to support minor loadings, including floor loading of up to 20kPa and isolated pad or strip footings to 100kPa	98	75
3	Fill to support pavements a) General fill b) Subgrade (to a depth of 0.3m)	 95 98	 70 75

- After excavation and proof compaction, the excavated base is to be inspected and approved by a representative from this office prior to backfilling. At this stage it can be assessed whether any further materials need to be removed or whether further compaction of the base is required.
- The ground level should be built up to design levels with the stockpiled sand materials and imported fill. If required, the imported fill should consist of free draining sand with not more than 5% passing a 75µm sieve and be free of organic matter and other deleterious materials. The fill sand materials should be placed in layers not exceeding 300mm loose thickness and compacted to achieve a minimum 8 PSP blows over the interval 150 – 450mm, 9 PSP blows over the interval 450 – 750mm and 11 PSP blows over the interval 750 – 1050mm.
- After remedial earthworks have been completed, the earthworks should be inspected and approved by a representative from this office.

4.3.2. Area 2 - Additional Earthworks

Soft compressible swampy material was encountered within SRP1. It is considered that ground improvement methods, such as high impact energy dynamic compaction (HIEDYC) or surcharging may be utilised to improve the ground conditions to a standard suitable for residential development. However, further investigation is required to delineate the soft compressible materials and confirm the appropriate earthwork remediation method.

5. CONCLUSIONS

A site investigation was carried out at the proposed commercial development site to assess the geotechnical conditions. Parameter and design recommendations are incorporated in the body of the report. The following conclusions have been drawn from the site investigation:

- The average subsurface soil profile within Area 1 encountered comprised topsoil to 0.1m, silty sand to sand FILL to 0.3m, underlain by loose to medium dense NATURAL sand to the investigated depth of 4.0m
- The average subsurface soil profile within Area 2 encountered comprised topsoil to 0.1m, loose to medium dense silty sand to 0.5m, sandy clay with organics to 2.5m, underlain by medium dense NATURAL sand to the investigated depth of 4.0m
- Groundwater was encountered in SRP1, SRP3, SRP7, SRP8 and SRP10 at a depth of 1.5m, 1.4m, 1.2m, 0.8m and 1.1m, respectively.
- The site can be classified as an equivalent Class “P” in accordance with AS 2870-2011 but Area 1 can be upgraded to Class “A” and Area 2 could be upgraded to Class “S”, if the recommended earthworks are undertaken.
- It is considered that the site is suitable for limited on-site drainage subject to the proposed development.
- Recommended earthworks include stripping of fill sand and unsuitable materials, excavation of loose materials, proof compaction of the base, placement of engineered fill and compaction of final level.
- As this is a preliminary investigation, it is recommended that a more comprehensive geotechnical investigation take place. The fieldwork for this can be undertaken at the same time as an ASS investigation should one be required.

6. LIMITATION OF FIELD INVESTIGATIONS

This report has been prepared in accordance with generally accepted consulting practice for Bollard WA c/- EKS Solutions using information supplied at the time and for the project specific requirements as understood by Structerre. To the best of our knowledge the information contained in this report is accurate at the date of issue, however it should be emphasised that any changes to ground conditions and/or the proposed structures may invalidate the recommendations given herein.

The conclusions and recommendations in this report are based on the site conditions revealed through selective point sampling, representing the conditions of the site in total, although the area investigated represents only a small portion of the site. The actual characteristics may vary significantly between successive test locations and sample intervals other than where observations, explorations and investigations have been made.

The materials and their geotechnical properties presented in this report may not represent the full range of materials and strengths that actually exist on site and the recommendations should be regarded as preliminary in nature. Allowances should be made for variability in ground conditions and any consequent impact on the development. Structerre accepts no responsibility and shall not be liable for any consequence of variations in ground conditions.

If ground conditions encountered during construction are different to that described in this report, this office should be notified immediately.

For and behalf of

STRUCTERRE CONSULTING ENGINEERS

Author: Amy Yates
Title: Engineering Geologist
Credentials: BSc Geological Sciences (Hons)

Authorised By: Robert Grant
Title: Geotechnical Section Manager
Credentials: BEng (Hons), MSc (Eng)

Job #	Revision	Authored	Checked	Authorised
J153793	0	AY	RG	RG

7. REFERENCES

Department of Water – Perth Groundwater Atlas

Geological Survey of Western Australia 1:50,000 Environmental Geology Series

AS 1170.4-2007 Structural design actions – Earthquake actions in Australia

AS 1289.3.1.2-2009 Methods of testing soils for engineering purposes – Soil classification tests – Determination of the liquid limit of a soil

AS 1289.3.2.1-2009 Methods of testing soils for engineering purposes – Soil classification tests – Determination of the plastic limit of a soil

AS 1289.3.3.1-2009 Methods of testing soils for engineering purposes – Soil classification tests – Calculation of the plasticity index of a soil

AS 1289.3.4.1-2009 Methods of testing soils for engineering purposes – Soil classification tests – Determination of the linear shrinkage of a soil

AS 1289.6.3.2-1997 Methods of testing soils for engineering purposes – Soil strength and consolidation tests – Determination of the penetration resistance of a soil – 9kg dynamic cone penetrometer test

AS 1726-1993 Geotechnical site investigation

AS 2870-2011 Residential slabs and footings

AS 3798-2007 Guidelines on earthworks for commercial and residential developments

AS 4055-2012 Wind loads for housing

Landgate

APPENDIX 1 – SITE LOCATION MAP

LEGEND

SRP:	Sample Retrival Probe
DCP:	Dynamic Cone Penetrometer Test
PERC:	Percolation Test

Note: Showing approximate test locations only

N

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PROJECT:	Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard
PROJECT #:	D105651
CLIENT:	**Bollard WA**
JOB #:	J153793
SCALE:	NTS
TITLE:	Geotechnical Investigation
DATE:	04/03/2015
DRAWN BY:	HK
CHECKED BY:	AY

LEGEND

SRP:	Sample Retrival Probe
DCP:	Dynamic Cone Penetrometer Test
PERC:	Percolation Test

Note: Showing approximate test locations only

N

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PROJECT: Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard

PROJECT #: D105651

JOB #: J153793

CLIENT: **Bollard WA**

SCALE: NTS

TITLE: Geotechnical Investigation

DATE: 04/03/2015

DRAWN BY: HK

CHECKED BY: AY

APPENDIX 2 – BORELOGS

PROJECT SITE: **Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard**	Job No: **J153793** Project No: **D105651**	GPS: E: 0390822 N: 6430739	TEST HOLE No. **SRP1**

SOIL BORELOG

DOC:GE3.010

DEPTH (M)	GEO. INTER.	USCS	DESCRIPTION OF SOIL	GRAPHIC LOG	MOISTURE	WATER LEVEL	DYNAMIC CONE PENETROMETER (BLOWS/150mm)
		—	TOPSOIL				10
	FILL	SM	Silty SAND; (fin to medium grained), non-plastic, dark grey, trace organic material (fine roots), dense to medium dense, dry to moist (Possible swamp deposits)		D - M	W.T. @1.5m 04/03/15	11 8 8 5 6 5 3 3
2.0	SWAMP	CH	Sandy CLAY; (high plasticity), dark grey with patchy green, with organic material (8.1%), loose, moist		M		5 3 3 2 3
4.0	BASSENDEAN SAND	SP	SAND; (fin to medium grained), no-plastic, pale grey with mottled grey/brown, trace silt, moist to wet		M-W		4 5 15 15+ Refusal @ 2370mm
6.0			End of Borehole @ 4.0m (Target Depth)				

Comments:

DRILLED BY:	LOGGED BY:	APPROVED BY:	DATE DRILLED:	DRILL METHOD:
BEW	HK	AY	04/03/2015	Sample Retrieval Probe

PROJECT SITE: **Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard**	Job No: **J153793** Project No: **D105651**	GPS: E: 0390949 N: 6430813	TEST HOLE No. **SRP2/ PERC1**

SOIL BORELOG

DOC:GE3.010

DEPTH (M)	GEO. INTER.	USCS	DESCRIPTION OF SOIL	GRAPHIC LOG	MOISTURE	WATER LEVEL	DYNAMIC CONE PENETROMETER (BLOWS/150mm)
	SWAMP BASSENDEAN SAND	—	TOPSOIL			DRY 04/03/15	
		SM	Silty SAND; (fin to medium grained), non-plastic, dark grey, trace organic material (fine roots), dry to moist		D - M		
		SP	SAND; (fin to medium grained), non plastic, patchy light grey, trace silt, dry to moist		D - M		
2.0			End of Borehole @ 1.0m (Target Depth for Percolation)				
4.0							
6.0							

Comments:

DRILLED BY:	LOGGED BY:	APPROVED BY:	DATE DRILLED:	DRILL METHOD:
BEW	HK	AY	04/03/2015	Sample Retrieval Probe

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PROJECT SITE: **Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard**	Job No: **J153793** Project No: **D105651**	GPS: E: 0391016 N: 6430746	TEST HOLE No. **SRP3**

SOIL BORELOG

DOC:GE3.010

DEPTH (M)	GEO. INTER.	USCS	DESCRIPTION OF SOIL	GRAPHIC LOG	MOISTURE	WATER LEVEL	DYNAMIC CONE PENETROMETER (BLOWS/150mm)
		—	TOPSOIL				5
	FILL	SM	Silty SAND; (fin to medium grained), non-plastic, brown/grey, trace organic material (fine roots), dense, dry to moist		D - M		8
			SAND; (fin to medium grained), non plastic, pale grey, trace silt, loose, dry to moist		D - M	W.T @1.4m 04/03/15	7
							4
							4
							5
							4
							4
			- moist to wet				5
	BASSENDEAN SAND		- mottled brown/grey, medium dense				4
2.0							7
							8
							12
					M-W		16
							20
		SP					15+
							Refusal @ 2360mm
4.0			End of Borehole @ 4.0m (Target Depth)				
6.0							

Comments:

DRILLED BY:	LOGGED BY:	APPROVED BY:	DATE DRILLED:	DRILL METHOD:
BEW	HK	AY	04/03/2015	Sample Retrieval Probe

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PROJECT SITE: **Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard**	Job No: **J153793** Project No: **D105651**	GPS: E: 0391119 N: 6430702	TEST HOLE No. **SRP4/ PERC2**

SOIL BORELOG

DOC:GE3.010

DEPTH (M)	GEO. INTER.	USCS	DESCRIPTION OF SOIL	GRAPHIC LOG	MOISTURE	WATER LEVEL	DYNAMIC CONE PENETROMETER (BLOWS/150mm)
		—	TOPSOIL				
	FILL	SP	SAND; (fin to medium grained), non-plastic, grey, with silt, trace organic material (fine roots), dry		D	DRY 04/03/15	
	BASSENDEAN SAND	SP	SAND; (fin to medium grained), non plastic, pale grey, trace silt, dry		D		
2.0			End of Borehole @ 1.0m (Target Depth for Percolation)				
4.0							
6.0							

Comments:

DRILLED BY:	LOGGED BY:	APPROVED BY:	DATE DRILLED:	DRILL METHOD:
BEW	HK	AY	04/03/2015	Sample Retrieval Probe

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PROJECT SITE: **Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard**	Job No: **J153793** Project No: **D105651**	GPS: E: 0391155 N: 6430643	TEST HOLE No. **SRP5**

SOIL BORELOG

DOC:GE3.010

DEPTH (M)	GEO. INTER.	USCS	DESCRIPTION OF SOIL	GRAPHIC LOG	MOISTURE	WATER LEVEL	DYNAMIC CONE PENETROMETER (BLOWS/150mm)
		—	TOPSOIL				8
	BASSENDEAN SAND		SAND; (fin to medium grained), non-plastic, pale grey, trace silt, medium dense, dry to moist		D - M		7
							7
							8
							8
							7
							6
							8
							6
							5
2.0		SP				DRY 04/03/15	5
			- pale brown, moist to wet				5
							5
							5
							8
							8
			- pale grey, moist to wet		M - W		8
							8
							9
							9
							9
							Target depth @3150mm
4.0			End of Borehole @ 4.0m (Target Depth)				
6.0							

Comments:

DRILLED BY:	LOGGED BY:	APPROVED BY:	DATE DRILLED:	DRILL METHOD:
BEW	HK	AY	04/03/2015	Sample Retrieval Probe

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PROJECT SITE: **Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard**	Job No: **J153793** Project No: **D105651**	GPS: E: 0391199 N: 6430526	TEST HOLE No. **SRP6/ PERC3**

SOIL BORELOG

DOC:GE3.010

DEPTH (M)	GEO. INTER.	USCS	DESCRIPTION OF SOIL	GRAPHIC LOG	MOISTURE	WATER LEVEL	DYNAMIC CONE PENETROMETER (BLOWS/150mm)
	FILL	—	TOPSOIL				
		SM	Silty SAND; (fine grained), non-plastic, grey, trace organic material (fine roots), dry		D	DRY 04/03/15	
	BASSENDEAN SAND	SP	SAND; (fin to medium grained), non plastic, pale grey, trace silt, dry to moist		D-M		
2.0			End of Borehole @ 1.0m (Target Depth for Percolation)				
4.0							
6.0							

Comments:

DRILLED BY:	LOGGED BY:	APPROVED BY:	DATE DRILLED:	DRILL METHOD:
BEW	HK	AY	04/03/2015	Sample Retrieval Probe

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PROJECT SITE: **Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard**	Job No: **J153793** Project No: **D105651**	GPS: E: 0391137 N: 6430556	TEST HOLE No. **SRP7**

SOIL BORELOG

DOC:GE3.010

DEPTH (M)	GEO. INTER.	USCS	DESCRIPTION OF SOIL	GRAPHIC LOG	MOISTURE	WATER LEVEL	DYNAMIC CONE PENETROMETER (BLOWS/150mm)
	FILL	—	TOPSOIL		D - M	W.T. @ 1.2m 04/03/15	2
		SP	SAND; (fin to medium grained), non-plastic, yellow / brown, trace silt, trace organic material (fine roots), very loose, dry to moist				3
		SP	SAND; (fin to medium grained), low plasticity, dark grey and brown, trace silt, with organic material (fine roots), medium dense, dry to moist				6
	BASSENDEAN SAND		- non plastic, pale grey, no organics, pale brown moist to wet				9
							6
							5
							6
							6
							7
							6
2.0		SP					6
							7
							7
							11
			- brown and grey, moist to wet		M - W		12
							15+
							Refusal @2280mm
4.0			End of Borehole @ 4.0m (Target Depth)				
6.0							

Comments:

DRILLED BY:	LOGGED BY:	APPROVED BY:	DATE DRILLED:	DRILL METHOD:
BEW	HK	AY	04/03/2015	Sample Retrieval Probe

PROJECT SITE: **Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard**	Job No: **J153793** Project No: **D105651**	GPS: E: 0391055 N: 6430464	TEST HOLE No. **SRP8**

SOIL BORELOG

DOC:GE3.010

DEPTH (M)	GEO. INTER.	USCS	DESCRIPTION OF SOIL	GRAPHIC LOG	MOISTURE	WATER LEVEL	DYNAMIC CONE PENETROMETER (BLOWS/150mm)
		—	TOPSOIL				3
	SWAMP	SM	Silty SAND; (fin to medium grained), non-plastic, grey, trace organic material (fine roots), loose, dry to moist		D - M	W.T. @ 0.8m 04/03/15	5
	BASSENDEAN SAND	SP	SAND; (fin to medium grained), non-plastic, mottled and pale grey, trace silt, medium dense, moist to moist				6
							8
							6
							7
							6
							6
							6
							7
2.0					M - W		6
							7
							6
							8
							10
							9
							11
							12
							11
							12
							12
							Target depth 3150mm
4.0			End of Borehole @ 4.0m (Target Depth)				
6.0							

Comments:

DRILLED BY:	LOGGED BY:	APPROVED BY:	DATE DRILLED:	DRILL METHOD:
BEW	HK	AY	04/03/2015	Sample Retrieval Probe

PROJECT SITE: **Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard**	Job No: **J153793** Project No: **D105651**	GPS: E: 0391007 N: 6430546	TEST HOLE No. **SRP9/ PERC4**

SOIL BORELOG

DOC:GE3.010

DEPTH (M)	GEO. INTER.	USCS	DESCRIPTION OF SOIL	GRAPHIC LOG	MOISTURE	WATER LEVEL	DYNAMIC CONE PENETROMETER (BLOWS/150mm)
	SWAMP	—	TOPSOIL				
		SM	Silty SAND; (fine grained), low to medium plasticity, brown and grey, with organic material (fine roots), dry to moist		D-M	DRY 04/03/15	
	BASSENDEAN SAND	SP	SAND; (fin to medium grained), non plastic, grey to pale grey, trace silt, trace organic material (fine roots), dry to moist		D-M		
2.0			End of Borehole @ 1.0m (Target Depth for Percolation)				
4.0							
6.0							

Comments:

DRILLED BY:	LOGGED BY:	APPROVED BY:	DATE DRILLED:	DRILL METHOD:
BEW	HK	AY	04/03/2015	Sample Retrieval Probe

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PROJECT SITE: **Lots 500 & 501 Bertram Road and Lot 502 Tamblyn Place, Wellard**	Job No: **J153793** Project No: **D105651**	GPS: E: 0391055 N: 6430464	TEST HOLE No. **SRP10**

SOIL BORELOG

DOC:GE3.010

DEPTH (M)	GEO. INTER.	USCS	DESCRIPTION OF SOIL	GRAPHIC LOG	MOISTURE	WATER LEVEL	DYNAMIC CONE PENETROMETER (BLOWS/150mm)
	SWAMP	—	TOPSOIL				5
		SM	Silty SAND; (fin to medium grained), non-plastic, grey, with organic material (fine roots), medium dense, dry to moist		D - M		9
	BASSENDEAN SAND	SP	SAND; (fin to medium grained), low to medium plasticity, dark grey, with silt, with organic material (fine roots), medium dense, dry to moist			W.T. @ 1.1m 04/03/15	11
							8
							4
			- non-plastic, brown, trace silt, no organics, moist to wet				8
							10
							13
							10
							8
2.0					M - W		12
							10
							10
							12
							13
							12
							16
							13
							13
							13
							12
							Target depth 3150mm
4.0			End of Borehole @ 4.0m (Target Depth)				
6.0							

Comments:

DRILLED BY:	LOGGED BY:	APPROVED BY:	DATE DRILLED:	DRILL METHOD:
BEW	HK	AY	04/03/2015	Sample Retrieval Probe

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APPENDIX 3 – LABORATORY TEST RESULTS

Sample No.	**25033**	**Client**	Geotechnical / Bollard WA c/- EKS Solutions
Job No.	J153793	**Project**	Lot 502, 500&501 Tamblyn Pl and Bertram Rd, Wellard

SAMPLE DETAILS

BH No. / Depth : SRP1 1.6-2.3m

Sample History : Air Dried ☐ 50°C Oven Dried ☒ Sample Preparation AS 1289 1.1

ATTERBERG LIMITS

Description	Method	Result (%)
Liquid Limit	AS 1289.3.1.2	113
Plastic Limit	AS 1289.3.2.1	24
Plasticity Index	AS 1289.3.3.1	88
Linear Shrinkage	AS 1289.3.4.1	21
Nature of Shrinkage		Curling

PARTICLE SIZE DISTRIBUTION

Method: AS 1289.3.6.1

Description: Particle size distribution by sieve analysis

Sieve Size (mm)	% Passing
19.0	100
2.36	100
0.425	86
0.075	68

Material Description: sandy CLAY of high plasticity

USC Group Symbol: CH

Accredited for compliance with ISO/IEC 17025

NATA

WORLD RECOGNISED ACCREDITATION
STRUCTERRE CONSULTING ENGINEERS BALCATTA LABORATORY ACCREDITATION NUMBER 18742

Signatory: _____ **Date:** 10-Mar-15

Grandier Billot

AS 1289.3.6.1 SAW Rev 1NATA Jan-15

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Material Test Certificate

Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

Report Number	S737754	**Client**	Geotech / Bollard WA c/-EKS Solutions
Site Office Job Number	S737754	**Project**	Lot 502 TAMBLYN PL & 500&501 Bertram Rd -WELLARD

Laboratory Number	S737754-1				
Sample					
Average organic content %	8.1				
Moisture Content %	55.9				

Laboratory Number					
Sample					
Average organic content %					

Remarks:

ASTM D 2974 Method C Method A
Furnace Temperature 440 °C

Date Wednesday, 11 March 2015

Authorised Signatory

Grandier Billot

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Phone (+618) 9205 4500 | Fax (+618) 9205 4501 | Email wageotechlab@structerre.com.au | Web www.structerre.com.au

APPENDIX 4 – BORELOG TERMINOLOGY

STRUCterre consulting engineers

Residential | Geotechnical | Commercial & Infrastructure

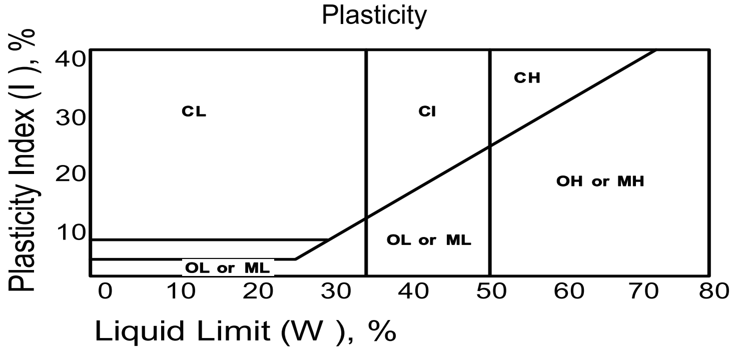
Inspect & Investigate | Energy Assessment | Environmental

BORELOG TERMINOLOGY

Particle Size Distribution

Major Division	Subdivision	Size
Boulders		>200mm
Cobbles		200 - 63mm
Gravel	Coarse	63 - 20mm
	Medium	20- 6mm
	Fine	6 - 2.36mm
Sand	Coarse	2.36 - 0.6mm
	Medium	0.6 - 0.2mm
	Fine	0.2 - 0.075mm

Plasticity



Consistency of Cohesive Soils

Term	Undrained Strength Su (kPa)	Field Guide
Very Soft	< 12	Exudes between the fingers when squeezed in hand
Soft	12 - 25	Can be moulded by light finger pressure
Firm	25 - 50	Can be moulded by strong finger pressure
Stiff	50 - 100	Cannot be moulded by Fingers. Can be indented by thumb.
Very Stiff	100 - 200	Can be indented by thumb nail
Hard	> 200	Can be indented with difficulty by thumb nail.
Friable	-	Crumbles or powders when scraped by thumbnail

Consistency/Density of Non-Cohesive Soils

Term	Density Index (%)	SPT "N" Value Comparison
Very Loose	< 15	0 - 4
Loose	15 - 35	4 - 10
Medium Dense	35 - 65	10 - 30
Dense	65 - 85	30 - 50
Very Dense	> 85	> 50

Moisture Content

D	Dry
M	Moist
W	Wet
S	Saturated

Minor Components

Term	BBÄBBÅÄÅCĀAĆÃÄ	ÂÆĄÆĄÆCĂĄÅĀĄĀĀÅÅÅĄÆĀ ĄÅÆĄÅÄÅCĀÀÅĈ
Trace	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component	Coarse grained soils: < 5 % Fine grained soils: <15%
With	Presence easily detected by feel or eye, soil properties little different to general properties of primary component	Coarse grained soils: 5 - 12 % Fine grained soils: 15 - 30%

Soil Legend

FILL	CLAY	GRAVEL	CONCRETE
TOPSOIL	SILT	LIMESTONE	COMBINATIONS
PEAT	SAND	BEDROCK	eg: Clay, Silty, Sandy

USCS

GW	Well graded gravel	SC	Clayey sand	OL	Organic low plasticity silt	CL	Low plasticity clay
GP	Poorly graded gravel	SM	Silty sand	ML	Low plasticity silt	CI	Intermediate plasticity clay
SW	Well graded sand			MH	High plasticity silt	CH	High plasticity clay
SP	Poorly graded sand			OH	Organic high plasticity silt	PT	Peat

DOC:GE:3.003

WA | QLD | NSW | VIC

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Phone (+618) 9205 4500 | Fax (+618) 9205 4501 | Email wageotecheng@structerre.com.au | Web www.structerre.com.au

BOREHOLE NUMBER: BH01

RPS
27-31 Troode Street
West Perth W.A. 6005
Ph: 9211 1111 Fax: 92111122

PROJECT NUMBER: D15170

LOCATION: Wellard

DRILLING COMPANY: Straprobe

DRILLING METHOD: Solid Stem Auger

WEATHER:

DRILLER: John

SCIENTIST: DW

DATE BEGUN: 01/10/2015

DATE COMPLETED: 01/10/2015

TOTAL DEPTH: 4.5

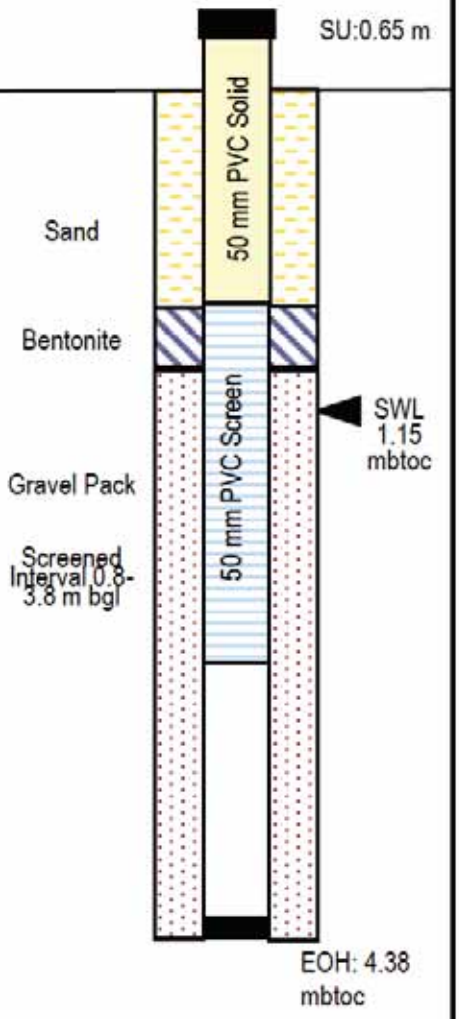
GROUND SURFACE ELEVATION:

SHEET: 1 OF: 4

STATIC WATER LEVEL	
DEPTH:	1.15 m btoc
DATE:	01/10/2015

DEPTH (m)	LITHOLOGY DESCRIPTION
0 – 0.1	Dark brown, slightly clayey sand and organics.
0.1-1.2	Dark brown, slightly clayey sand with clay increasing with depth.
1.2-2	Sandy clay, dark brown/black. Moist, plastic.
2-3	Clayey sand. Grey.
3-4.5	Sand, and some clay inclusions. Grey

BORE INSTALLATION



Lockable bore: Yes / No Geotextile stocking: No Class: 18 PVC. Case diameter: 50mm

BOREHOLE NUMBER: BH01

RPS
27-31 Troode Street
West Perth W.A. 6005
Ph: 9211 1111 Fax: 92111122

PROJECT NUMBER: D15170

LOCATION: Wellard

DRILLING COMPANY: Straprobe

DRILLING METHOD: Solid Stem Auger

WEATHER:

DRILLER: John

SCIENTIST: DW

DATE BEGUN: 01/10/2015

DATE COMPLETED: 01/10/2015

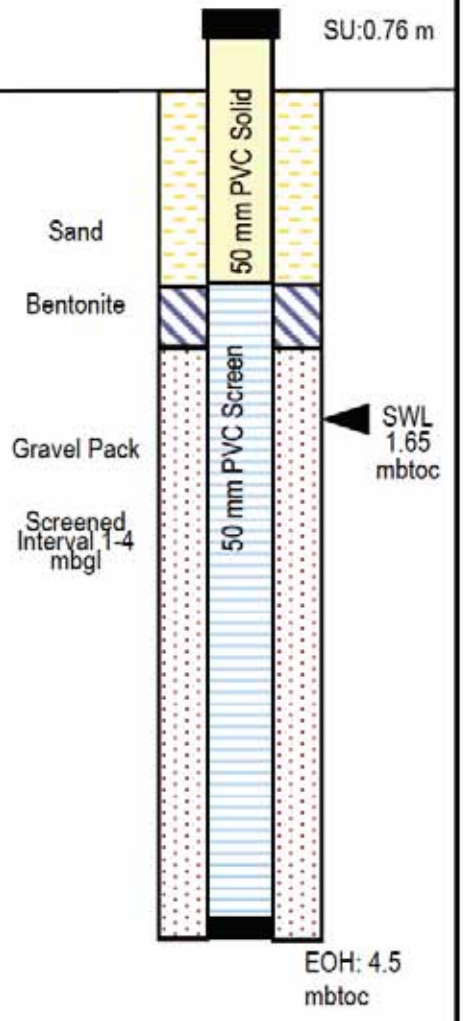
TOTAL DEPTH: 4.5

GROUND SURFACE ELEVATION:

SHEET: 2 OF: 4

STATIC WATER LEVEL	
DEPTH:	1.65 m btoc
DATE:	01/10/2015

DEPTH (m)	LITHOLOGY DESCRIPTION
0 – 0.1	Sand MF, brown/ grey and some organics.
0.1-4.5	Sand MF, grey



Lockable bore: Yes / No Geotextile stocking: No Class: 18 PVC. Case diameter: 50mm

BOREHOLE NUMBER: BH03

RPS
27-31 Troode Street
West Perth W.A. 6005
Ph: 9211 1111 Fax: 92111122

PROJECT NUMBER: D15170

LOCATION: Wellard

DRILLING COMPANY: Straprobe

DRILLING METHOD: Solid Stem Auger

WEATHER:

DRILLER: John

SCIENTIST: DW

DATE BEGUN: 01/10/2015

DATE COMPLETED: 01/10/2015

TOTAL DEPTH: 4.0

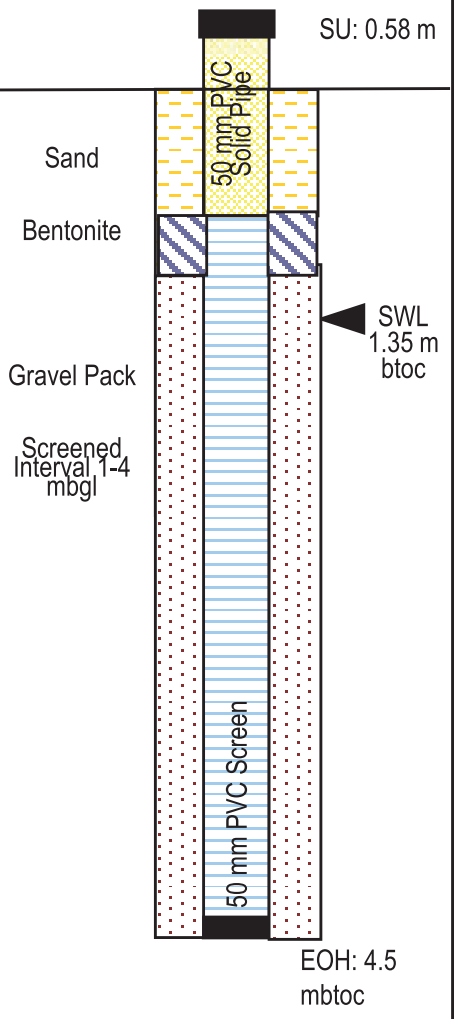
GROUND SURFACE ELEVATION:

SHEET: 3 OF: 4

STATIC WATER LEVEL	
DEPTH:	1.35 m btoc
DATE:	01/10/2015

DEPTH (m)	LITHOLOGY DESCRIPTION
0 – 0.1	Sand MF and organics. Brown grey
0.1-4.0	Sand MF, grey.

BORE INSTALLATION



Lockable bore: Yes / No Geotextile stocking: No Class: 18 PVC. Case diameter: 50mm

BOREHOLE NUMBER: BH04

RPS
27-31 Troode Street
West Perth W.A. 6005
Ph: 9211 1111 Fax: 92111122

PROJECT NUMBER: D15170

LOCATION: Wellard

DRILLING COMPANY: Straprobe

DRILLING METHOD: Solid Stem Auger

WEATHER:

DRILLER: John

SCIENTIST: DW

DATE BEGUN: 01/10/2015

DATE COMPLETED: 01/10/2015

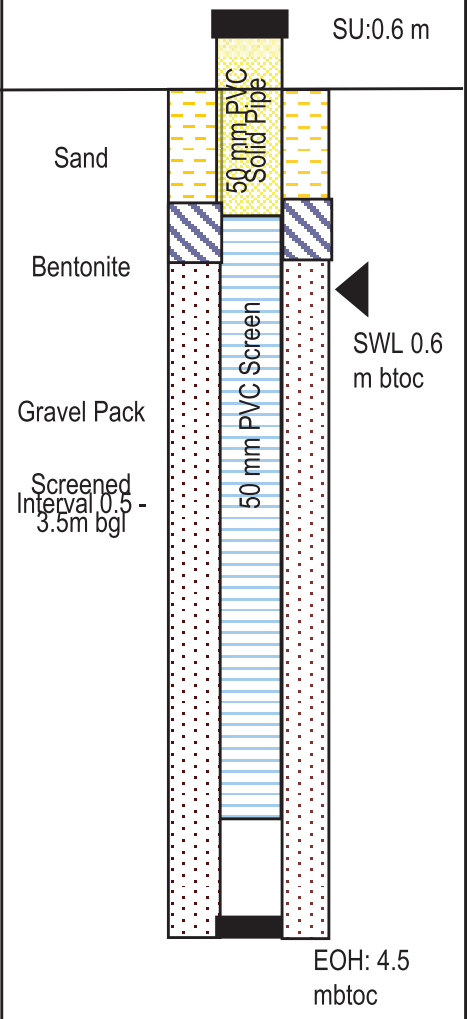
TOTAL DEPTH: 4.5

GROUND SURFACE ELEVATION:

SHEET: 4 OF: 4

STATIC WATER LEVEL	
DEPTH:	at surface
DATE:	01/10/2015

DEPTH (m)	LITHOLOGY DESCRIPTION
0 – 0.15	Sand, dark brown and organics.
0.15-4.5	Sand MF, grey.



Lockable bore: Yes / No Geotextile stocking: No Class: 18 PVC. Case diameter: 50mm

Appendix E

Development at the Bollard Bulrush Swamp

Prepared by GHD (2010)

Memorandum

25 November 2010

To	Darren Evans, Greg Rowe & Associates		
Copy to			
From	Helen Brookes	Tel	61 8 6222 8702
Subject	Development of Bollard Bullrush Swamp	Job no.	61/25042/01

Please note that this memorandum supersedes all previous communications on this matter and that it should not be released or reproduced by any party until the Department of Water have given formal approval for the modelling.

Introduction

It is proposed to develop land immediately surrounding the Bollard Bullrush Swamp environmental protection policy lake boundary. The development proposes to amend the environmental protection policy boundary in the north east and extend development further into the floodway. In order that development may occur areas of the floodway will have to be filled and so it is necessary to determine the up and downstream impacts of this effective reduction in the flood capacity of the swamp.

GHD have been engaged to undertake preliminary investigations into the impact of the proposed fill for the purposes of a rezoning application. The results of this preliminary modelling are not intended for publication at this time and may not be published until they have been reviewed and approved by the Department of Water and the Water Corporation.

Methodology

The dimensions of the Bollard Bullrush Swamp as modelled for the Jandakot Drainage and Water Management Plan were amended to reflect the proposed filling of the proposed development areas to the south and north east of the swamp as seen in Figure 1. Modelling assumed that the environmental protection policy boundary and buffer are successfully moved so that the full extent of development can go ahead.

In addition, because of the proposed change in land use within the development areas, the percentage of impermeable area (and hence generated runoff) was increased according the local structure plan shown in Figure 1. This will give a worst case indication of the likely impact, since it does not take into consideration that the development will provide additional compensation and promote additional infiltration through the use of water sensitive urban design and therefore is likely to retain or reduce predevelopment runoff characteristics.

A second scenario has also been modelled which incorporates detention capacity within the development to maintain the pre-development discharge peak flow rates into the Main Drain.

The modelling parameters used adapted from those established within the Jandakot DWMP and are presented in Tables 1 and 2 below.

Table 1 Land use impervious areas

Land use	Area (m^2)	Percent impervious	Impervious area (m^2)
School	77797	72%	56014
Grouped Dwellings	7682	28%	2151
Aged Persons	10020	35%	3507
Low Density	481644	28%	134860
Existing Residential	223430	28%	62560
Roads	381155	80%	304924
Medium Density	209403	28%	58633
POS	144472	0%	0
Drainage	935238	0%	0
Total	**2,470,841**		**622,649**

Table 2 Runoff surface characteristics

Runoff surface ID	Description	Surface type	Surface roughness (Manning's n)	Initial loss (mm)	Fixed runoff coefficient
61	URBAN (Perv') 2yr	Pervious	0.025	0	0.1
62	URBAN (Perv') 10yr	Pervious	0.025	0	0.15
63	URBAN (Perv') 100yr	Pervious	0.025	0	0.2
7	URBAN (IMP)	Impervious	0.015	15	1

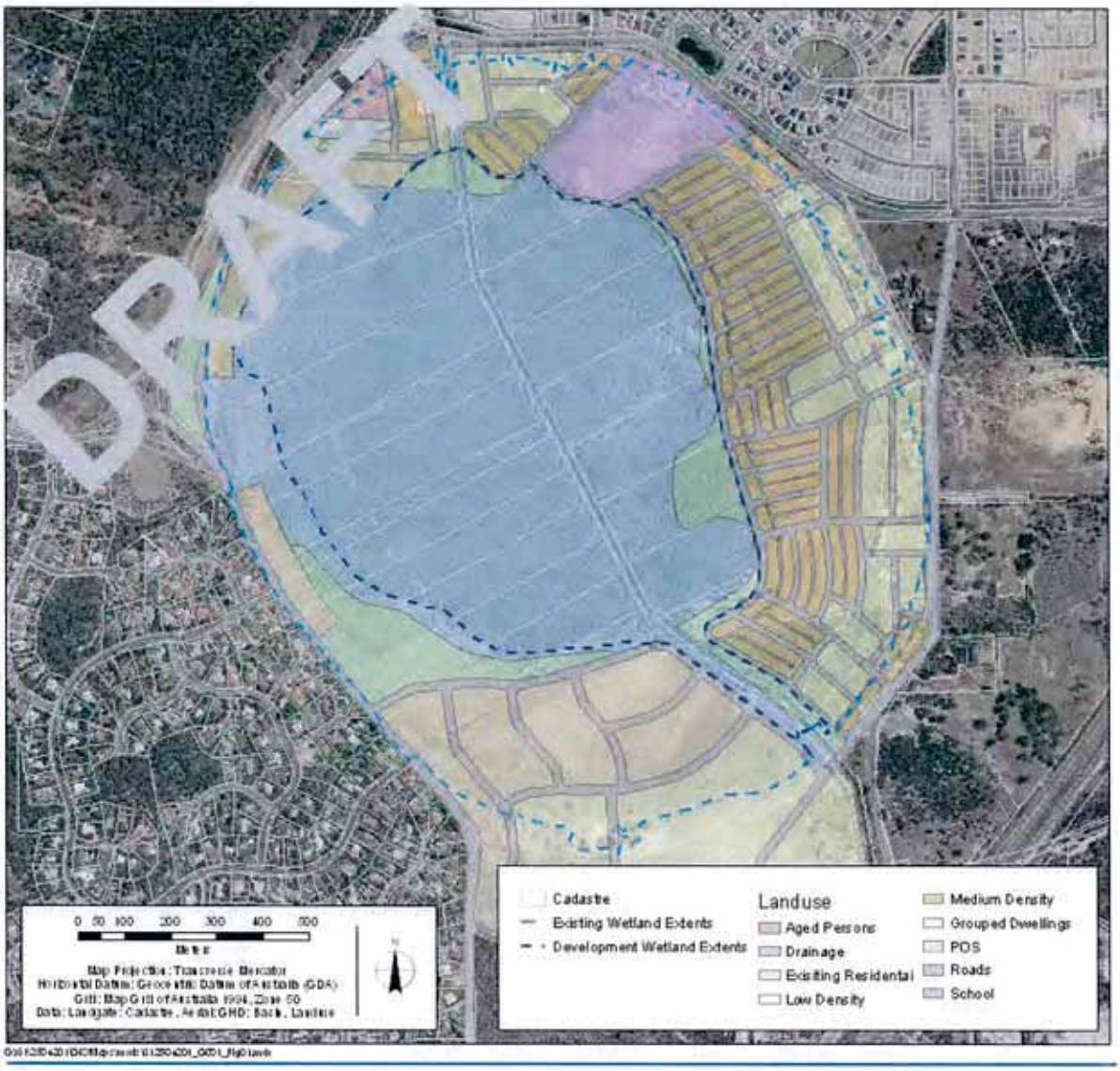


Figure 1 Exiting and Ultimate Wetland Extents with Proposed Landuse

Notes to figure 1:

1. Wetland extents indicated by the hatched lines are the areas available within the pre- and post-development models to accept overflow from the Peel Main Drain.
2. The land use type 'drainage' is used to define runoff parameters only and does not reflect the flooded area predicted by the model.

Results

Table 3 below presents top water levels and peak flow rates from modelling undertaken in support of the Jandakot Drainage and Water Management Plan at critical locations. Tables 4 and 5, also below, present a summary of the results of modelling for the two scenarios described above. Table 6 presents the discharge peak flow rates and required detention capacities within the development.

Table 3 Jandakot Drainage and Water Management Plan modelling results

Location	Top Water Level (mAHD)		Peak Flow (m^3/s)	
	10 year ARI	100 year ARI	10 year ARI	100 year ARI
Peel Main Drain at Bertram Road	7.90	8.20	3.25	3.82
Bollard Bullrush Swamp	4.82	5.61	3.38	4.00
Peel main Drain at Millar Road	4.70	5.59	4.38	5.06

Table 4 Modelling of full extent of proposed development

Location	Top Water Level (mAHD)		Peak Flow (m^3/s)	
	10 year ARI	100 year ARI	10 year ARI	100 year ARI
Peel Main Drain at Bertram Rd	7.90 *(no change)*	8.20 *(no change)*	3.25 *(no change)*	3.82 *(no change)*
Bollard Bullrush Swamp	4.85 *(+ 30 mm)*	5.65 *(+ 40 mm)*	3.38 *(no change)*	4.00 *(no change)*
Peel main Drain at Millar Road	4.72 *(+20 mm)*	5.62 *(+ 30 mm)*	4.73 *(+ 350 L/s)*	5.77 *(+ 710 L/s)*

Table 5 Modelling of proposed development including provision of on-site detention

Location	Top Water Level (mAHD)		Peak Flow (m^3/s)	
	10 year ARI	100 year ARI	10 year ARI	100 year ARI
Peel Main Drain at Bertram Rd	7.90 *(no change)*	8.20 *(no change)*	3.25 *(no change)*	3.82 *(no change)*
Bollard Bullrush Swamp	4.82 *(no change)*	5.62 *(no change)*	3.38 *(no change)*	4.00 *(no change)*
Peel main Drain at Millar Road	4.70 *(no change)*	5.59 *(no change)*	4.39 *(+ 10 L/s)*	5.14 *(+ 80 L/s)*

Table 6 Discharge peak flows and required detention volumes for the proposed development

ARI storm event	Basin outflow (m^3/s)	Storage volume required (m^3)
10 Year	0.2	30,000
100 Year	0.35	39,000

Conclusions

The modelling summarised above indicates that in scenario 1, which is the worst case scenario given no detention capacity within the development area, the top water level within the Bollard Bullrush Swamp changes by less than 100 mm for the 100 year ARI event and that levels both up and downstream also remain relatively unchanged.

The scenario 2 results indicated that by providing a total detention capacity of approximately 39,000 m^3 for a 100 year ARI event (30,000 m^3 for a 10 year ARI event) within the development area the change in top water level will be zero.

Suitable fill levels for development must be determined by detailed site investigations in conjunction with drainage and earthworks design for the site. This modelling indicates that a minimum habitable floor level of 6.12 m AHD will be required to ensure that 500 mm of clearance is provided from the 100 year ARI event flood level in Bollard Bullrush Swamp.

Peak flows upstream of and within the swamp also remain unchanged, however there is an increase of up to 710 L/s on the downstream peak flow rate in the 100 year ARI event. This increase in flow rate is related to the increased impervious area and it will be a requirement of development that sufficient detention capacity is provided within the drainage system and public open space areas to ensure that this does not occur.

In scenario 2 the increase in downstream peak flow rate is managed through the provision of 39,000 m^3 total detention capacity within the development area. This results in a downstream peak flow rate in the 100 year ARI event of 5,140 L/s which is within 80 L/s of the predevelopment downstream peak flow rate.

The indicated detention capacity of 39,000 m^3 for the 100 year ARI event which is required in order to maintain the peak discharge peak flow rates for the development will need to reviewed during the development of drainage designs. It is likely that the drainage design process will be able to reduce this detention capacity through water sensitive urban design practices, providing capacity for minor events throughout the development on lots and in road reserves as well as provision of flood detention areas within the normal public open space provision.

Recommendations:

1. Rezoning submissions should indicate that the change in top water level is predicted to be zero in the 10 and 100 year ARI events as a result of the proposed development.
2. Rezoning submissions should also indicate that there is less than 100 L/s predicted increase in peak downstream flow rates in the 10 and 100 year ARI events as a result of the proposed development, and that this is not likely to cause any downstream impacts.
3. The design of the proposed development should provide sufficient detention capacity within lots, road reserves and/or public open space to ensure that predevelopment peak discharge flow rates are not exceeded (indicatively 30,000 m^3 and 39,000 m^3 respectively for the 10 and 100 year ARI events).
4. The design of the proposed development should incorporate a minimum habitable floor level of 6.12 m AHD.

Helen Brookes
Manager, Waterways

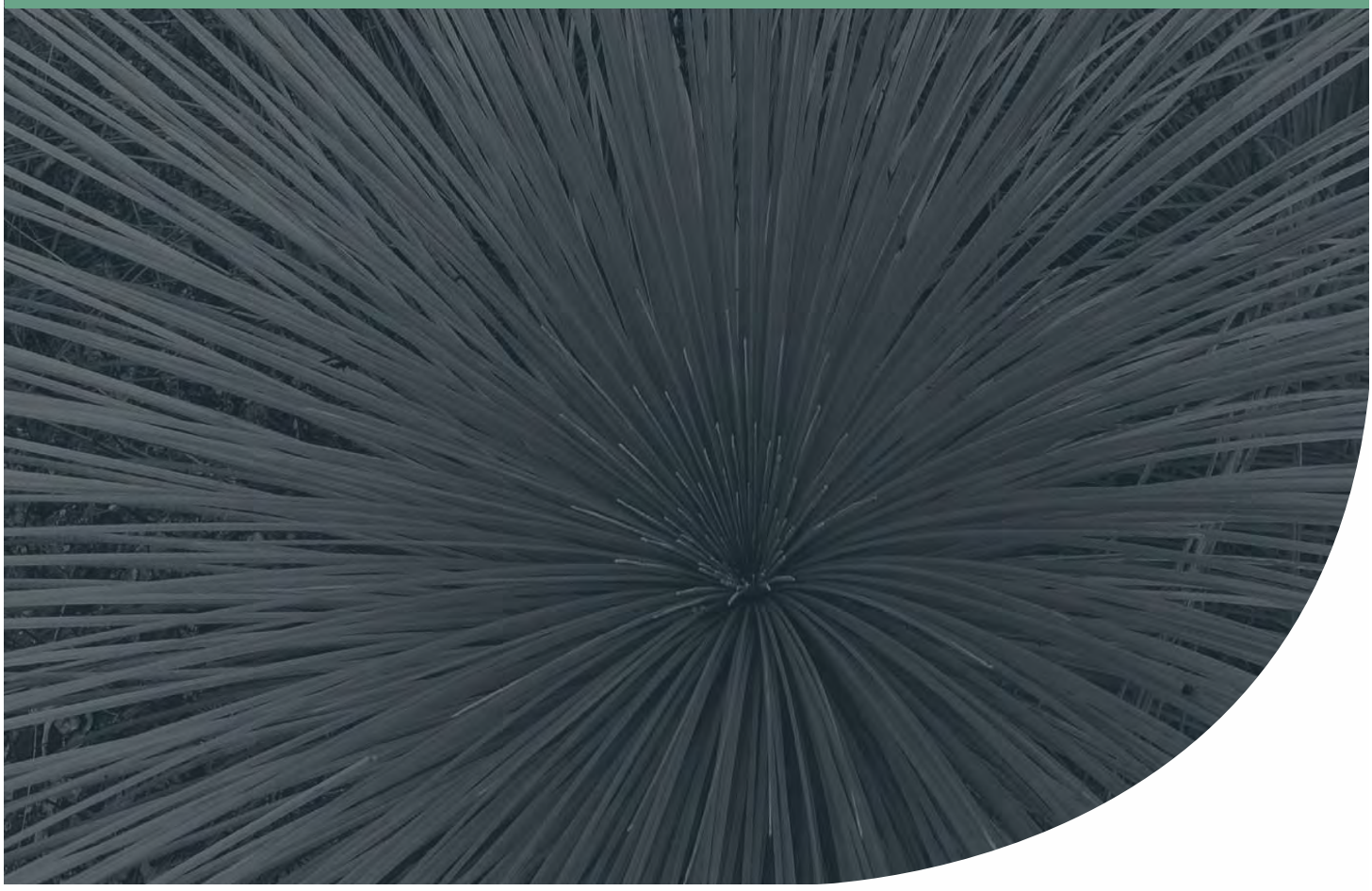
APPENDIX C | BUSHFIRE MANAGEMENT PLAN

Bushfire Management Plan

Lot 500 Bertram Road, Wellard Local Structure Plan Amendment

Project No: EP20-047(06)

Prepared for The Kings College
December 2020



Document Control

Doc name:	Bushfire Management Plan Lot 500 Bertram Road, Wellard Local Structure Plan Amendment				
Doc no.:	**EP20-047(06)--005 BRB**				
Version	**Date**	**Author**		**Reviewer**	
1	December 2020	Bianca Bertelli	BRB	Jason Hick	JDH
				Dana Elphinstone	DAE
	Issued to client for review.				
A	December 2020	Bianca Bertelli	BRB	Jason Hick	JDH
	Updated in response to client comments.				

Disclaimer:

This document has been prepared in good faith and is derived from information sources believed to be reliable and accurate at the time of publication. Nevertheless, it is distributed on the terms and understanding that the author is not liable for any error or omission in the information sources available or provided to us, or responsible for the outcomes of any actions taken based on the recommendations contained herein. It is also expected that our recommendations will be implemented in their entirety, and we cannot be held responsible for any consequences arising from partial or incorrect implementation of the recommendations provided.

This document has been prepared primarily to consider the layout of development and/or the appropriate building construction standards applicable to development, where relevant. The measures outlined are considered to be prudent minimum standards only based on the standards prescribed by the relevant authorities. The level of bushfire risk mitigation achieved will depend upon the actions of the landowner or occupiers of the land and is not the responsibility of the author. The relevant local government and fire authority (i.e. Department of Fire and Emergency Services or local bushfire brigade) should be approached for guidance on preparing for and responding to a bushfire.

Notwithstanding the precautions recommended in this document, it should always be remembered that bushfires burn under a wide range of conditions which can be unpredictable. An element of risk, no matter how small, will always remain. The objective of the Australian Standard AS 3959-2018 is to "prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire while the front passes" (Standards Australia 2018). Building to the standards outlined in AS 3959 does not guarantee a building will survive a bushfire or that lives will not be lost.

Executive Summary

The Kings College (the proponent) are progressing with an amendment to the existing Local Structure Plan over Lot 500 Bertram Road, Wellard to facilitate the future development of The Kings College primary and secondary school. The existing Structure Plan for Lot 500 and 501, Bertram Road, Wellard, approved in 2017, was prepared in anticipation of the site being developed for residential uses, therefore the proponent is seeking an amendment to enable the proposed alternate land use. The expansion of The Kings College will occur over the northern portion of Lot 500 Bertram Road, Wellard (the site). The site is 5.00 hectares (ha) in size and is located approximately 32 km south of the Perth Central Business District, within the City of Kwinana.

The site is located within a mixed urban and rural-residential area, with Bertram Road and urban development to the north, large rural-residential lots to the east, the Bollard Bulrush Swamp Conservation Category Wetland (CCW) (UFI 15866) and Peel Main Drain to the south, The Kings College buildings and sporting ovals and the Freeway Church to the west. The site is currently zoned 'Urban' under the Metropolitan Region Scheme (MRS), and 'Development', under the City of Kwinana Town Planning Scheme (TPS) No.2.

The proposed structure plan amendment is shown by the *Lots 500 (No.2) & 501 (No.214) Bertram Road, Wellard Local Structure Plan* (Harley Dykstra 2020) (referred to herein as the 'proposed Local Structure Plan (LSP)'), provided in **Appendix A.** The proposed LSP has responded to the requirement for a 50 m wetland buffer for the Bollard Bulrush Swamp CCW. The wetland buffer will be implemented in accordance with the City of Kwinana's Local Planning Policy (LPP) No.3 - *Bollard Bulrush East Landscape Master Plan,* which ensures that it provides an effective wetland buffer function. The wetland buffer will incorporate two landscaping zones; Zone A and Zone B allowing for a combination of outdoor play and recreation and conservation land uses. Zone A encompasses the future 'Parks Recreation and Drainage' reserve abutting the Bollard Bulrush Swamp, which will be revegetated with local native species. The proponent will cede the 'Parks Recreation and Drainage' reserve area to the Crown as development progresses which will provide a consolidated wetland area for protection into the future. Zone B comprises The Kings College outdoor play and recreation open space, which will be appropriately landscaped and maintained to reduce bushfire hazards to the school. This area will form a 'managed interface' between the Kings College and Bollard Bulrush Swamp (and the associated wetland rehabilitation area). The remainder of the proposed LSP is the 'Special Use: Education Establishment' zone incorporating The Kings College development including primary and secondary classrooms, café and kitchen facilities, gym, hardcourts and aquatic centre.

The southern portion of the site is currently designated as a 'bushfire prone area' under the state-wide *Map of Bush Fire Prone Areas* as prepared by the Office of Bushfire Risk Management (OBRM 2019). Accordingly, the proposal is subject to the bushfire policy measures prescribed State Planning Policy 3.7 *Planning in Bushfire Prone Areas,* and its associated Guidelines, and the methods described in AS 3959: 2018 *Construction of buildings in bushfire prone areas.*

The purpose of this BMP is to assess the bushfire hazards, within and nearby the site, and identify the management strategies required to ensure that the development of the land is consistent with the intent of SPP 3.7 "to preserve life and reduce the impact of bushfire on property and infrastructure." As part of this, a Bushfire Attack Level (BAL) assessment involving the classification of

vegetation in accordance with AS 3959 within 150 m of the site has been undertaken as a measure of the bushfire risk and determine to the siting and construction requirements. The following bushfire hazards were identified within and surrounding the site:

- Forest (Class A) vegetation to the south of the site associated with the densely vegetated portion of the Bollard Bulrush Swamp CCW (UFI 15866) which extends further to the east and west
- Woodland (Class B) vegetation within and surrounding the site associated with stands of remnant native *Melaleuca rhaphiophylla* (Swamp Paperbark) and *Eucalyptus rudis* (Flooded Gum) trees within rural-residential lots
- Scrub (Class D) vegetation along the eastern boundary of the site associated with scattered *Banksia spp*. and *Xanthorrhoea spp.* (grass trees) over unmanaged open paddocks
- Grassland (Class G) vegetation over the majority of the site and surrounding rural-residential lots to the east consisting of unmanaged open paddocks.

Overall, the outcomes of this BMP demonstrate that as development progresses, it will be possible for an acceptable solution to be adopted for each of the applicable bushfire protection criteria outlined in the Guidelines. This includes:

- **Location**: all future built form should be located in an area subject to a low or moderate bushfire hazard, and should achieve a BAL rating of BAL-29 or less, without requiring clearing or modification remnant vegetation proposed to be retained and allowing for the proposed revegetation of the wetland buffer. Based on the bushfire hazard level assessment, the site is located in an area of extreme and moderate bushfire hazard level. As development within the site is progressed, classified vegetation will be removed and development will be located within an area subject to a bushfire hazard level of low or moderate.
- **Siting and Design**: all future habitable school buildings can be sited within the proposed development so that BAL-29 or less can be achieved based on the proposed LSP. This has been achieved through the strategic location of internal driveway reserves and footpaths and the managed recreational open spaces which will be designed and maintained to low threat in order minimise the hazard to the school development.
- **Vehicular Access**: provision of an integrated road network that provides access to at least two different destinations, with roads to comply with the technical requirements outlined in Table 6 of Appendix Four in the Guidelines (WAPC & DFES 2017), including roads with a trafficable surface width of at least 6 m. The proposed LSP provides for a perimeter driveway will connect to the existing public road network, specifically Bertram Road to the north, further connecting onto Mortimer Road to the east and Challenger Avenue to the west.
- **Water**: the development will be provided with a permanent and reticulated water supply to support onsite firefighting requirements.

The management/mitigation measures to be implemented through the proposed structure plan and future development of the site have been outlined as part of this BMP. Following certification, the BAL ratings determined within this BMP (or as part of future stage-based BAL assessments) can be used to support future building approval processes.

Future education uses will meet the criteria of a ‘vulnerable’ land use in accordance with the definitions provided in SPP 3.7 and the Guidelines. The buildings will accommodate groups of young

children who are generally classed to have reduced physical and mental ability to respond in a bushfire event. Where vulnerable land uses are proposed to be developed in an area exposed to a BAL rating of BAL-12.5 or greater, development applications for these types of land uses are required to be supported by a Bushfire Management Plan and an Emergency Evacuation Plan.

The BAL assessment indicates that the 'Special Use: Education Establishment' area will be mostly located within BAL – LOW with a small proportion classified as BAL – 12.5. The future education buildings will be considered as Class 9, and while the requirements of *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas* (AS 3959) are not directly applicable to this building class, these types of buildings are subject to higher construction standards in accordance with the Building Code of Australia (BCA). Despite the potential for some education buildings to be located within BAL – 12.5, these buildings will be able to provide sufficient integrity for evacuation. Evacuation is recommended for vulnerable students (susceptibility to smoke effects) and the site provides areas accessible on foot that are BAL-LOW suitable for assembly and staging for evacuation.

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List of Abbreviations

Table A1: Abbreviations – General terms

General terms	
AHD	Australian Height Datum
AS	Australian Standard
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
BEEP	Bushfire Emergency Evacuation Plan
BMP	Bushfire Management Plan
BPAD	Bushfire Planning and Design
CCW	Conservation Category Wetland
DUP	Dual Use Path
EEP	Emergency Evacuation Plan
ESL	Emergency Services Levy
FDI	Fire Danger Index
FZ	Flame Zone
MUW	Multiple Use Wetland
RMP	Risk Management Plan

Table A2: Abbreviations – Organisations

Organisations	
DBCA	Department of Biodiversity Conservation and Attractions
DoW	Department of Water (now known as Department of Water and Environment Regulation)
DFES	Department of Fire and Emergency Services
OBRM	Office of Bushfire Risk Management
SES	State Emergency Services
WAPC	Western Australian Planning Commission

Table A3: Abbreviations – Legislation and policies

Legislation	
Guidelines	*Guidelines for Planning in Bushfire Prone Areas version 1.3 (WAPC and DFES 2017)*
SPP 3.7	*State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)

Table A4: Abbreviations – Planning and building terms

Planning and building terms	
AS 3959	*Australian Standard 3959-2018 Construction of buildings in bushfire prone areas*
BCA	Building Code Australia
LSP	Local Structure Plan
LPP	Local Planning Policy
TPS	Town Planning Scheme
MRS	Metropolitan Region Scheme
ISO 31000:2009	AS/NZS ISO 31000:2009 *Risk management – principles and guidelines*

1 Introduction

1.1 Background

The Kings College (the proponent) are progressing with an amendment to the existing Local Structure Plan over Lot 500 Bertram Road, Wellard to facilitate the future development of The Kings College primary and secondary school. The existing Structure Plan for Lot 500 and 501, Bertram Road, Wellard, approved in 2017 was prepared in anticipation of the site being developed for residential development, as such, the proponent is seeking an amendment to enable the proposed land use. The expansion of The Kings College will occur over the northern portion of Lot 500 Bertram Road, Wellard (the site). The site is 5.00 hectares (ha) in size and is located approximately 32 km south of the Perth Central Business District, within the City of Kwinana, as shown in **Figure 1.**

The proposed structure plan amendment is shown by the *Lots 500 (No.2) & 501 (No.214) Bertram Road, Wellard Local Structure Plan* (Harley Dykstra 2020) (referred to herein as the 'proposed Local Structure Plan (LSP)'), provided in **Appendix A.**

The site is located within a mixed urban and rural-residential area, with Bertram Road and urban development to the north, large rural-residential lots to the east, the Bollard Bulrush Swamp Conservation Category Wetland (CCW) (UFI 15866) and Peel Main Drain to the south, the existing college buildings and sporting ovals and the Freeway Church to the west. The site is currently zoned 'Urban' under the Metropolitan Region Scheme (MRS), and 'Development', under the City of Kwinana Town Planning Scheme (TPS) No.2, as shown in **Plate 1**.

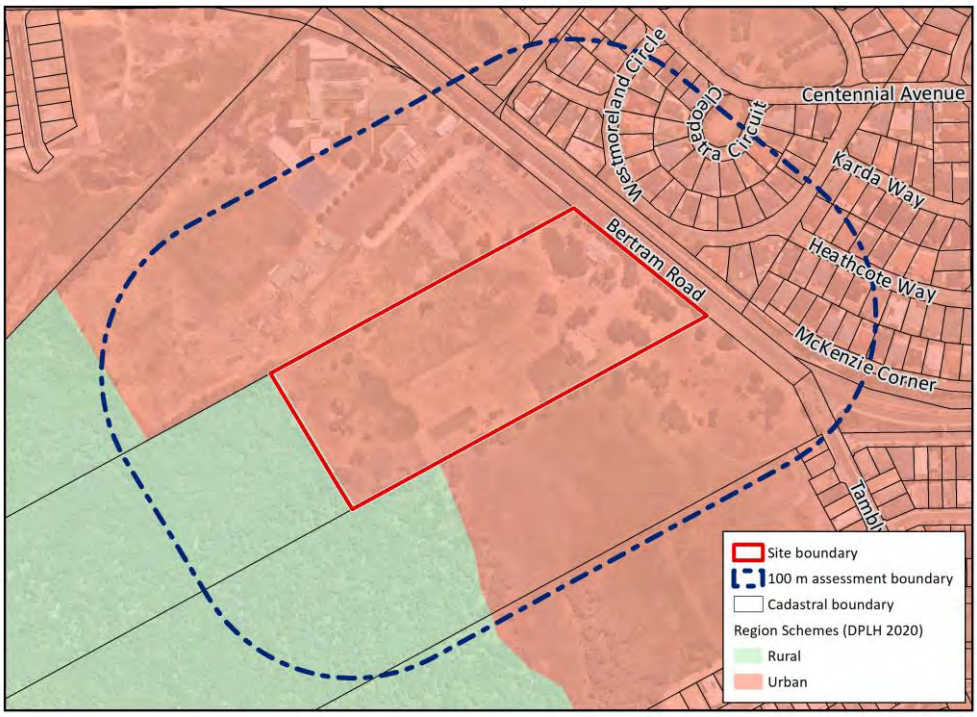

Plate 1: Metropolitan Region Scheme (MRS) zones and reserves within and surrounding the site.

The southern portion of the site is currently designated as a 'bushfire prone area' under the state-wide *Map of Bush Fire Prone Areas* as prepared by the Office of Bushfire Risk Management (OBRM 2019), as shown in **Plate 2**. The Western Australian *Planning and Development Act 2005* requires for any land identified as bushfire prone that an assessment of the bushfire risk affecting the site is undertaken using the methodology described in *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2018). The suitability of the land, for the intended land use, is then to be assessed having regard to the determined risk and its compliance with the intent and objectives of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (the Guidelines) (WAPC and DFES 2017).

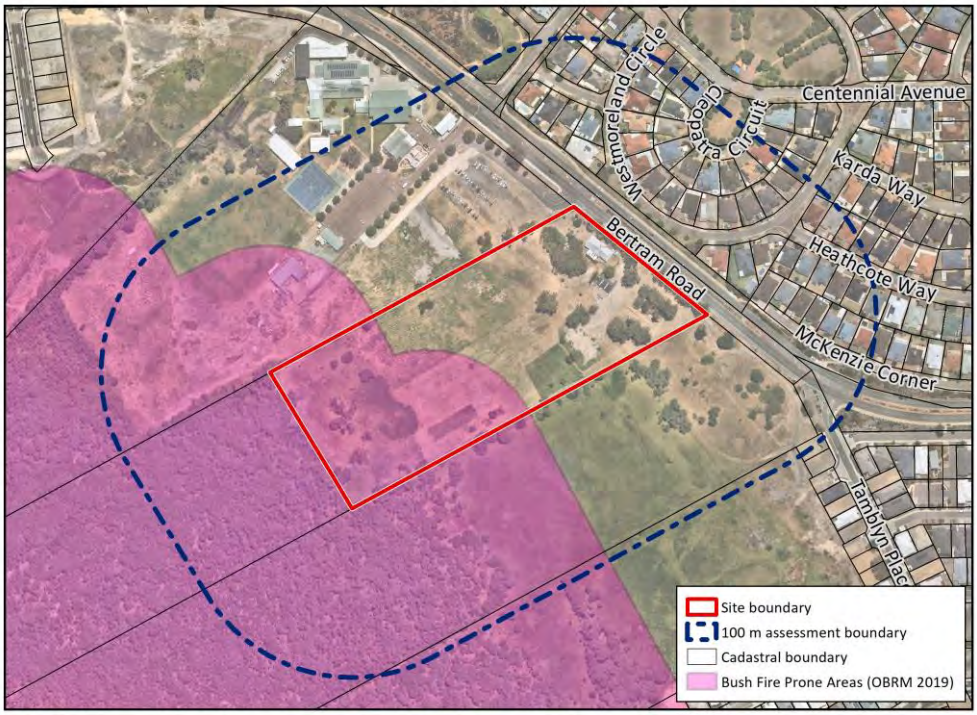

Plate 2: Areas within and surrounding the school site identified as 'bushfire prone areas' (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2019).

1.2 Aim of this report

The purpose of this BMP is to assess bushfire hazards within the site and nearby and ensure that the threat posed by any identified hazards can be appropriately mitigated and managed. The BMP has been prepared to support the proposed development of the site and addresses the requirements of SPP 3.7 (WAPC 2015), the Guidelines (WAPC and DFES 2017) and AS 3959 (Standards Australia 2009). The document includes:

- An assessment of the existing classified vegetation in the vicinity of the development site (within 150 m) and consideration of bushfire hazards that will exist in the post development scenario (**Section 3**).
- Commentary on how the future development can achieve the bushfire protection criteria outlined within the Guidelines (**Section 5**).
- An outline of the roles and responsibilities associated with implementing this BMP (see **Section 6**).

1.3 Statutory policy and framework

The following key legislation, policies and guidelines are relevant to the preparation of a bushfire management plan:

- *Bush Fires Act 1954*
- *Fire and Emergency Services Act 1998*
- *Planning and Development Act 2005* and associated regulations
- *Building Act 2011* and associated regulations
- *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)
- *Guidelines for Planning in Bushfire Prone Areas version 1.3* (WAPC and DFES 2017)
- *Australian Standard AS 3959 – 2018 Construction of buildings in bushfire prone areas* (Standards Australia 2018)

1.4 Historic Planning Context

The current 'Urban' MRS zoning of the site was established in 2013 under the Western Australian Planning Commission (WAPC) MRS Amendment 1188/57. MRS amendment 1188/57 was referred to the Environmental Protection Authority (EPA), in March 2010 and was formally assessed by the EPA resulting in Ministerial Statement 961. The EPA's assessment determined the appropriate extent of the 'Urban' zone (with the wetland representative of CCW values remaining 'Rural') and recommended the requirement for a 50 metre (m) wetland buffer to protect the Bollard Bulrush Swamp CCW (UFI 15866).

Consistent with the MRS zoning of the land, the site is zoned 'Development' pursuant to City of Kwinana Town Planning Scheme (TPS) No.2. The City of Kwinana TPS No.2. outlines the requirement for a Structure Plan prior to subdivision and/or development within the 'Development' land use zone. In addition, the City of Kwinana's LPP No.3 applies to all land within the Bollard Bulrush West urban cell zoned 'Development' under TPS No.2.

In 2017, an LSP over Lots 500 & 501 Bertram Road, Wellard (the existing LSP) was prepared to facilitate residential development over the site. The proponent is seeking to amend the existing LSP prepared in anticipation of the site being developed for residential purposes, to allow for the proposed educational land-uses. The proposed LSP provides a 50 m buffer from the boundary of the Bollard Bullrush Swamp CCW (UFI 15866) in accordance with the EPA's recommendations (March 2010) and the City of Kwinana's LPP No.3.

1.5 Description of the Proposed Local Structure Plan

The site is proposed to be developed for educational land uses, in line with the proposed LSP provided in **Appendix A**. The structure plan extends over northern portion of lot 500 Bertram Road applying to the land zoned 'Urban' under the MRS and 'Development' under the City of Kwinana TPS No.2, and proposes the following land uses:

- A 'Special Use: Education Establishment' zone incorporating The Kings College primary and secondary educational establishment buildings, café and kitchen facilities, gym, hardcourts and aquatic centre.
- A 50 m buffer for Bollard Bullrush Swamp CCW (UFI 15866) as outlined in The Kings College, Johnson Road, Wellard Landscape Masterplan (Emerge Associates 2020) (**Appendix B**) comprising:
    - A 'Park Recreation and Drainage' conservation reserve abutting the Bollard Bulrush Swamp (**Zone A**) which will be revegetated with local native species. The proponent will cede the 'Parks Recreation and Drainage' reserve area to the Crown as development progresses which will provide a consolidated wetland area for protection into the future.
    - The Kings College recreational open space (**Zone B**) will be landscaped and maintained to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959. This area will form a 'managed interface' between the Kings College and Bollard Bulrush Swamp (and the associated wetland rehabilitation area).

The land-uses associated with the proposed structure plan will involve the construction of new school buildings and classrooms within the site, which meets the definition of 'vulnerable' as provided in SPP 3.7 and the Guidelines. Specific operational measures relevant for preparing an emergency evacuation plan for 'vulnerable' land uses will need to be addressed in accordance with Section 5.5.2 of the Guidelines (WAPC & DFES 2017) at subsequent stages of planning and development.

1.6 Description of land characteristics

The site is relatively flat, with elevation ranging from approximately 4 m Australian Height Datum (AHD) in the western portion of the site to 8 m AHD in the east corner of the site.

The site has been subject to ongoing disturbance due to existing and historical rural land-uses including livestock grazing and horse agistment. The majority of the site and surrounding rural-residential lots to the east consist of unmanaged open paddocks with scattered remnant native trees. The northern portion of the site currently supports several sheds, horse stables and cultivated gardens.

Land uses surrounding the site include:

- Bertram Road and exiting residential development zoned 'Urban' under the MRS and 'Residential' under the City of Kwinana TPS No.2 to the north of the site
- Broad acre rural landholdings zoned 'Urban' under the MRS and 'Development' under the City of Kwinana TPS No.3 to the east of the site, which forms part of the Lot 500, 501 Bertram Road Local Structure Plan (Approved WAPC 2016).
- Bollard Bulrush Swamp CCW (UFI 15866) and associated remnant native vegetation, zoned 'Rural' under the MRS and 'Parks Recreation and Drainage' and 'Rural A' under the City of Kwinana TPS No.2 to the south of the site. Further to the south is the Peel Main Drain, a Water Corporation drain discharging to the Serpentine River at Kerulup Pool.
- The Kings College pre-kindy to Year 12 school facilities and The Kings Chapel (Freeway Church) infrastructure to the west of the site.

2 Environmental Considerations

In accordance with the *Bushfire Management Plan – BAL Contour* template prepared by the Department of Planning, Lands and Heritage (2018), this BMP has considered whether there are any environmental values within the development site or nearby that may require specific consideration through protection, retention or revegetation. To support this, a review of publicly available databases as well as site specific information (where available) has been undertaken, with particular reference to the Shared Location Information Platform (SLIP) databases.

The site was cleared of remnant vegetation prior to 1953 (based on available historic aerial photography) with the exception of scattered paddock trees and utilised for agricultural land uses associated with dairy farming. Between 1974 and 1989 dwellings, sheds, horse stables and cultivated gardens are evident within the northern portion of the site necessitating the removal of scattered remnant trees. Areas of relatively undisturbed intact remnant native vegetation exist to the south of the site within the Bollard Bulrush Swamp, while more disturbed vegetation (i.e. remnant native trees over paddock grasses) occurs within the site. Due to the historical disturbance within the site, the site does not contain any conservation significant values, but does contain an area that has been identified as a buffer to the Bollard Bulrush Swamp CCW.

The environmental values identified within and surrounding the site have been summarised in **Table 1** below.

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases)

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe value that may be impacted
Conservation category wetlands (CCW) and buffer (Geomorphic wetlands, Swan Coastal Plain (DBCA-019))	Yes	A CCW wetland (UFI: 15866), associated with Bollard Bulrush Swamp, is located immediately south-west of the site. The proposed LSP provides 50 m buffer from future school development incorporating a managed wetland interface, Dual Use Path and a conservation reserve. Further consideration of the buffer treatment has been provided in the Environmental Assessment and Management Strategy (EAMS) (Emerge Associates 2020a) prepared to support the Local Structure Plan amendment. The entire site is also mapped as a multiple use wetland (UFI: 13327). The MUW has been previously cleared for agricultural purposes and contains pasture species with scattered paddock trees. The high level of disturbance has reduced the ecological value of the vegetation of the MUW which supports vegetation in 'Completely Degraded' condition This wetland feature does not need to be retained, and no buffer or revegetation is required.
RAMSAR wetlands (DBCA-010)	No	No RAMSAR wetlands are identified within the mapping as occurring within the development site or in close proximity.
Threatened and priority flora (DBCA-036)	No	No species of threatened or priority flora were identified as occurring within the site as part of previous surveys (ENV Australia 2011b; Emerge Associates 2020c)

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases) (continued)

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe value that may be impacted
Threatened and priority fauna (DBCA-037)	No	A majority of the site itself does not contain suitable habitat for conservation significant fauna species due to previous clearing of native vegetation. Remnant vegetation associated with the Bollard Bulrush Swamp may contain suitable habitat for conservation significant fauna species such as *Isoodon obesulus fusciventer* (Quenda) (ENV Australia 2011a; Emerge Associates 2020c). However, the Quenda is unlikely to occur within the site due to the lack of microhabitats and clearing of the site for grazing of domestic animals creating a highly fragmented habitat.
Threatened ecological communities (DBCA-038)	No	Not applicable. The site has been historically cleared of a majority of remnant vegetation. No TECs were identified within the site as part of previous surveys (ENV Australia 2011b; Emerge Associates 2020c).
Bush Forever areas (DPLH-019)	No	Not applicable.
Clearing regulations – Environmentally Sensitive Areas (ESA) (DWER-046)	Yes	One ESA is present over the western site, extending over approximately 1.75 ha, likely associated with the mapped extent of the Bollard Bulrush CCW (UFI 15866). A 50 m buffer to the CCW will be implemented in accordance with the proposed LSP (**Appendix A**) incorporating the extent of the ESA. The presence of an ESA will only be a relevant consideration where clearing of native vegetation not subject to a Schedule 6 exemption (of the *Environmental Protection Act 1986*) is proposed. Proposed development within the site is unlikely to impact on the identified ESA due to the lack of native vegetation. Opportunities to retain the remnant native trees within the school development will be possible, and will be confirmed during final development design and bulk earthworks requirements.
Swan Bioplan Regionally Significant Natural Areas 2010 (DWER-070)	No	Not applicable.
Acid Sulfate Soils (DWER-055)	Yes	The majority of the site is classified as having a 'high to moderate risk' of ASS occurring within 3 m of the natural soil with a small area in the eastern corner of the site classified as having 'moderate to low risk' of ASS occurring within 3 m of the natural soil surface. An Acid Sulfate Soil investigation may be required to be undertaken for the site where excavation below groundwater level is anticipated.
Aboriginal heritage (DAA-001)	No	Not applicable. No aboriginal heritage places are identified within the site. A 'Registered Aboriginal Site', Site 3568 Camp is located approximately 1 km to the south-east of the site.
Non-indigenous heritage (SHO-003)	No	Not applicable. No non-indigenous heritage sites were identified within or nearby to the site based on the available mapping.

2.1 Native vegetation – modification and clearing

'Environmentally sensitive areas' (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding significant, threatened or scheduled flora, vegetation communities or ecosystems. Exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply within ESAs. However, exemptions under Schedule 6 of the EP Act still apply, including any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the EP Act).

One ESA has been mapped as occurring within the site based upon a review of the *Clearing Regulations – Environmentally Sensitive Areas* dataset (DWER 2020). This mapped ESA is likely associated with Bollard Bullrush Swamp CCW to the south west of the site. Proposed development within the site is unlikely to impact on the identified ESA due to the lack of native vegetation present and the incorporation of the entire extent of the ESA within the proposed 50 m wetland buffer.

As discussed in **Section 1.6**, no intact native plant communities were identified within the site due to historical disturbance resulting in the entirety of the site mapped as **Parkland Cleared** in 'Completely Degraded' condition and therefore contains limited significant flora or vegetation values. This vegetation is not considered to be 'native vegetation' and therefore the development of the site will not be impacted by the presence of the ESA.

Notwithstanding, the proposed LSP will provide an opportunity to rehabilitate the vegetation associated with Bollard Bulrush Swamp CCW (UFI 15866) and the 50 m buffer through the consolidation of a 'Parks Recreation and Drainage' reserve. Opportunities to retain the remnant native trees within the school development will be possible and will be confirmed during final development design and bulk earthworks requirements. Where clearing of remnant native trees within the site is proposed, a clearing permit will need to be attained pursuant to Part V of the *Environmental Protection Act 1986* (unless a valid exemption applies).

2.2 Revegetation and landscape plans

The site is bound to the south by the Bollard Bulrush Swamp CCW (UFI 15866). In order to maintain the wetland ecological function, a 50 m buffer from the boundary of the wetland to any future development has been provided. The proposed LSP provisions will require a portion of the 50 m buffer zone to be placed under a 'Park Recreation and Drainage' reserve and ceded to the State for conservation purposes, as detailed in **Section 1.5**.

The wetland buffer will incorporate two landscaping zones; Zone A and Zone B allowing for a combination of outdoor play and recreation and conservation land uses, as outlined in The Kings College, Johnson Road, Wellard Landscape Masterplan (Emerge Associates 2020) (**Appendix B**). The 'Park Recreation and Drainage' conservation reserve abutting the Bollard Bulrush Swamp (**Zone A**) will be revegetated with local native species. This vegetation will, therefore, be a bushfire hazard and is a relevant consideration for the assessment of bushfire risk in this BMP. This area is generally delineated by the DUP.

The Kings College recreational open space (**Zone B**), while part of the CCW buffer, will be landscaped and maintained to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959. This area will form a 'managed interface' between the Kings College and Bollard Bulrush Swamp (and the associated wetland rehabilitation area). Zone B will incorporate a balance of native planted pockets and open turf areas with a planting of average density of 1 plant per 2 m2 but clumped around retained mature trees and mulched to supress weeds. Ongoing management of Zone B likely to include:

- Regular removal of weeds and built up dead material (such as fallen branches, leaf litter etc.)
- Application of ground/surface covers such as mulch or non-flammable materials as required.
- Regular mowing/slashing of grass to less than 100 millimetres (mm) in height.

3 Bushfire Assessment Results

Bushfire risk for the site has been appropriately considered both in context to the site and potential impact upon the site.

Appendix Two of the Guidelines provides a description for undertaking contextual hazard level assessment using the vegetation classifications from AS 3959. The purpose is to identify at the strategic level the Bushfire Hazard Level (BHL) and the likely impact and intensity of a bushfire attack.

AS 3959 has been used to determine the impact on the site. Its objective is to reduce the risk of ignition and loss of a building to bushfire. It provides a consistent method for determining a radiant heat level (radiant heat flux) as a primary consideration of bushfire attack. It measures the Bushfire Attack Level as the radiant heat level (kWm^2) over a distance of 100 m.

AS 3959 also prescribes deemed to satisfy construction responses that can resist the determined radiant heat level at a given distance from the fire. It is based on six Bushfire Attack Level (BAL) ratings: BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ.

As school buildings are not Class 1, Class 2, Class 3 or Class 10a buildings, they are not required to be built to a higher construction standard following Australian Standard *AS 3959:2018 Construction of buildings in bushfire-prone areas* (AS 3959) (Standards Australia 2018). Notwithstanding, structure plans that are proposed within bushfire prone areas are required to have a BMP prepared for it, as per the Guidelines. Higher construction requirements apply to the Class 9b classroom buildings in accordance with the Building Code of Australia (BCA) where fire resistance properties, including building structural integrity during a fire, are required to be addressed.

3.1 Bushfire attack level (BAL) assessment

In accordance with Appendix Five of the Guidelines, a method 1 BAL assessment has been undertaken to support the proposed development of the site and determine the BAL ratings likely to be applicable to future habitable buildings. This has been based on the vegetation classifications and the effective slope under the vegetation, with the result presented on the BAL contour plan.

Not all vegetation is a classified bushfire risk. Vegetation and ground surfaces that are exempt from classification as a potential hazard are identified as a low threat under Section 2.2.3.2 of AS 3959. Low threat vegetation includes the following:

- Any vegetation that is more than 100 m from the site.
- Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified.
- Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site, or each other or of other areas of vegetation being classified.
- Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified.
- Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.

- Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and wind breaks.

3.1.1 Assessment inputs

Classifying bushfire hazards takes into account the vegetation structure within the site and surrounding area for a minimum of 100 m, in accordance with AS 3959. The assignment of the vegetation classifications is based on consideration of the fuel layers of different vegetation types. This can be broken-down into five segments as illustrated in **Plate 3** below.

A site visit was undertaken on 4 April 2020 providing and assessment of existing vegetation within the site and surrounding 150 m in accordance with AS 3959 and the Guidelines.

Table 2 below outlines:

- The pre-development AS 3959 vegetation classifications (and associated photo locations) are shown in **Figure 2.**
- The post-development AS 3959 vegetation classifications are shown in **Figure 3.**
- The effective slope for each area of classified vegetation present in the post-development scenario is shown in **Figure 4.**

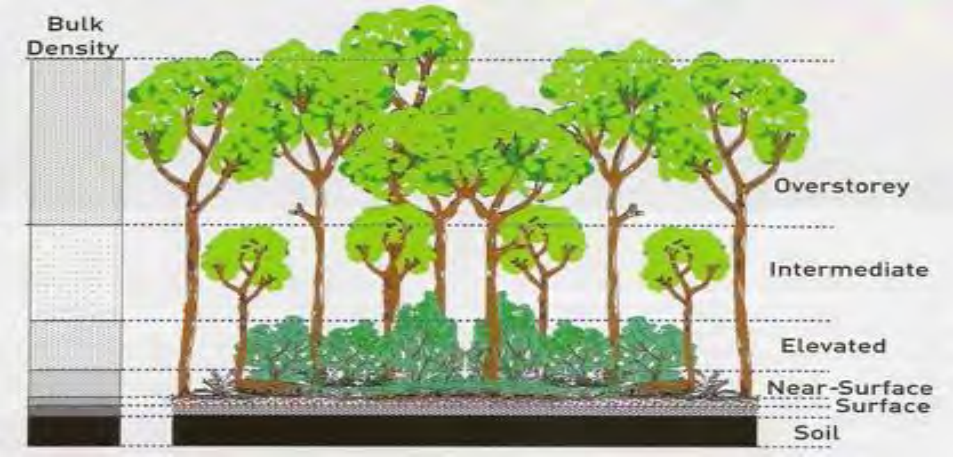

Plate 3: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)

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Table 2: Vegetation type and effective slope within the site and surrounding 150 m

Pre development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 vegetation classification**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 vegetation classification and effective slope**
1	**AS 3959 classification (Figure 2):** Forest (Class A) **Bushfire hazard rating (Figure 3):** Extreme Forest (Class A) vegetation has been identified to the south of the site associated with the densely vegetated Bollard Bullrush Swamp. This vegetation is characterised by *Eucalyptus rudis* (Flooded gum) and *Melaleuca raphiophylla* (Swamp Paperback) growing over 6 m in height, with an understory of native sedge and scrub species. Forest vegetation within and surrounding the site is associated with a continuous fuel layer, with surface, near-surface, intermediate and elevated fuel loads.	 *Photo location 1: Forest vegetation to the south of the site*  *Photo location 2: Forest vegetation to the east of the site*  *Photo location 3: Forest vegetation to the west of the site abutting the Kings College sporting oval*  *Photo location 4: Forest vegetation to the south of the site*	1	**AS 3959 classification (Figure 4):** Forest (Class A) **Effective slope (Figure 5):** Flat/upslope The Forest vegetation within the Bollard Bullrush Swamp will be retained and enhanced as part of future development. No fuel management of this area is proposed. It is assumed this vegetation will remain in the same condition as the pre-development assessment and will therefore be a bushfire hazard for the foreseeable future.

Table 2: Vegetation type and effective slope within the site and surrounding 150 m (continued)

Pre development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 vegetation classification**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 vegetation classification and effective slope**
2	**AS 3959 classification (Figure 2):** Woodland (Class B) **Bushfire hazard rating (Figure 3):** Extreme Patches of woodland vegetation have been identified within the northern portion of the site, in addition to the east of the site within rural-residential Lot 501 Bertram Road. These areas of woodland vegetation are characterised by overstorey *Eucalyptus* spp. trees, with surface and near-surface fuel loads of unmanaged grass understory.	 *Photo location 5: Woodland vegetation to the east of the site within Lot 501 Bertram Road.*  *Photo location 6: Woodland vegetation to the east of the site within Lot 501 Bertram Road.*  *Photo location 7: Woodland vegetation to the east of the site within Lot 501 Bertram Road.*	4	**AS 3959 classification (Figure 4):** Non-vegetated area (exclusion clause 2.2.3.2(e)) **Effective slope (Figure 5):** Not applicable Woodland vegetation within the site will be converted to non-vegetated areas (exclusion clause 2.2.3.2 (e)), associated with the Kings College school infrastructure, the proposed perimeter driveway and sporting ovals. It is noted that some of these areas may contain managed grass, particularly the oval, or garden beds in the future (as part of developing in/around future buildings), however for ease of reference and distinction have been excluded as non-vegetated. In addition, the patches of woodland vegetation to the east of the site within Lot 501 will be removed in the post-development scenario. The existing approved Lot 500 & 501 Bertram Road Local Structure Plan (Atlus Planning 2017) for this area is intended to be developed for residential use in the short-term future.

Table 2: Vegetation type and effective slope within the site and surrounding 150 m (continued)

Pre development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 vegetation classification**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 vegetation classification and effective slope**
3	**AS 3959 classification (Figure 2):** Scrub (Class D) **Bushfire hazard rating (Figure 3):** Extreme Scrub vegetation has been identified along the eastern boundary of the site abutting the adjacent large residential landholding. Scrub vegetation is characterised primarily by *Banksia* spp. growing over native and non-native species including *Xanthorrhoea* spp. and *Chamelaucium* spp. The scrub vegetation is having continuous fuel loads into the canopy, approximately 5 – 6 m in height. It is noted that there are occasional trees located within the scrub vegetation, however these are scattered and do not constitute the dominant vegetation type, and therefore this vegetation has been classified as scrub.	 *Photo location 8: Scrub vegetation along the eastern boundary of the site*  *Photo location 9: Scrub vegetation along the eastern boundary of the site.*	5	**AS 3959 classification (Figure 4):** Non-vegetated area (exclusion clause 2.2.3.2(e)) **Effective slope (Figure 5):** Not applicable Scrub vegetation within the site will be converted to non-vegetated areas (exclusion clause 2.2.3.2 (e)), associated with the Kings College school infrastructure, the proposed perimeter driveway and sporting ovals. It is noted that some of these areas may contain managed grass or garden beds in the future (as part of developing in/around future buildings), however for ease of reference and distinction have been excluded as non-vegetated. In addition, the scrub vegetation along the eastern boundary of the site within the privately rural-residential Lot 501 will be removed in the post-development scenario. The existing approved Lot 500 & 501 Bertram Road Local Structure Plan (Atlus Planning 2017) for this area is intended to be developed for residential use in the short-term future.

Table 2: Vegetation type and effective slope within the site and surrounding 150 m (continued)

Pre development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 vegetation classification**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 vegetation classification and effective slope**
4	**AS 3959 classification (Figure 2):** Grassland (Class G) **Bushfire hazard rating (Figure 3):** Moderate Grassland vegetation has been identified within the site, in addition to the north, east and south of the site associated with unmanaged rural paddocks. Grassland vegetation within and surrounding the site is characterised by open areas of unmanaged grassland with surface and near-surface fuel loads. Occasional scattered paddock trees are located within and surrounding the site, however, the overstorey density is less than 10%.	 *Photo location 10: Grassland vegetation within the central portion of the site*  *Photo location 11: Grassland vegetation adjacent to the south-eastern boundary of the site*  *Photo location 12: Grassland vegetation to the south-east of the site within Lot 501 Bertram Street*  *Photo location 13: Grassland vegetation to the west of the site within The Kings College Lot 950 Bertram Street*	1	**AS 3959 classification (Figure 4):** Forest (Class D) **Effective slope (Figure 5):** Flat/upslope A portion of the grassland vegetation within the 50 m buffer zone will be revegetated to a Forest (Class A) vegetation classification to the south of the DUP and within the future 'Parks Drainage and Recreation' reserve.
			5	**AS 3959 classification (Figure 4):** Non-vegetated area (exclusion clause 2.2.3.2(e)) **Effective slope (Figure 5):** Not applicable Grassland vegetation within the northern portion of the site will be converted to non-vegetated areas (exclusion clause 2.2.3.2 (e)), associated with the Kings College school infrastructure, the proposed internal driveway and sporting ovals.

Table 2: Vegetation type and effective slope within the site and surrounding 150 m (continued)

Pre development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 vegetation classification**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 vegetation classification and effective slope**
4	**AS 3959 classification (Figure 2):** Grassland (Class G) **Bushfire hazard rating (Figure 3):** Extreme Continued from above.	Continued from above.	6	**AS 3959 classification (Figure 4):** Low threat vegetation (exclusion clause 2.2.3.2(f)) **Effective slope (Figure 5):** Not applicable A portion of the grassland vegetation within the 50 m buffer zone will be managed to a 'low threat' standard for active/passive recreation purposes, to the north of DUP abutting The Kings College school infrastructure. In addition, the patches of grassland vegetation to the east of the site within Lot 501 will be removed in the post-development scenario. The existing approved Lot 500 & 501 Bertram Road Local Structure Plan (Atlus Planning 2017) for this area is intended to be developed for residential use in the short-term future.

Table 2: Vegetation type and effective slope within the site and surrounding 150 m (continued)

Pre development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 vegetation classification**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 vegetation classification and effective slope**
5	**AS 3959 classification:** Non-vegetated (Exclusion clause 2.2.3.2 (e)) **Effective slope (Figure 5):** Not applicable Non-vegetated areas such as roads, driveways, existing residential and school buildings and hard-court play areas within and surrounding the site have been excluded in accordance with Clause 2.2.3.2(e) of AS 3959. It is noted that areas that are identified as non-vegetated within the existing residential and school areas may include areas of low threat vegetation such as managed grass/garden areas/verges, however, for ease of reference have been excluded as non-vegetated on the basis that these the school development area.	 *Photo location 14: Non vegetated bare earth area within the northern portion of the site.*  *Photo location 15: Bituminised school carpark area to the west of the site.*  *Photo location 16: Non vegetated sealed carpark to the west of the site*  *Photo location 17: Residential development area to the north of the site (exclusion 2.2.3.2(e)(f)).*	5	**AS 3959 classification (Figure 4):** Non-vegetated area (exclusion clause 2.2.3.2(e)) **Effective slope (Figure 5):** Not applicable The existing maintenance regimes for all existing non-vegetated areas surrounding the site are assumed to continue in the long term. In addition, areas within the site that have been identified as non-vegetated will remain as non-vegetated when converted to school infrastructure and roads as part of the development of the site.

Table 2: Vegetation type and effective slope within the site and surrounding 150 m (continued)

Pre development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 vegetation classification**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 vegetation classification and effective slope**
6	**AS 3959 classification:** Low threat vegetation (exclusion clause 2.2.3.2(f)) **Effective slope (Figure 5):** Not applicable Low threat vegetation has been identified external to the site to the north, east and west associated with open paddocks managed to a low threat standard in accordance with the City of Kwinana fire notice.	 *Photo location 18: Low threat managed parkland area within the northern portion of the site.*  *Photo location 19: Low threat dual use playing field and carpark area to the west of the site.*  *Photo location 20: Low threat managed vegetation within the northern portion of the site*  *Photo location 21: Low threat turf areas within the northern portion of the site*	6	**AS 3959 classification (Figure 4):** Low threat vegetation (exclusion clause 2.2.3.2(f)) **Effective slope (Figure 5):** Not applicable The maintenance regimes for all existing low threat vegetation surrounding the site is assumed to continue in the long-term based on current land uses and management arrangements, in accordance with the requirements of the City of Kwinana fire notice.

3.1.2 Post development assumptions

The BAL assessment, to determine the predicated BAL ratings applicable to the site, has assumed the following:

- **Designated FDI**: 80
- **Flame temperature**: 1090 K
- **Vegetation classification**: forest (Class A) and grassland (Class G) identified within 150 m of the site (see **Figure 3**)
- **Effective slope beneath classified vegetation**: flat/upslope (see **Figure 4**)

In addition to the above, the following key assumptions have informed this assessment:

- The majority of classified vegetation within the site will be removed or modified to achieve low threat in accordance with Section 2.2.3.2 of AS 3959. Scattered native trees will be retained where possible. Management would include:
  - Clearing of vegetation.
  - Regular maintenance including removal of weeds and dead material.
  - Where remnant trees are retained, these will be low pruned to 2 m from the ground.
  - Application of ground covers such as mulch or non-flammable materials.
  - Where grass/turf is present, this will be regularly cut so that the grass is maintained at or below 100 mm in height.
- It is assumed the Bollard Bulrush Swamp buffer zone will be designed and implemented within the site and surrounding Lots 500 and 950 Bertram Road, Wellard in accordance with The Kings College, Johnson Road, Wellard Landscape Masterplan (**Appendix B**) and the Bollard Bulrush East Landscape Master Plan (**Appendix C**). As such, the following treatments have been assumed within the buffer zone:
  - A Forest (Class A) vegetation classification has been assumed immediately abutting the Bollard Bullrush Swamp CCW (Zone A), within the portion to be revegetated to a similar standard to the existing wetland vegetation and ceded to the State under a 'Park Recreation and Drainage' reserve.
  - A 'low threat' vegetation classification has been assumed within The Kings college outdoor play and recreation open space (Zone B), which will be landscaped and maintained to reduce bushfire hazards to the school. This area will incorporate a balance of native planted pockets and open turf areas with a planting of average density of 1 plant per 2 m2 but clumped around retained mature trees and mulched to supress weeds.
- Classified vegetation within Lot 501 to the east of the site will be removed in the post-development scenario and converted to 'non vegetated' based on the future planned residential development in accordance with the existing LSP. It is noted that some of these areas may contain managed grass or garden beds in the future (as part of developing in/around future buildings), however for ease of reference and distinction have been excluded as non-vegetated.

3.1.3 Assessment outputs

The BAL assessment completed for the site indicates that a BAL rating of BAL-29 or less can be achieved at future habitable buildings based on the indicated spatial layout for the structure plan (**Appendix A**).

Table 3 provides a summary of the setback distances necessary from classified vegetation to achieve the indicated BAL ratings, with the BAL Contour Plan (**Figure 6**) being a visual representation of these distances. The setback distances are based on the post-development classified vegetation, effective slope (**Figure 5**) and are taken from Table 2.5 of AS 3959.

Table 3: Setback distances based on vegetation classification and effective slope and Table 2.5 of AS 3959, as determined by the method 1 BAL assessment

Vegetation classification (see Figure 2)	Effective slope (see Figure 3)	Distance to vegetation	BAL rating (see Figure 4)
Forest (Class A)	Flat/upslope	< 16 m	BAL-FZ
		16 - < 21 m	BAL-40
		21 - < 31 m	BAL-29
		31 - < 42 m	BAL-19
		42 - < 100 m	BAL-12.5
		> 100 m	BAL-LOW
Grassland (Class G)	Flat/upslope	< 6 m	BAL-FZ
		6 - < 8 m	BAL-40
		8 - < 12 m	BAL-29
		12 - < 17 m	BAL-19
		17 - < 50 m	BAL-12.5
		> 50 m	BAL-LOW

4 Identification of Bushfire Hazard Issues

From a bushfire hazard management perspective, the key issues that are likely to require management and/or consideration as part of future development within the site include:

- Provision of appropriate separation distance from bushfire hazards to the south of the site to ensure a BAL rating of BAL-29 or less can be achieved at future habitable buildings (built form).
- Ensuring that The Kings college outdoor play and recreation open space is appropriately designed and implemented to achieve low threat standards in accordance with AS 3959, to support the use of this area as part of an asset protection zone.
- Provision of appropriate vehicular access to ensure that when development within the site is fully constructed, egress to at least two different destinations will be available to future school children and emergency personnel.
- Provision of appropriate water supply and associated infrastructure.

These issues are considered further in **Section 5.**

5 Assessment against the Bushfire Compliance Criteria

This BMP provides an outline of the mitigation strategies for the structure plan that will ensure future subdivision and associated development progresses can achieve an acceptable solution under the bushfire protection criteria detailed within Appendix Four of the Guidelines (WAPC and DFES 2017). The bushfire protection criteria identified in the Guidelines and addressed as part of this BMP are:

- Element 1: Location of the development
- Element 2: Siting and design of the development
- Element 3: Vehicular access
- Element 4: Water supply.

As part of future development, it is likely that an 'acceptable solution' will be able to address the intent of all four bushfire protection criteria as part of future development of the site. A summary of how this can be achieved and an associated compliance statement for each has been provided in **Table 4.**

Table 4: Summary of bushfire protection criteria and compliance statement

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 1: Location	To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.	A1.1 Development location		Based on the bushfire hazard level assessment, the site is located in an area of extreme and moderate bushfire hazard level. As development within the site is progressed, classified vegetation will be removed and development will be located within an area subject to a bushfire hazard level of low or moderate. The BAL contour plan (see **Figure 6**) indicates that the entirety of the site will be able to achieve a BAL rating of BAL-29 or less. The Kings College establishment building area will be mostly located within BAL – LOW with a small proportion classified as BAL – 12.5. The school buildings will be considered as Class 9, and while the requirements of *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas (AS 3959)* are not directly applicable to this building class, these types of buildings are subject to higher construction standards in accordance with the Building Code of Australia (BCA). Despite the potential for some future buildings to be located within BAL – 12.5, these buildings will be able to provide sufficient integrity for evacuation. The acceptable solution can be satisfied.	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 1: Location.
		Yes.	N/A		
Element 2: Siting and design	To ensure the siting and design of development minimises the level of bushfire impact.	A2.1 Asset Protection Zone		Asset protection zones (APZ) around buildings are an important bushfire protection measure influencing the safety of people and property. The APZ is a low fuel area immediately surrounding a building, and can include non-flammable features such as irrigated landscapes, gardens, driveways, public roads and managed public open space. The main bushfire hazards for the proposed development is associated with classified vegetation related to Bollard Bulrush Swamp to the south of the site, and areas that form part of the buffer, where they are proposed to be revegetated. The outcomes of the BAL assessment (see **Figure 6**) indicates that the Special Use: Education Establishment zone (and associated habitable education buildings) can be located in areas subject to a BAL rating of BAL-29 or less, with the majority of future education buildings likely to be subject to a BAL rating of BAL-12.5 or BAL-LOW. This is achieved through the outdoor play and recreation open space (Zone B) at the interface of the revegetation area, which will be landscaped and maintained to a 'low threat' standard to support this area being used as an APZ. This area will incorporate a balance of native planted pockets and open turf areas with a planting of average density of 1 plant per 2 m2 but clumped around retained mature trees and mulched to supress weeds.	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 2: Siting and design.

Table 4: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 2: Siting and design (Continued from above)	(Continued from above)	A2.1 Asset Protection Zone		Appropriate separation can be provided between habitable buildings and areas of bushfire hazard through the provision of an APZ. The APZ, in accordance with the Guidelines, is composed of: • Areas of managed wetland interface between the future Kings College development and Bollard Bulrush Swamp. This interface is shown in **Appendix B** and will support passive recreation and tree retention. • Managed internal driveway reserves and footpaths. Overall, the acceptable solution can be satisfied for the future development and associated habitable buildings. Class 1, 2, 3 and 10a buildings, where located within a designated bushfire prone area and an area subject to a BAL rating of BAL-12.5 or higher will need to satisfy higher construction standards in accordance with AS 3959.	(Continued from above)
Element 3: Vehicular access	To ensure vehicular access serving a subdivision/ development is available and safe during a bushfire event.	A3.1 Two access routes		The site provides connections to multiple destinations, namely: • A direct connection to Bertram Road to the north of the site, which then provides egress to the north-west to Challenger Avenue, and to the east to Kwinana Freeway. Kwinana Freeway is a major regional north and south connector • Future direct connections to planned residential development to the east of the site, providing egress to the broader road network • An internal loop driveway supporting egress, shown in Error! Reference source not found.	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 3: Vehicular access.
		Yes.	N/A		
		A3.2 Public road		Existing roads surrounding the site, in addition to the proposed new public roads within the site, can and will comply with the minimum standards outlined in Appendix Four of the Guidelines (WAPC and DFES 2017) or as agreed with the City of Kwinana and includes a minimum 6 m-wide trafficable surface.	
		Yes.	N/A		

Table 4: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 3: Vehicular access (Continued from above)	(Continued from above)	A3.3 Cul-de-sac (including dead-end-road)		Not applicable. No permanent cul-de-sacs are proposed as part of the development within the site. If temporary cul-de-sacs are required as part of staged development, these should be provided with appropriate turnaround areas (with a minimum 17.5 m-wide diameter head and trafficable surface (i.e. compacted limestone, gravel or similar)) until the full public road network is constructed as part of future development.	(Continued from above)
		N/A	N/A		
		A3.4 Battle-axe		Not applicable. No battle-axe lots are proposed as part of the development of the site.	
		N/A	N/A		
		A3.5 Private driveway longer than 50 m		Access will be through private perimeter driveway approx. 770 m in length. Any driveways longer than 50 m will meet the minimum standards as set out in the Guidelines. The perimeter driveway can and will comply with the minimum standards outlined in Appendix Four of the Guidelines (WAPC and DFES 2017), including construction suitable for two-wheel-drive vehicles, minimum horizontal and vertical clearance, overtaking bays ever 200 m and appropriate turn around areas. This can be confirmed at the building licence stage.	
		Yes.	N/A		
		A3.6 Emergency access way		Not applicable. Given the proposed structure plan provides for egress to at least two different destinations and the no cul-de-sacs are proposed, emergency access ways are not required as part of the proposed development of the site.	
		N/A	N/A		
		A3.7 Fire service access routes (perimeter roads)		Not applicable. Future development within the site will be provided with appropriate vehicular access, as outlined above, and therefore fire service access routes are not required. However, the structure plan provides for a five-metre-wide Dual Use Path which will provide secondary fire access along the Bollard Bulrush Swamp interface, between the buffer zone and the school development. The fire service access route will provide future connection points for the adjoining Structure Plan area to the east to allow for the continuation of the road more broadly within the surrounding region.	
		N/A	N/A		
		A3.8 Firebreak width		Where required, firebreaks will be provided in accordance with City of Kwinana fire break notice (or as specified by the City of Kwinana in accordance with Section 33 of the *Bush Fires Act 1954* and may vary depending upon the presence of strategic firebreaks (i.e. fire service access routes).	
		Yes.	N/A		

Table 4: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 4: Water	To ensure water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.	A4.1 Reticulated areas		Bushfire events in this area are responded to by a network of career Fire and Rescue Service stations and the State Emergency Service (SES). Fire response services require ready access to an adequate water supply during bushfire emergencies. The site will connect with a reticulated water supply and will include fire hydrants installed by the developer to meet the specifications of Water Corporation (*Design Standard (DS) 63 Water Reticulation Standard Design and Construction Requirements for Water Reticulation Systems up to DN250*) and DFES. Fire hydrants on land zoned for residential purposes are generally required such that the rear of a building is no more than 120 m from a public hydrant.	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 4: Water.
		Yes.	N/A		
		A4.2 Non-reticulated areas		Not applicable.	
		N/A	N/A		
		A4.3 Individual lots within non-reticulated areas (only for use if creating 1 additional lot and cannot be applied cumulatively)		Not applicable.	
		N/A	N/A		

5.1 Additional management strategies

5.1.1 Future approval considerations

The BAL assessment within this document is considered to be a conservative assessment of potential bushfire risk posed to future habitable buildings within the site based on the assumptions outlined in **Section 3** and will be a relevant consideration as part of future development to ensure a BAL rating of BAL-29 or less is achieved at new habitable buildings.

The measures to be implemented through this structure plan and associated future subdivision process have been outlined as part of this BMP and can be used to support future planning and development approval processes. If the development layout changes, a revised BMP is likely to be required to support any future subdivision/development application.

5.1.2 Landscape management

5.1.2.1 Within the site

The Kings college outdoor play and recreation open space

As outlined within **Section 1.5**, The Kings College recreational open space (**Zone B**), while part of the CCW buffer, will be landscaped and maintained to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959. This area will form a 'managed interface' between the Kings College and Bollard Bulrush Swamp (and the associated wetland rehabilitation area). Zone B will incorporate a balance of native planted pockets and open turf areas with a planting of average density of 1 plant per 2 m^2 but clumped around retained mature trees and mulched to supress weeds. Ongoing management of Zone B likely to include:

- Regular removal of weeds and built up dead material (such as fallen branches, leaf litter etc.)
- Application of ground/surface covers such as mulch or non-flammable materials as required.
- Regular mowing/slashing of grass to less than 100 millimetres (mm) in height.

Parks Recreation and Drainage Reserve

The 'Park Recreation and Drainage' reserve (Zone A) will be revegetated to a Forest (Class A) vegetation classification in accordance with the Landscape Master Plan (**Appendix B**). No fuel management of this area is proposed.

5.1.2.2 Surrounding the site

Within existing private landholdings

Where indicated as a low threat in **Figure 3**, it is assumed that the private landholdings surrounding the site will be managed by the applicable landowners and/or management authority in accordance with existing maintenance regimes or the City of Kwinana fire control notice (as published).

Classified vegetation within Lot 501 to the east of the site will be removed in the post-development scenario and converted to 'non vegetated' based on the future planned residential development in accordance with Lot 500 & 501 Bertram Road Local Structure Plan (Atlus Planning 2017). It is noted that some of these areas may contain managed grass or garden beds in the future (as part of developing in/around future buildings), however for ease of reference and distinction have been excluded as non-vegetated.

As stated in **Section 1.4,** The City of Kwinana's LPP No.3 (**Appendix B**) provides an integrated plan for the treatment of the interface of the Bollard Bulrush Swamp in the different Structure Plan areas surrounding the wetland. The City of Kwinana's LPP No.3 applies to all land within the Bollard Bulrush West urban cell zoned 'Development' under TPS No.2, which includes the site and surrounding lots.

It is assumed the 50 m buffer interface will be designed and implemented on the surrounding Lots 500 and 950 Bertram Road, Wellard in accordance with the *Bollard Bulrush East Landscape Master Plan*. A future conservation reserve abutting the Bollard Bulrush Swamp will be revegetated with local native species and classified as Forest (Class A) in the post development scenario. This area is generally delineated by the DUP. The area to the north of the DUP will be utilised for active/passive recreational purposes and will be landscaped to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959.

5.1.3 City of Kwinana Fire Break Notice

The City of Kwinana releases a fire break notice annually (or as required) to provide a framework for bushfire management within the City. The City of Kwinana is able to enforce this order in accordance with Section 33 of the *Bush Fires Act 1954* and landowners will need to ensure compliance with the fire break notice, as published, or any directions provided by the City of Kwinana.

In particular, in accordance with the fire break notice, where land is 1,499 m^2 or less, all long grass, weeds etc. should be slashed, mowed or trimmed down to a height no greater than 50 mm across the entire property.

5.1.4 Vulnerable land uses

The Kings College proposed education buildings will meet the criteria of a 'vulnerable' land use in accordance with the definitions provided in SPP 3.7 and the Guidelines. The buildings will accommodate groups of young children who are generally classed to have reduced physical and mental ability to respond in a bushfire event.

The BAL assessment indicates that Special Use: Education Establishment area (which will support the education buildings) will be mostly located within BAL – LOW with a small proportion classified as BAL – 12.5. The future education buildings will be considered as Class 9, and while the requirements

of *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas* (AS 3959) are not directly applicable to this building class, these types of buildings are subject to higher construction standards in accordance with the Building Code of Australia (BCA). Despite the potential for some education buildings to be located within BAL – 12.5, these buildings will be able to provide sufficient integrity for evacuation or shelter-in-place.

Where vulnerable land uses are proposed to be developed in an area exposed to a BAL rating of BAL-12.5 or greater, development applications for these types of land uses are recommended to be supported by a Bushfire Management Plan and an Emergency Evacuation Plan.

5.1.5 Public education and preparedness

Community bushfire safety is a shared responsibility between individuals, the community, government and fire agencies. DFES has an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. The DFES publication '*Prepare. Act. Survive.'* (DFES 2014) provides advice on preparing for and surviving the bushfire season. Other downloadable brochures are available from http://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/pages/publications.aspx

The City of Kwinana provides bushfire safety advice to residents available from their website https://www.kwinana.wa.gov.au/our-services/emergency-services/bushfires-fire-control/Pages/default.aspx. Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in high-risk areas in addition that that provided in this BMP.

In the case of a bushfire in the area, advice would be provided to businesses by DFES, the Department of Biodiversity Conservation and Attractions (DBCA) and/or the City of Kwinana on any specific recommendations with regard to responding to the bushfire, including evacuation if required. However, it is highly recommended that residents make themselves aware of their responsibilities with regard to preparing for and responding to a potential bushfire that may impact upon them, their property and their visitors at the time, regardless of the BAL rating the building is subject to.

6 Responsibilities for Implementation and Management of Bushfire Measures

Table 5 outlines the future responsibilities of the proponent (developer), future landowners and the City of Kwinana associated with implementing this BMP with reference to ongoing bushfire risk mitigation measures for existing land uses (through compliance with the City of Kwinana fire break notice) or future mitigation measures to be accommodated as part of the development process. These responsibilities will need to be considered as part of the subsequent development and implementation process.

Table 5: Responsibilities for the implementation of this BMP

Management action	Timing
Developer	
The managed wetland interface should be designed, implemented and maintained to achieve a low threat standard in accordance with Section 2.2.3.2 of AS 3959. This will include modifying existing vegetation through the removal/thinning of vegetation and where appropriate retention of mature trees. Ongoing management is likely to include (but is not limited to): • Regular removal of weeds and built up dead material (such as fallen branches, leaf litter etc.) • Low pruning of trees. • Application of ground/surface covers such as mulch or non-flammable materials as required. • Regular mowing/slashing of grass to less than 100mm in height.	As part of subdivision and development, and ongoing as required during the developer maintenance period.
Ensuring construction of new dwelling/s complies with AS 3959, as per the applicable BAL rating, determined as part of this BMP (outlined within Section 3 of this BMP) or through a separate BAL assessment. The BAL rating for a new dwelling should not exceed BAL-29.	As part of building design and construction
Install internal perimeter driveway to the standards outlined in Appendix Four of the Guidelines (WAPC and DFES 2017).	As part of building design and construction
Ensuring that where hydrants are located, these are not obstructed and remain visible at all times. Ongoing, where	As part of building design and construction.
Ensuring that their property complies with the City of Kwinana fire break notice/s as published and/or in accordance with directions given by the local government. This includes maintaining the entire lot to a low threat standard until developed.	Ongoing, as required.
City of Kwinana	
Providing fire prevention and preparedness advice to landowners upon request, including the *Homeowners Bush Fire Survival Manual: Prepare, Act, Survive* (or similar suitable documentation) and the latest City of Kwinana fire break notice.	Ongoing, as required
Monitoring compliance with the City of Kwinana fire break notice and enforcing requirements as required.	Ongoing, as required
Water Corporation	
The Water Corporation is responsible for the ongoing maintenance and repair of water hydrants.	Ongoing, as required.

7 Applicant Declaration

7.1 Accreditation

This BMP has been prepared by Emerge Associates who have been providing bushfire risk management advice for more than six years, undertaking detailed bushfire assessments (and associated approvals) to support the land use development industry.

Anthony Rowe is a Fire Protection Association of Australia (FPAA) Level 3 Bushfire Planning and Design (BPAD) accredited practitioner (BPAD no. 36690) with over ten years' experience and is supported by a number of team members who have undertaken BPAD Level 1 and Level 2 training and are in the processing of gaining formal accreditation.

7.2 Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Signature:

Name: Anthony Rowe

Company: Emerge Associates

Date: 3 December 2020

BPAD Accreditation: Level 3 BPAD no. 36690

8 References

8.1 General references

The references listed below have been considered as part of preparing this document.

Department of Fire and Emergency Services (DFES) 2014, *Prepare. Act. Survive.*, Perth. August 2014.

Emerge Associates 2020a, *Environmental Assessment and Management Strategy – Lot 500 Bertram Road, Wellard Local Structure Plan Amendmen*, The Kings College, EP20-047(07)--005, 1.

Emerge Associates 2020b, *Local Water Management Strategy Addendum – Lot 500 Bertram Road, Wellard Local Structure Plan Amendment*, The Kings College, EP20-047(07)--003, 1.

Emerge Associates 2020c, *Reconnaissance Flora and Fauna Survey - Lot 500 Bertram Road, Wellard Local Structure Plan Amendment* EP20-047(01)--002 TAA Ecology Summary, Rev 1.

ENV Australia 2011a, *Bollard Bullrush East - Fauna Assessment*.

ENV Australia 2011b, *Bollard Bullrush East - Flora and Vegetation Assessment*.

Standards Australia 2009, *AS 3959-2009 Construction of buildings in bushfire-prone areas*, Sydney.

Standards Australia 2018, *AS 3959:2018 Construction of buildings in bushfire-prone areas*, Sydney.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Perth.

Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2017, *Guidelines for Planning in Bushfire Prone Areas Version 1.3*, Western Australia. December 2017.

8.2 Online references

Landgate 2020, *Map Viewer*, viewed November 2020, https://www0.landgate.wa.gov.au/maps-and-imagery/interactive-maps/map-viewer

Office of Bushfire Risk Management (OBRM) 2020, Map of Bush Fire Prone Areas, viewed November 2020, https://maps.slip.wa.gov.au/landgate/bushfireprone/

Figures

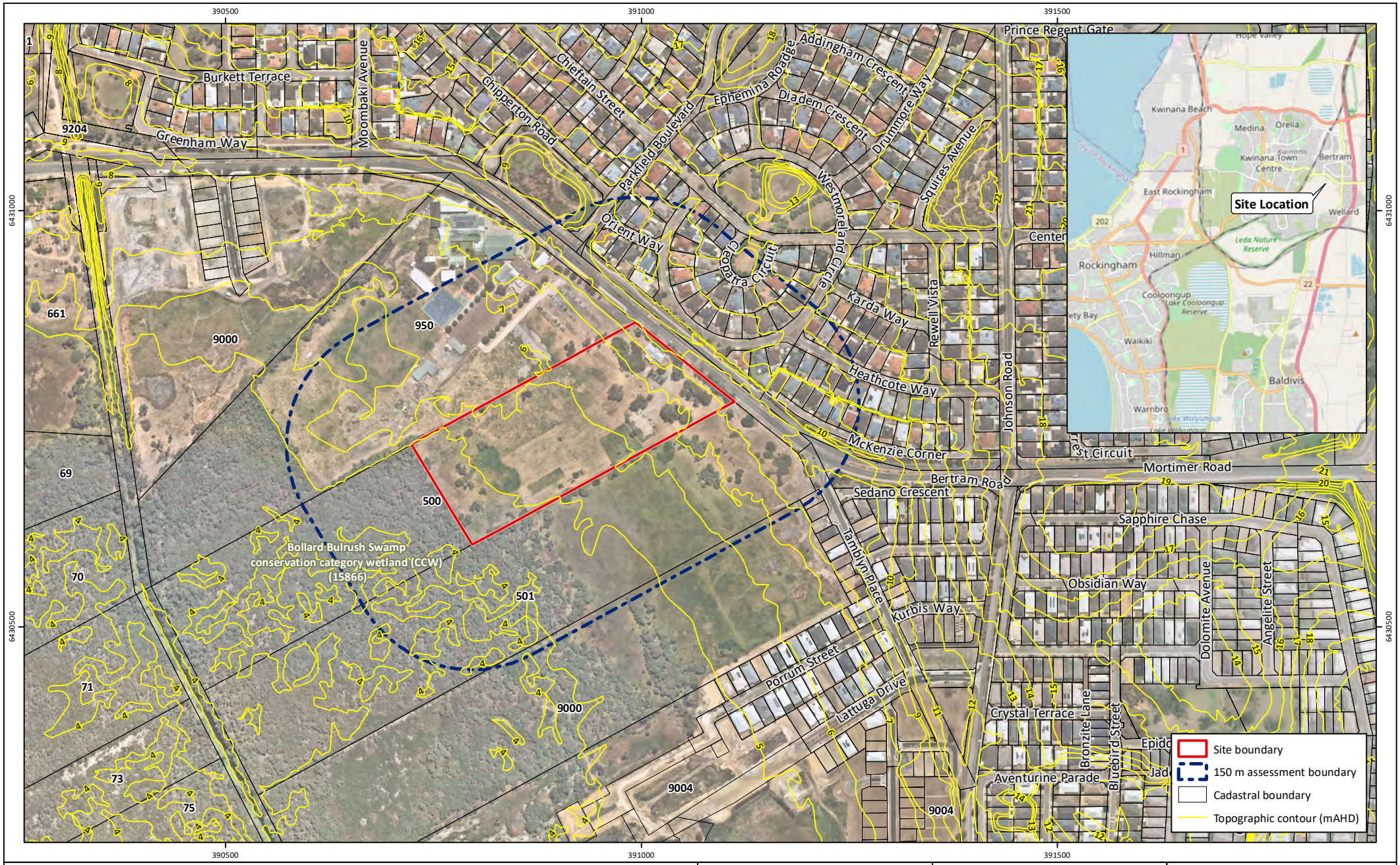

Figure 1: **Site Location and Topographic Contours**

Project:	Bushfire Management Plan Lot 500 Bertram Road, Wellard Local Structure Plan Amendment
Client:	The Kings College

Plan Number:
EP20-047(06)--F32

Drawn:	GAR
Date:	26/11/2020
Checked:	BRB
Approved:	AJR
Date:	02/12/2020

N

0 100 200
Metres

Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

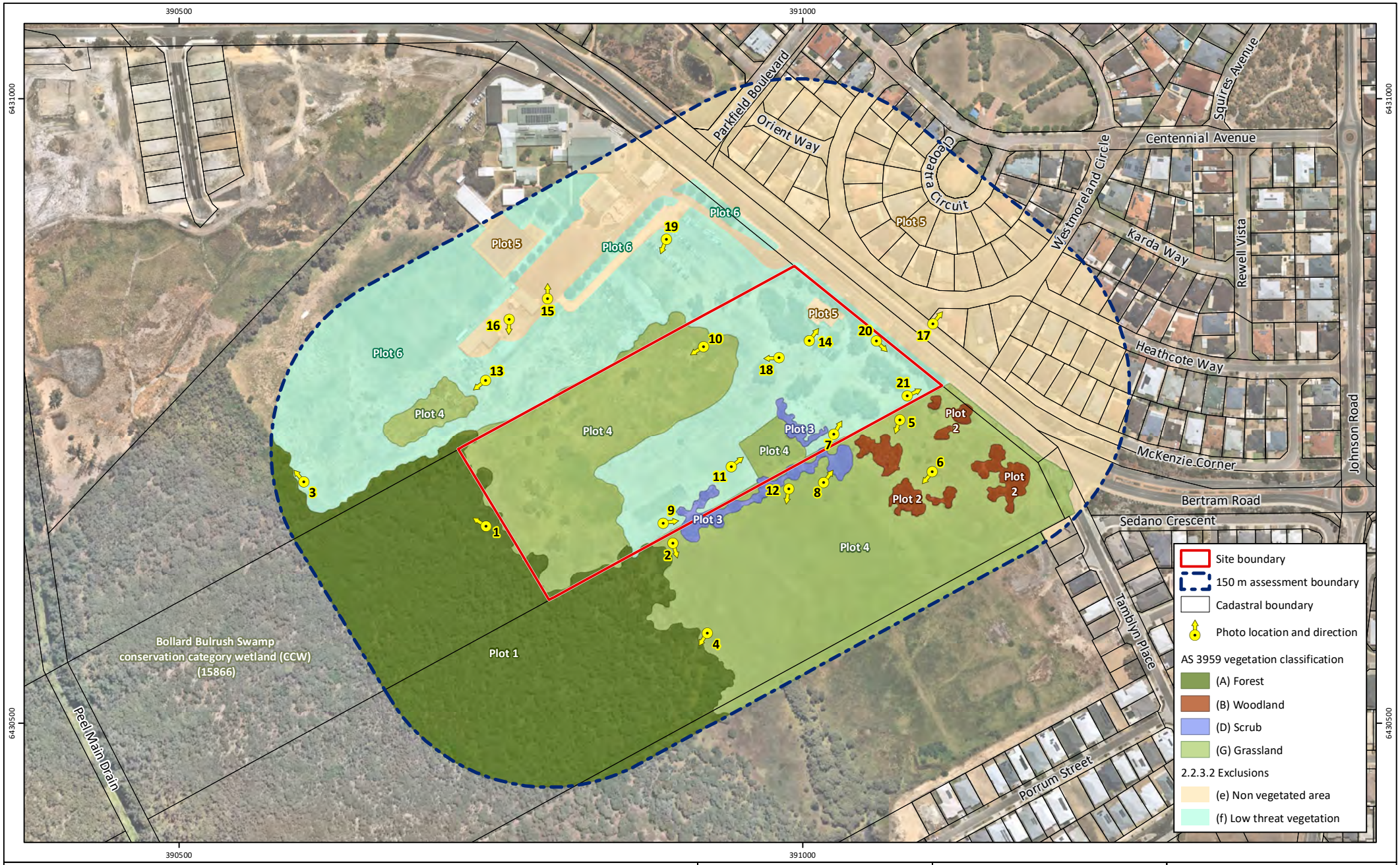

Figure 2: **Existing Site Conditions - AS3959 Vegetation Classifications**

Project: Bushfire Management Plan
Lot 500 Bertram Road, Wellard Local Structure Plan Amendment

Client: The Kings College

Plan Number:
EP20-047(06)--F33

Drawn:	GAR
Date:	26/11/2020
Checked:	BRB
Approved:	AJR
Date:	02/12/2020

N

0 50 100 150
Metres

Scale: 1:4,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

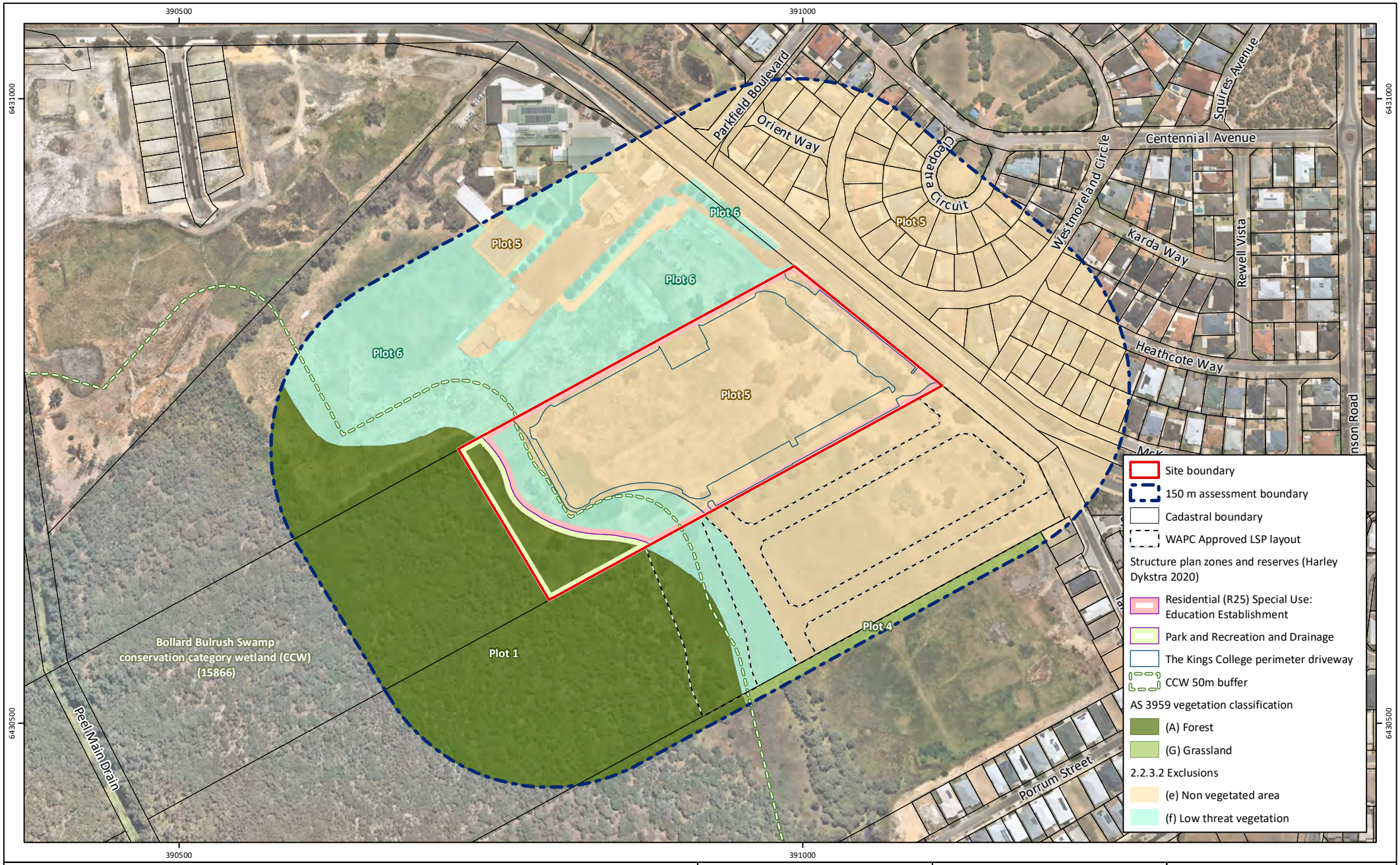

Figure 3: Post Development Site Conditions - AS 3959 Vegetation Classifications

Project: Bushfire Management Plan
Lot 500 Bertram Road, Wellard Local Structure Plan Amendment
Client: The Kings College

Plan Number:
EP20-047(06)--F34
Drawn: GAR
Date: 26/11/2020
Checked: BRB
Approved: AJR
Date: 02/12/2020

N

0 50 100 150
Metres
Scale: 1:4,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

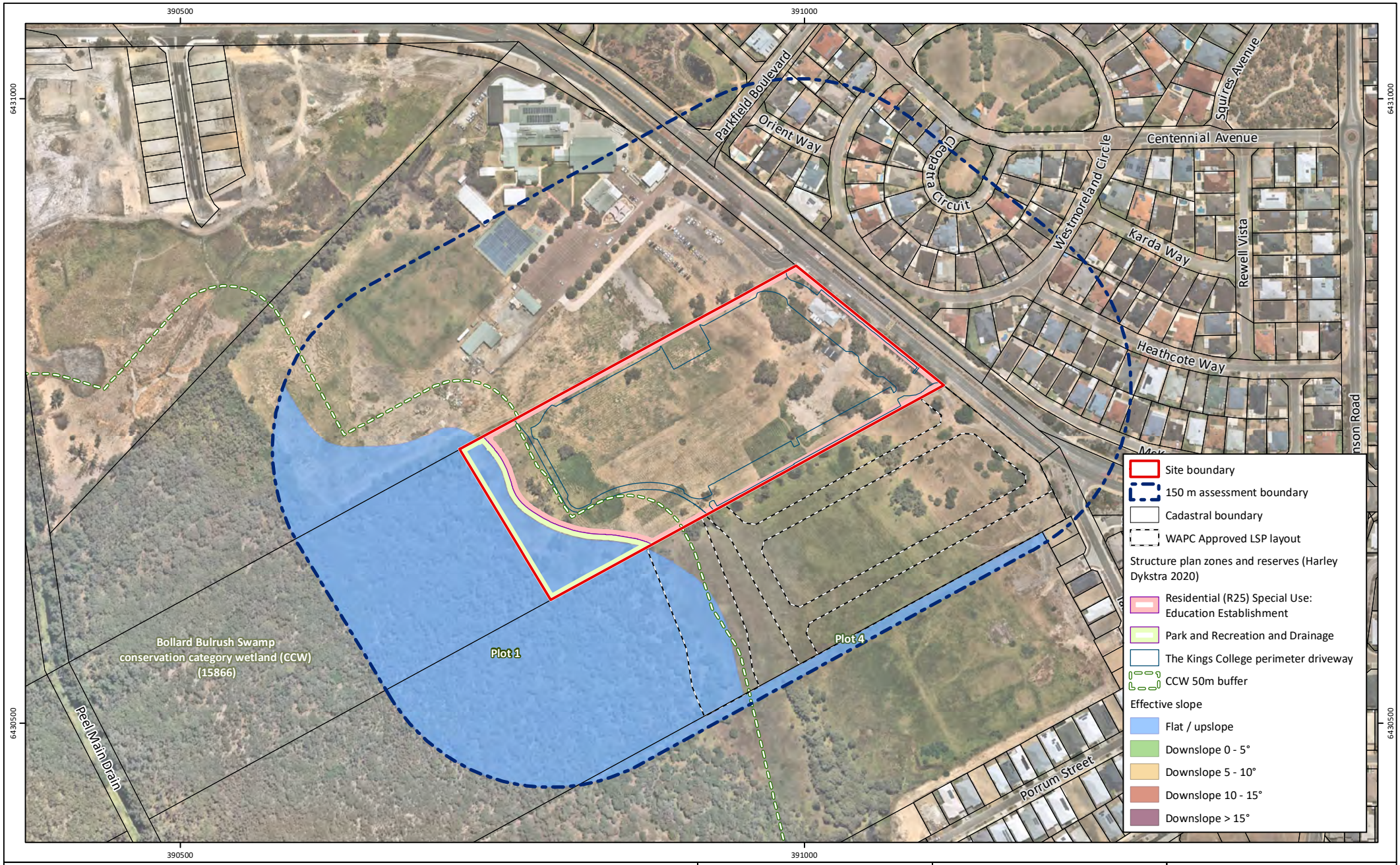

Figure 4: Post Development Site Conditions - Effective Slope

Project: Bushfire Management Plan
Lot 500 Bertram Road, Wellard Local Structure Plan Amendment

Client: The Kings College

Plan Number:
EP20-047(06)--F35

Drawn:	GAR
Date:	26/11/2020
Checked:	BRB
Approved:	AJR
Date:	02/12/2020

N

0 50 100 150
Metres

Scale: 1:4,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

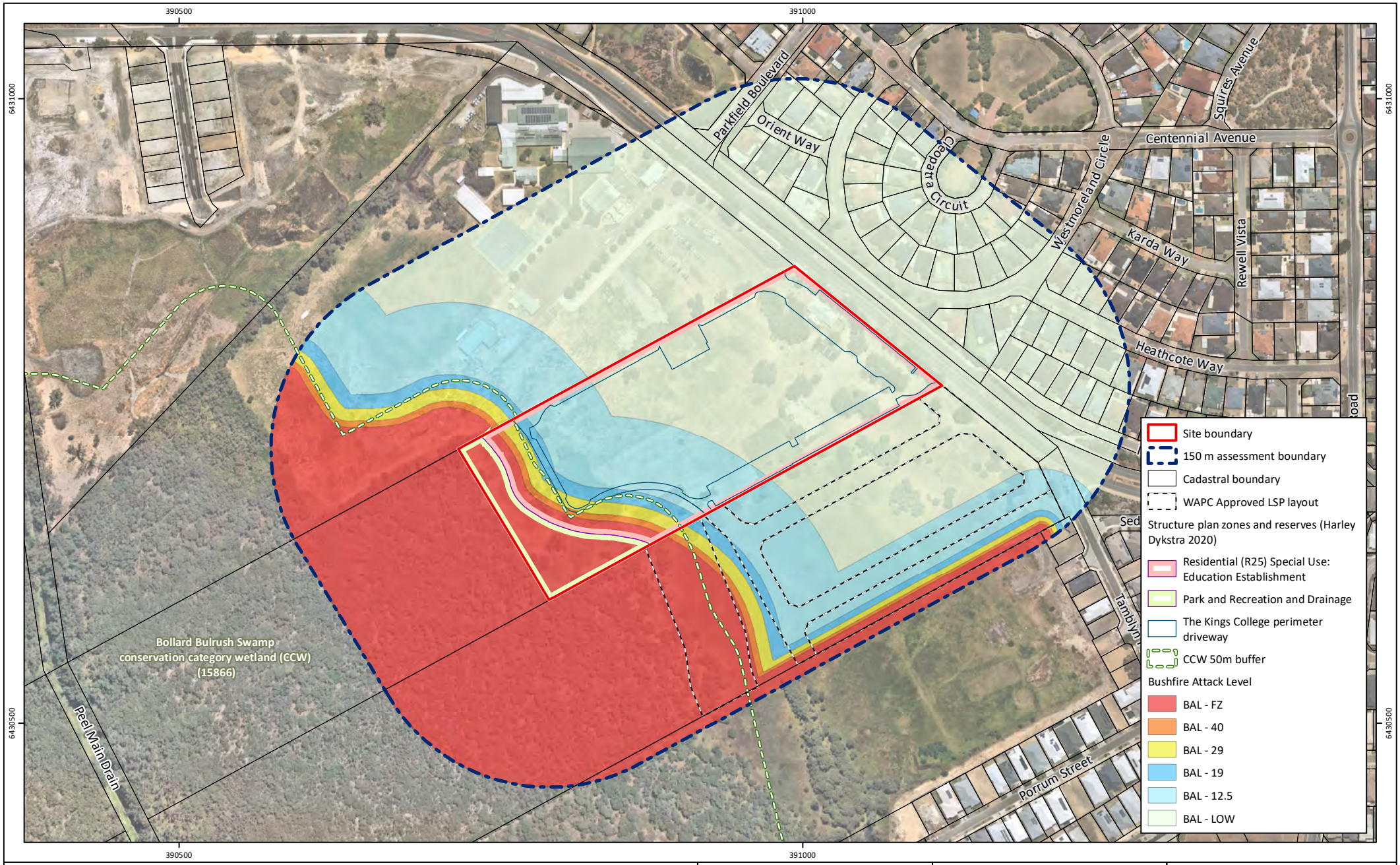

Figure 5: Bushfire Attack Level Contours

Project: Bushfire Management Plan
Lot 500 Bertram Road, Wellard Local Structure Plan Amendment

Client: The Kings College

Plan Number:
EP20-047(06)--F36

Drawn:	GAR
Date:	26/11/2020
Checked:	BRB
Approved:	AJR
Date:	02/12/2020

N

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Metres

Scale: 1:4,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

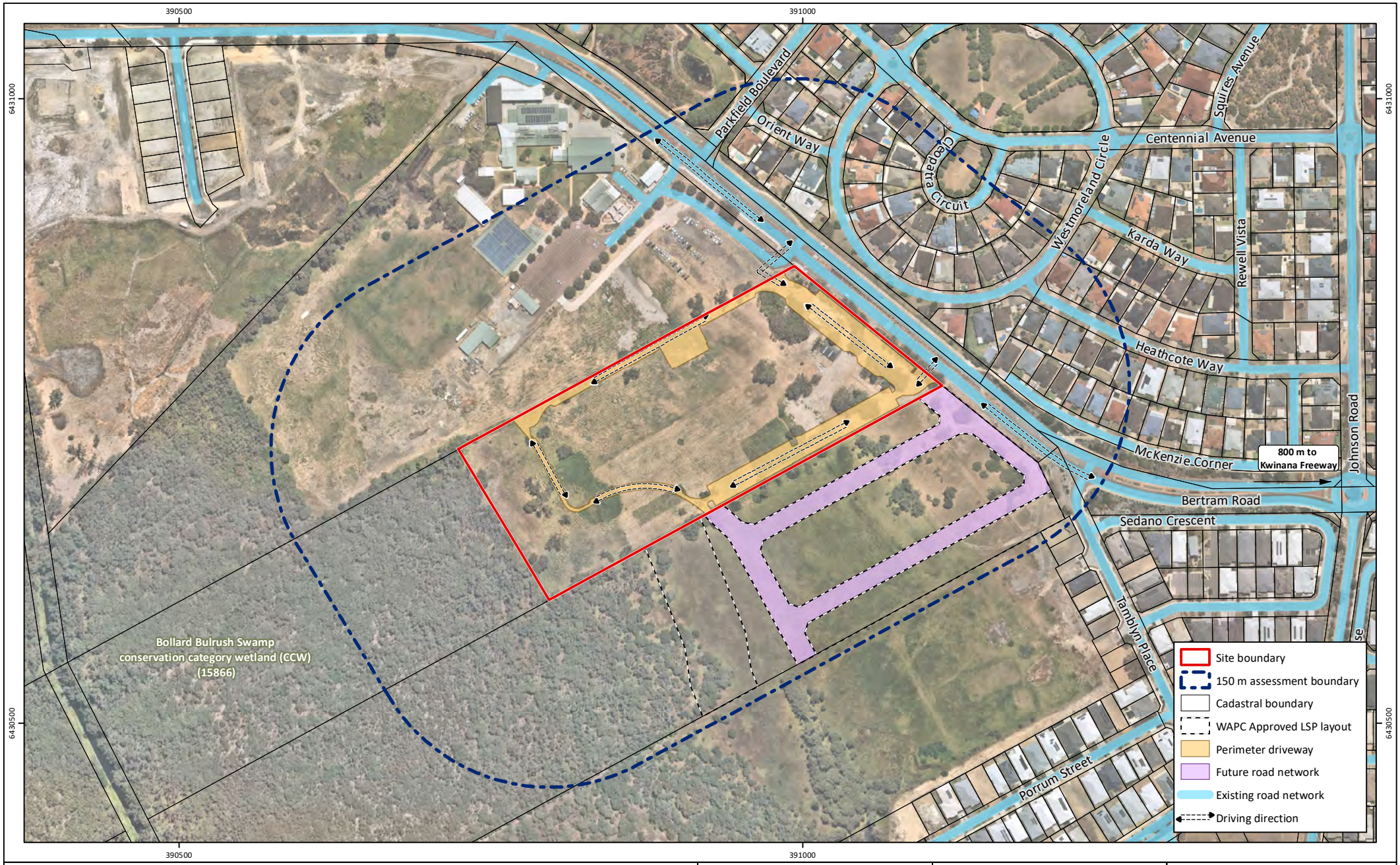


Figure 6: Vehicle Access

Project: Bushfire Management Plan
Lot 500 Bertram Road, Wellard Local Structure Plan Amendment
Client: The Kings College

Plan Number:
EP20-047(06)--F37
Drawn: GAR
Date: 26/11/2020
Checked: BRB
Approved: AJR
Date: 02/12/2020

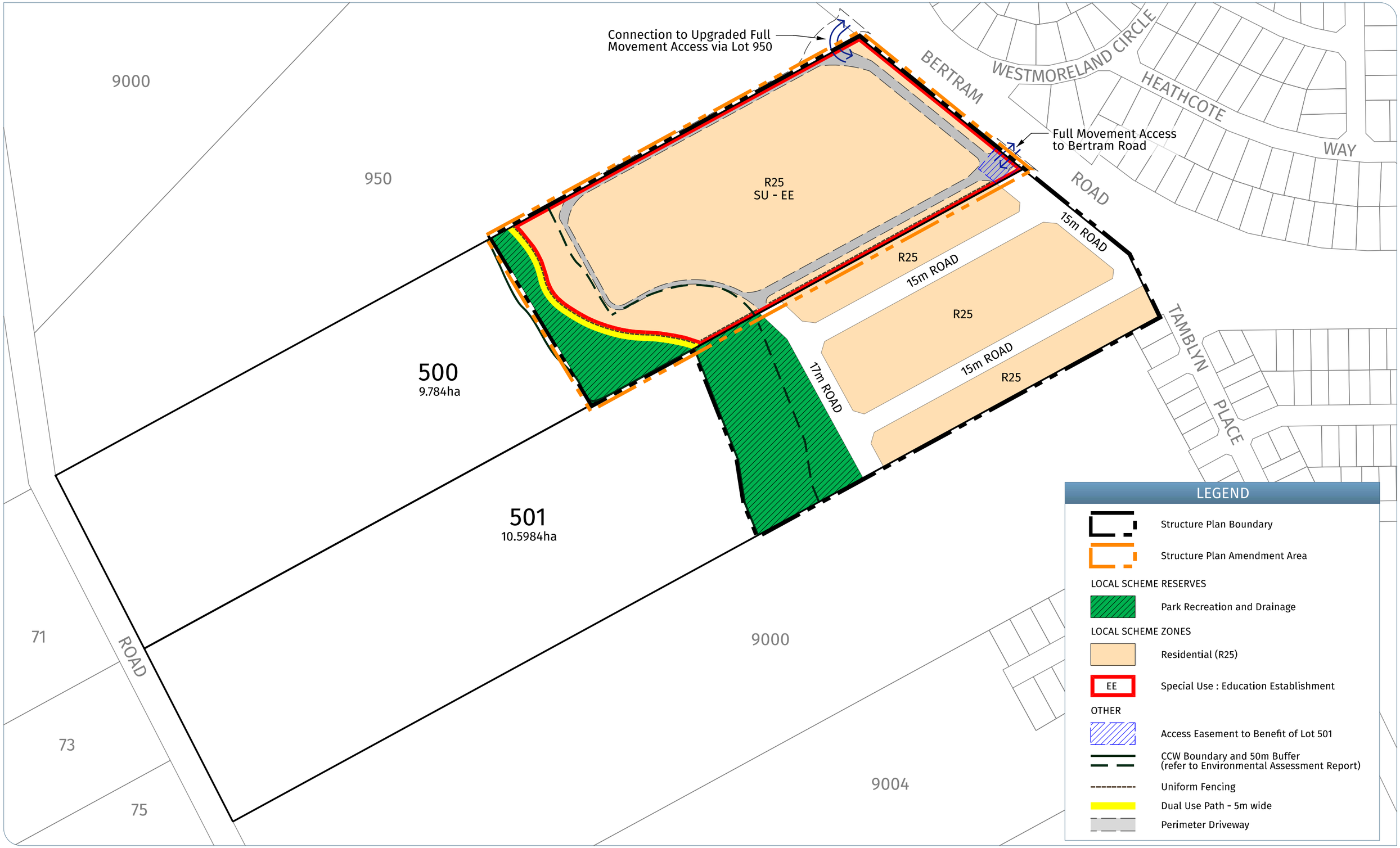
N

0 50 100 150
Metres
Scale: 1:4,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix A

Lots 500 (No.2) & 501 (No.214) Bertram Road, Wellard Local Structure Plan (Harley Dykstra 2020)



LEGEND

- Structure Plan Boundary
- Structure Plan Amendment Area

LOCAL SCHEME RESERVES

- Park Recreation and Drainage

LOCAL SCHEME ZONES

- Residential (R25)
- EE — Special Use : Education Establishment

OTHER

- Access Easement to Benefit of Lot 501
- CCW Boundary and 50m Buffer (refer to Environmental Assessment Report)
- Uniform Fencing
- Dual Use Path - 5m wide
- Perimeter Driveway

STRUCTURE PLAN

Lots 500 (No. 202) & 501 (No.214) Bertram Road, WELLARD

Plan No.	21968-04	
Date	27/10/20	
Drawn	NP	
Checked	DM	
Revision	A	
Scale	1:2500@A3	0 20m 40m 60m

PERTH & FORRESTDALE:
Lvl 1, 252 Fitzgerald St
PERTH WA 6000
15/2 Hensbrook Loop,
FORRESTDALE WA 6112
T: 08 9495 1947
E: metro@harleydykstra.com.au
ALBANY | BUNBURY | BUSSELTON | FORRESTDALE | PERTH

NOTE: This plan has been prepared for planning purposes. Areas, Contours and Dimensions shown are subject to survey

Harley Dykstra®
PLANNING & SURVEY SOLUTIONS

Appendix B

The Kings College, Johnson Road, Wellard Landscape Masterplan (Emerge Associates 2020)

THE KINGS COLLEGE, BERTRAM ROAD, WELLARD

December 2020

Site Structure Plan Amendment

emerge ASSOCIATES

LOCATION PLAN

BACKGROUND:

The Kings College (the proponent) are progressing with an amendment to the existing Local Structure Plan over Lot 500 Bertram Road, Wellard to facilitate the development of The Kings College primary and secondary school. The existing Structure Plan for Lot 500 and 501, Bertram Road, Wellard, approved in 2017 was prepared in anticipation of the site being developed as for residential development, which will require an amendment to enable the proposed land use. The expansion of The Kings College will occur over the northern portion of Lot 500 Bertram Road, Wellard (the site).

The site is 5.00 hectares (ha) in size and is located approximately 32 km south of the Perth Central Business District, within the City of Kwinana. The site is located within a mixed urban and rural-residential area, with Bertram Road and urban development to the north, large rural-residential lots to the east, the Bollard Bulrush Swamp Conservation Category Wetland (CCW) (UFI 15866) and Peel Main Drain to the south, The Kings College buildings and sporting ovals and the Freeway Church to the west. The site is currently zoned 'Urban' under the Metropolitan Region Scheme (MRS), and 'Development', under the City of Kwinana Town Planning Scheme (TPS) No.2.

PURPOSE OF THIS REPORT:

The purpose of the Landscape Report is to provide a synthesis of information regarding the landscape values and attributes of the site. Specifically, this report:

- Identifies the landscape uses and attributes of the site
- Discusses the land use for the structure plan area.
- Discusses how the structure plan layout responds to the existing environmental features and values, and future landscape management requirements as part of the future planning and development process.
- Addresses the interface of the site with the adjacent wetland

LANDSCAPE MASTER PLAN:

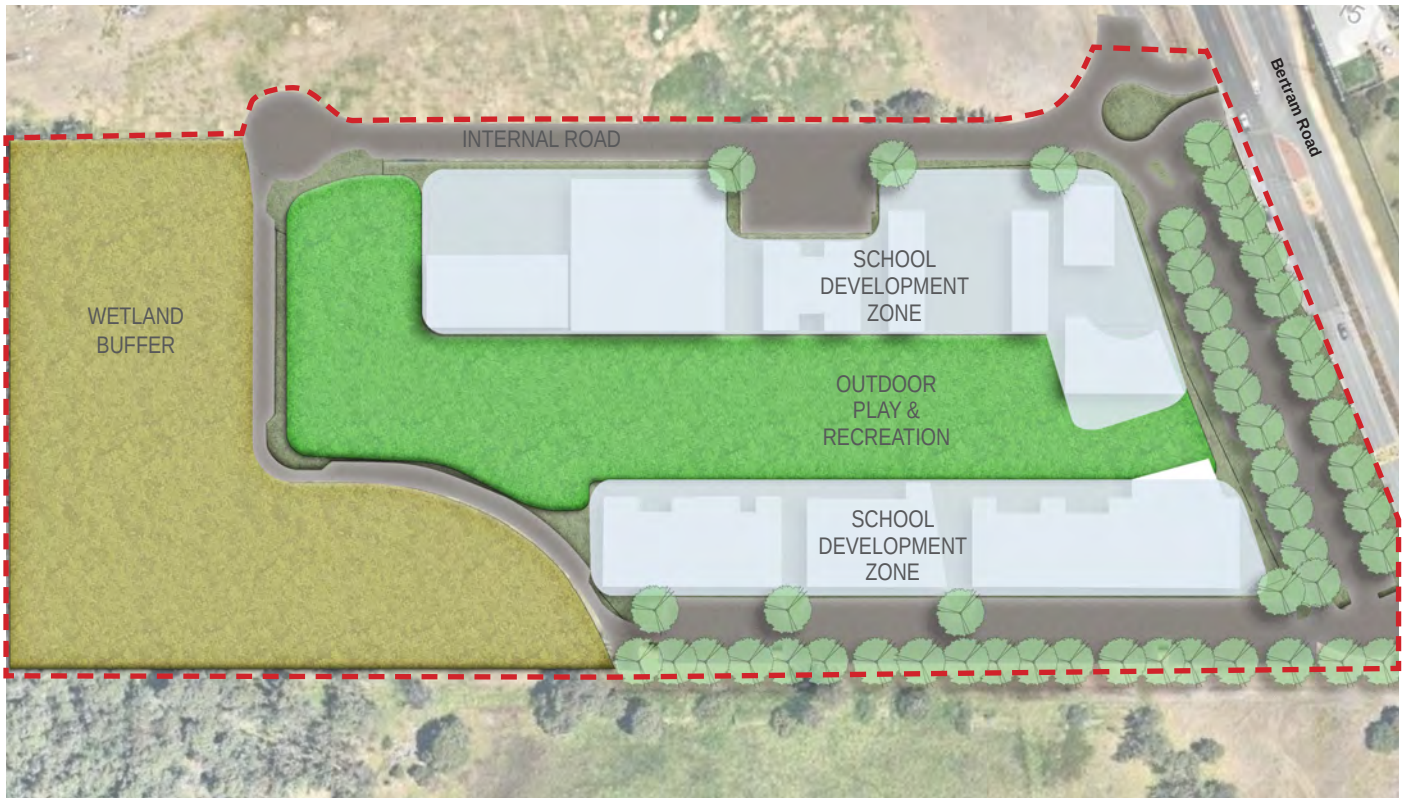
The landscape master plan offers a range of active and passive opportunities for the students of The Kings College, providing accessibility and connectivity throughout the site whilst also playing an important role in protecting the sites adjacent natural assets.

The plan provides connections both externally and internally to key nodes from the school, adjacent landowners and natural assets. Continuous pedestrian/cycling paths will link along the wetland in accordance with the Bollard Bulrush Wetland Masterplan and will include appropriate planting, amenities in the form of passive recreation opportunities and seating.

The plan identifies the requirement for a balanced approach to ensure the social and recreational requirements of the future students and users of Bollard Bulrush Wetland are balanced with the ecological and engineering constraints imposed by the site.

DWG ENVIRO-73
REV D
DATE DEC 2020

LANDSCAPE STRATEGY PLAN



LEGEND

- EXTENT OF WORKS
- INDICATIVE TREES

KINGS COLLEGE SUMMARY

SCHOOL DEVELOPMENT LANDSCAPE
- Turf area for active recreation
- Hard courts for play and active recreation
- Gathering spaces for students to congregate
- Play space and picnic facilities
- Pedestrian/Cycle Path network links to adjacent development.
- Planting appropriate to Education Department specification.

OUTDOOR PLAY & RECREATION
- Balance of native planted pockets and open turf areas
- Large gathering spaces beneath trees
- Informal seating spaces on walls or boulders
- Informal active recreation space

STREETSCAPE
- Predominantly native planted
- Trees planted in rows to provide shade for carparks
- Primary focus on providing shade and heavy green infrastructure

WETLAND BUFFER - 50m
- Balance of passive recreation areas incorporating native planting to comply with the requirements for low threat vegetation and the opportunity to retain mature trees.
- Revegetation of native plant species to a portion of the 50 m buffer at the Bollard Bulrush Swamp interface.

SITE STRUCTURE PLAN

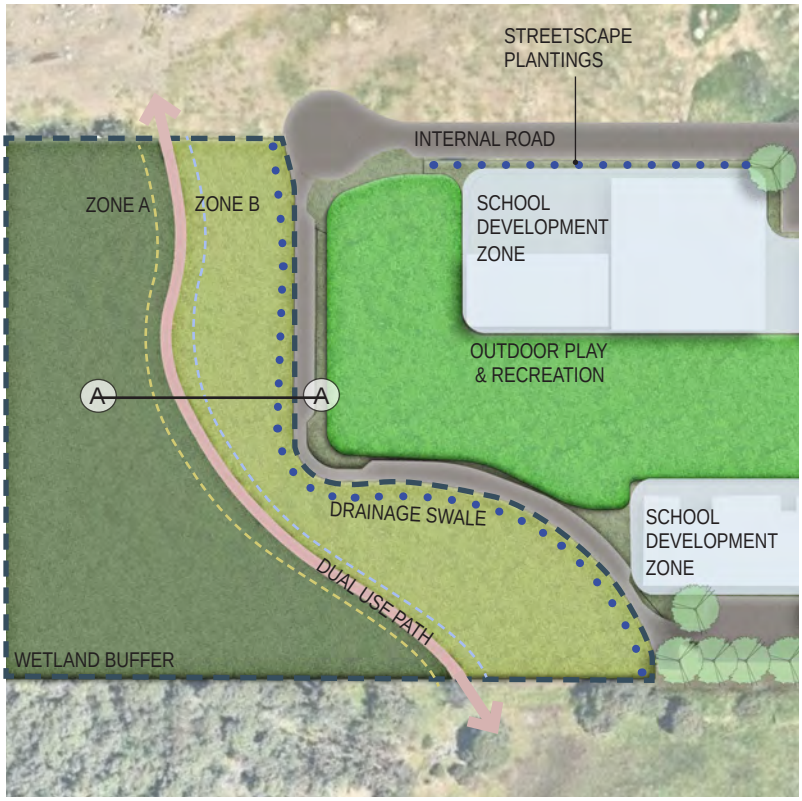
THE KINGS COLLEGE, BERTRAM ROAD WELLARD

DWG **ENVIRO-73**
REV **D**
DATE **DEC 2020**
0 25 50 75 100 m
SCALE **1 : 2000 @ A4**

emerge ASSOCIATES

CONNECTION BETWEEN SCHOOL AND BOLLARD BULLRUSH SWAMP

SWALE AND WETLAND BUFFER INTERFACE



CONCEPT

- Maintain and enhance the existing vegetation within a portion of the wetalnd buffer.
- Meandering dual use path runs the length of the wetland buffer and links to greater path networks
- Native seed planting within passive recreational open spaces between The Kings College and the wetland rehabilitation area, designed to achieve a low threat vegetation standard in accordance with AS3959
- Restricted access to wetland

FUNCTIONS

- Strategic revegetation
- Dual use path
- Provide linkages to pedestrian networks within and outside the development
- Drainage swale

ENVIRONMENTAL CONSIDERATIONS

- No irrigation
- Revegetation of native plant communities to a portion of the 50 m buffer (Zone A) at the Bollard Bulrush Swamp interface
- Removal of weed species
- A portion of the 50 m buffer (Zone B) will be landscaped to provide a managed interface to the wetland reserve. This area will be designed to achieve 'low threat' vegetation in accordance with Section 2.2.3.2 of AS 3959.

BOLLARD BULLRUSH SWAMP BUFFER

WETLAND BUFFER - 50m

- Balance of passive recreation open spaces incorporating planting to achieve a 'low threat' bushfire classification, in addition to rehabilitation planting at the interface of the Bollard Bullrush Swamp.
- Clearance provided for fire vehicle access
- Creating a connection from the school to the wetland, turning open spaces in to unique and welcoming places

DUAL USE PATH

- Provides secondary fire access between buffer and the school. Access points to core firebreak to be provided every 400m. DUP to align where possible with developers approved LSP plans.

ROADSIDE DRAINAGE SWALE

CONSERVATION FENCE AND LIMESTONE TRACK

SCHOOL BOUNDARY FENCE

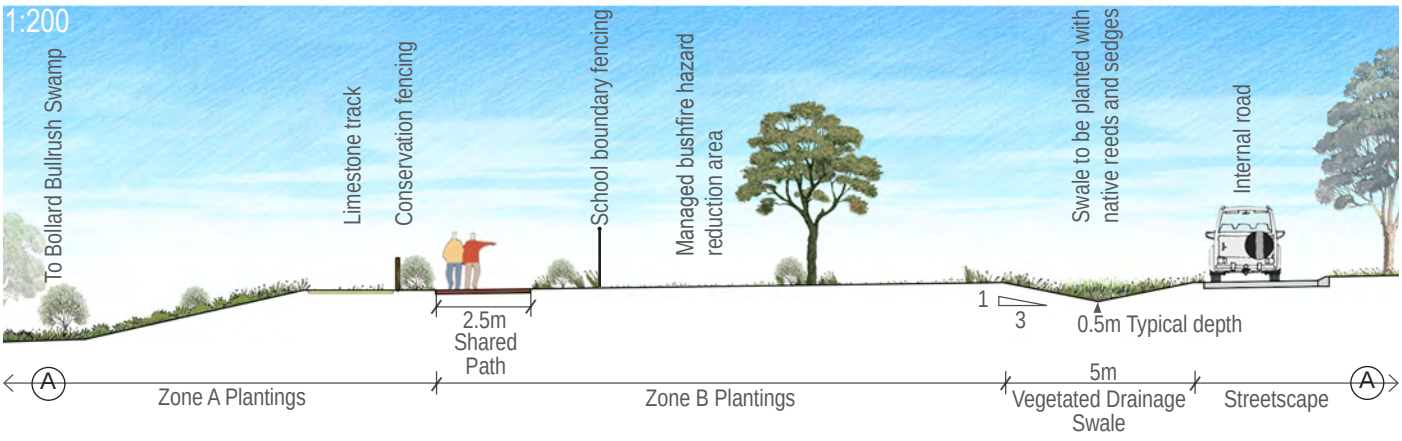
ZONE A

- Revegetation planting to wetland side
- Density of 1 plant mer m^2

ZONE B

- A passive recreation area between The Kings College and Bollard Bulrush Swamp (and the associated Wetland rehabilitation area), incorporating drainage and the opportunity to retain mature trees.
- Will be landscaped and maintained to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959.
- Average density of 1 plant per 2 m^2 but clumped around retained mature trees interspersed with areas of thick woodchip to suppress weeds.

INDICATIVE SECTION



SECTION A - INDICATIVE SECTION WHERE PATH IS LOCATED AT EDGE OF WETLAND BUFFER ZONE

- Sections are conceptual and are subject to change during the detailed design process
- Levels provided are indicative and subject to change during the detail design process

SITE STRUCTURE PLAN

THE KINGS COLLEGE, BERTRAM ROAD WELLARD

DWG ENVIRO-73
REV D
DATE DEC 2020
SCALE 1 : 2000 @ A4

emerge ASSOCIATES

PLANTING CONSIDERATIONS

- A range of native plant species that complement the surroundings have been selected.
- Plants chosen range from low, dense groundcovers to strappy leafed plants, grasses and small to medium sized shrubs.
- Plants native to the local area will provide colourful floral displays throughout the year and attract native birds to the area.
- The use of native plants will minimise maintenance and irrigation requirements and ensure long term plant survival.
- A portion of the 50 m buffer (Zone B) will be designed to achieve 'low threat' vegetation in accordance with Section 2.2.3.2 of AS 3959. and cross referenced with Councils preferred environmental planting suggestions.
- Clear views to the existing wetland trees will be maintained.

Groundcovers

Adenanthos cuneatus

Casuarina glauca

Calothamnus quadrifidus 'Little Ripper'

Calothamnus hirsutus

Convolvulus Moroccan

Erempohila glabra 'Kalbarri Carpet'

Grevillea Gingin Gem

Juniperus conferta

Eremophila glabra

Scaevola 'Purple Passion'

Shrubs

Adenanthos sericea dwarf

Olearia axillaris 'Little Smokie'

Calothamnus quadrifidus 'One-sided Bottlebrush'

Grevillea olivacea

Westringia grey box

Dianella revoluta 'Variegated'

Dianella 'Tas Red'

Melaleuca 'Little Nessie'

Lomandra Tanika

Lomandra wingarra

Trees

Agonis flexuosa

Eucalyptus sideroxylon

Eucalyptus torquata

Melaleuca quinquenervia

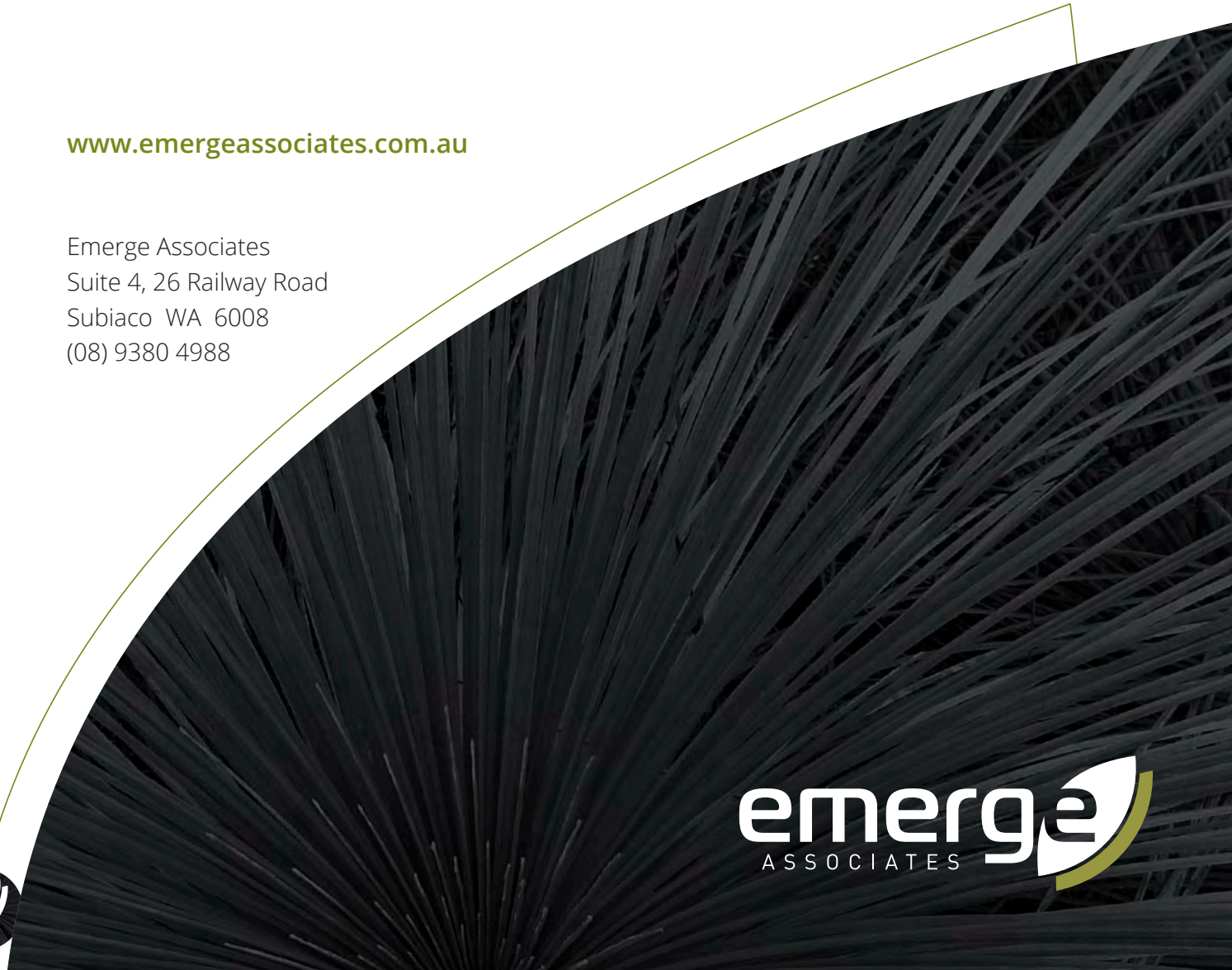
VTipuana tipu

DWG ENVIRO-73
REV D
DATE DEC 2020 SCALE NOT TO SCALE

emerge ASSOCIATES

www.emergeassociates.com.au

Emerge Associates
Suite 4, 26 Railway Road
Subiaco WA 6008
(08) 9380 4988



Appendix C

Bollard Bulrush East Landscape Masterplan (Emerge Associates 2017)

DUAL USE PATH
Provides secondary fire access between buffer and POS.
Access points to core firebreak to be provided every 400m.
DUP to align where possible with developers approved LSP plans.
Path alignment adjacent existing trees where possible for shade and interest
DUP to link to future Tramway Trail and possible future trail along Peel Main Drain to create trail loops.
Themed elements will be incorporated into the DUP to indicate the main path of travel around the wetland for users .

PEEL MAIN DRAIN CROSSINGS
Bridge crossings across Peel Main Drain at 2 locations, north and south of the wetland to create a trail loop.

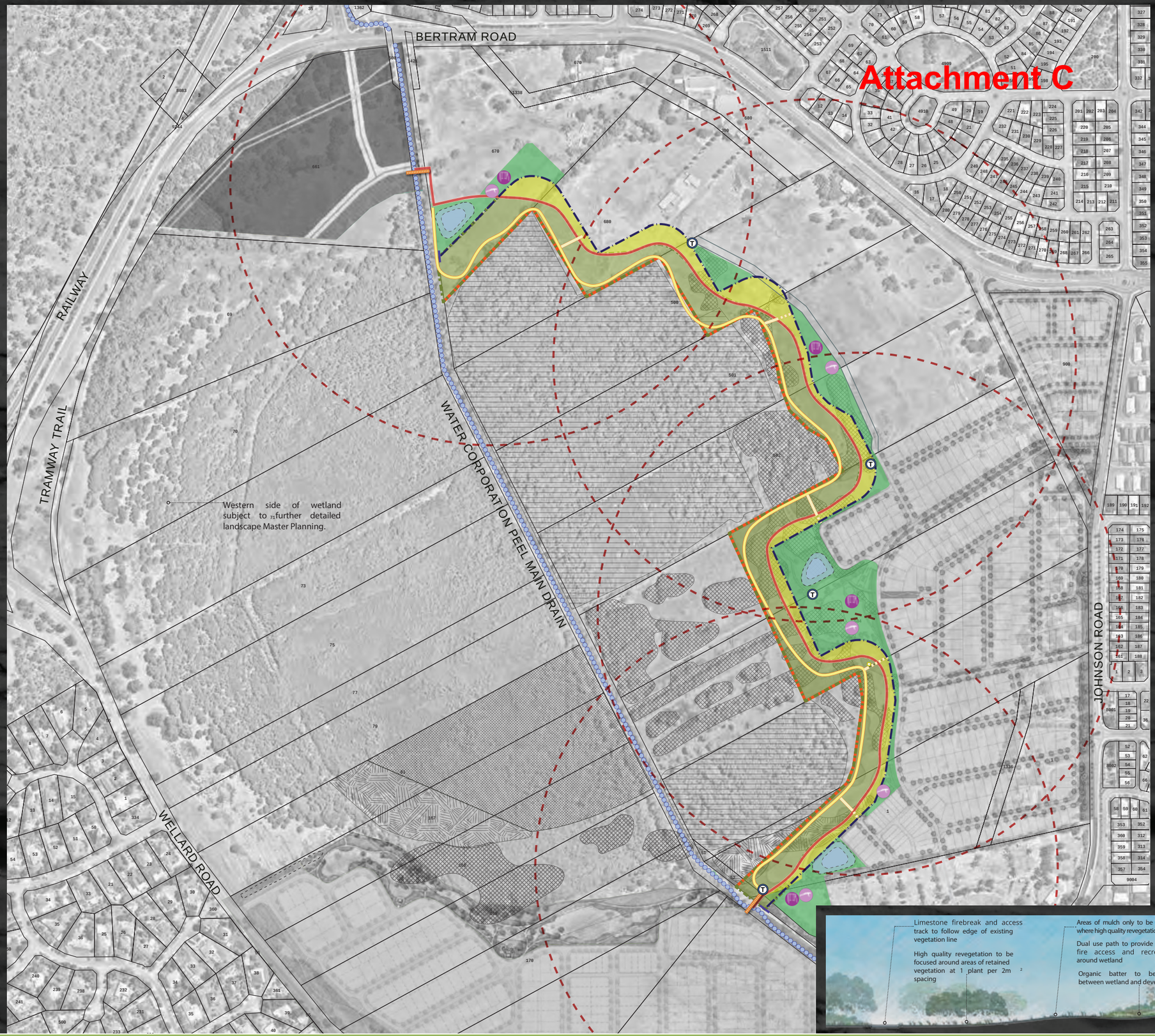
CONSERVATION FENCE
1.2m high reserve fence with ringlock mesh, top wire and galvanised steel picket posts to core edge. 3.5m wide access gates with treated timber posts every 400m.

BUFFER ZONE
Developers to create irregular, 'organic' batter from road to existing buffer/tree levels to create a more natural aesthetic and not to create an 'over-engineered' look.
Revegetation to be focused around areas of retained vegetation to assist with ongoing environmental management
Areas of mulch only to be considered where high quality revegetation provided by developer
Irrigated turf to be permitted within buffer adjacent POS.

FIREBREAK
3m wide firebreak and access track to be located adjacent existing vegetation line, internal of conservation fencing
Overtaking lane provided every 200m (4m wide).
Doubles as walking trail and located adjacent existing trees where possible for users comfort/shade.

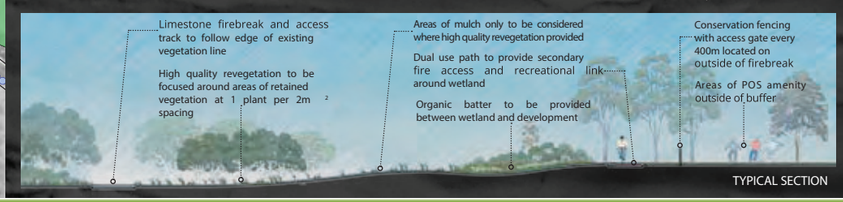
PLAY ELEMENTS
A variety of styles and colours to be used to complement the surrounding environment.
Multi user/ age, interpretive and inclusive play opportunities.

FURNITURE
Clear - anodised aluminium furniture elements.
Mid Grey/Cedar colours to complement the natural environment rather than contrast.



LEGEND
- WETLAND CORE BOUNDARY
- 50m BUFFER ZONE
- VEGETATION COMMUNITIES
  - Eucalyptus rudis ssp. rudis
  - Melaleauca rhaphiophylla
  - Low woodland of Melaleauca rhaphiophylla, Eucalyptus rudis ssp. rudis
  - Low Open Forest of Melaleuca rhaphiophylla, Melaleuca preissiana, Eucalyptus rudis ssp. rudis and Bauma articulata
- CONSERVATION FENCE - 1.2m HEIGHT
- FIREBREAK - 3m WIDE LIMESTONE
- PATH - RED ASPHALT DUAL USE PROVIDES SECONDARY FIRE ACCESS
- FUTURE BRIDGE LINK
- PLAYGROUND
- FITNESS EQUIPMENT
- TRAIL HEAD
- FUTURE TRAIL LINKS
- STORMWATER DETENTION AREAS
- KICKABOUT SPACE
- PUBLIC OPEN SPACE AREA
- REVEGETATION PLANTING 'B' WITHIN BUFFER ZONE, AVERAGE DENSITY OF 1 PLANT PER 2M2 BUT CLUMPED AROUND EXISTING VEGETATION INERSPERSED WITH AREAS OF THICK WOODCHIP TO SUPPRESS WEEDS
- REVEGETATION PLANTING 'A' TO WETLAND SIDE, DENSITY OF 1 PLANT PER m
- 400m WALKABLE CATCHMENT BETWEEN JUNIOR PLAYGROUNDS
- WETLAND FIREBREAK ACCESS LINK AND GATE

SIGNAGE
Trail heads to include interpretive and directional signage.
Interpretive signage themes include; vegetation communities, wetland / Peel Main Drain history, native fauna, cultural history.



TYPICAL SECTION

DWG · COK01-LO1
REV · G
DATE · FEB 2017
SCALE · 1:6000 @ A3

BOLLARD BULRUSH EAST
LANDSCAPE MASTER PLAN

City of Kwinana

emerge ASSOCIATES
Integrated Science & Design

APPENDIX D | LANDSCAPE STRATEGY

THE KINGS COLLEGE, BERTRAM ROAD, WELLARD

December 2020

Site Structure Plan Amendment

emerge ASSOCIATES

LOCATION PLAN

BACKGROUND:

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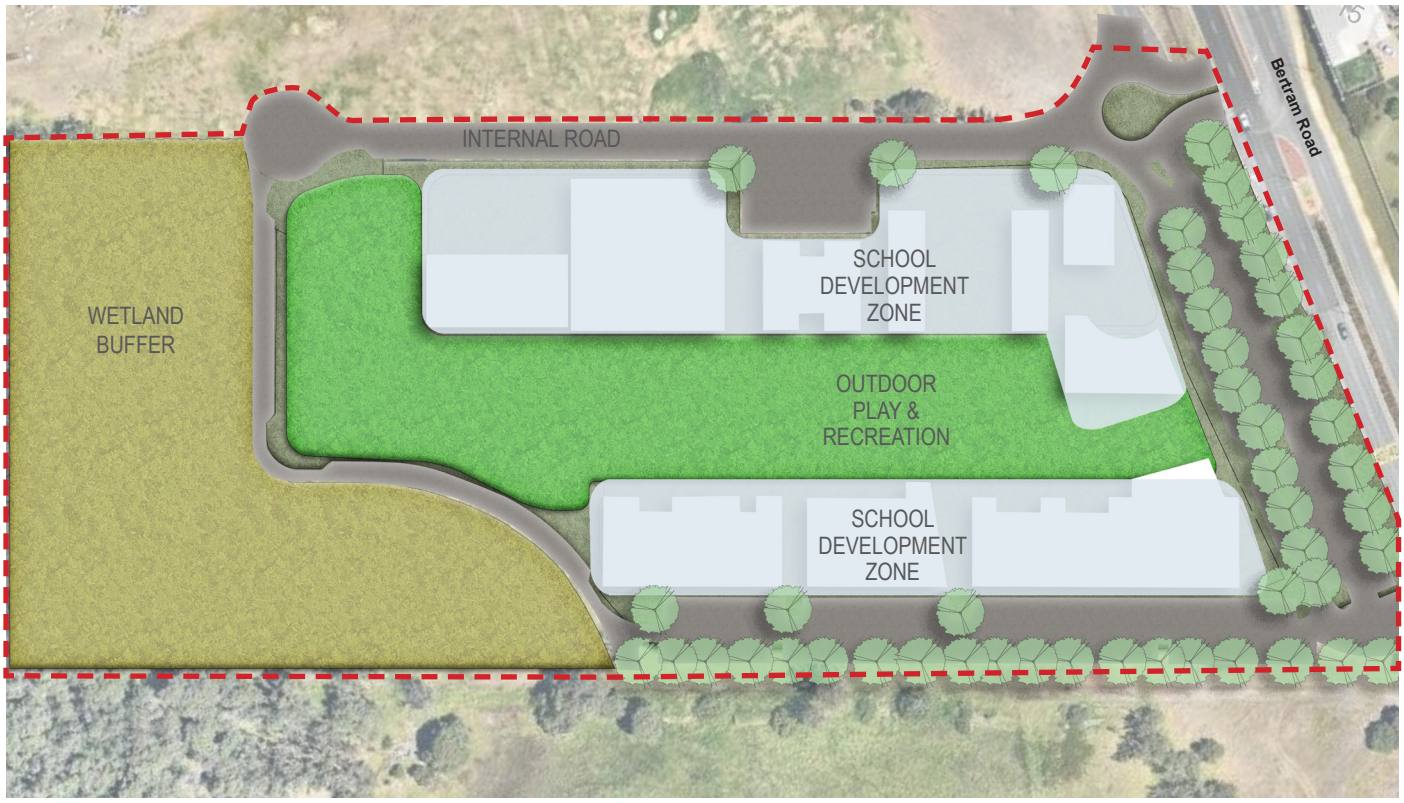
DWG ENVIRO-73
REV D
DATE DEC 2020

LANDSCAPE STRATEGY PLAN



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- INDICATIVE TREES

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WETLAND BUFFER - 50m
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SITE STRUCTURE PLAN

THE KINGS COLLEGE, BERTRAM ROAD WELLARD

DWG ENVIRO-73
REV D
DATE DEC 2020

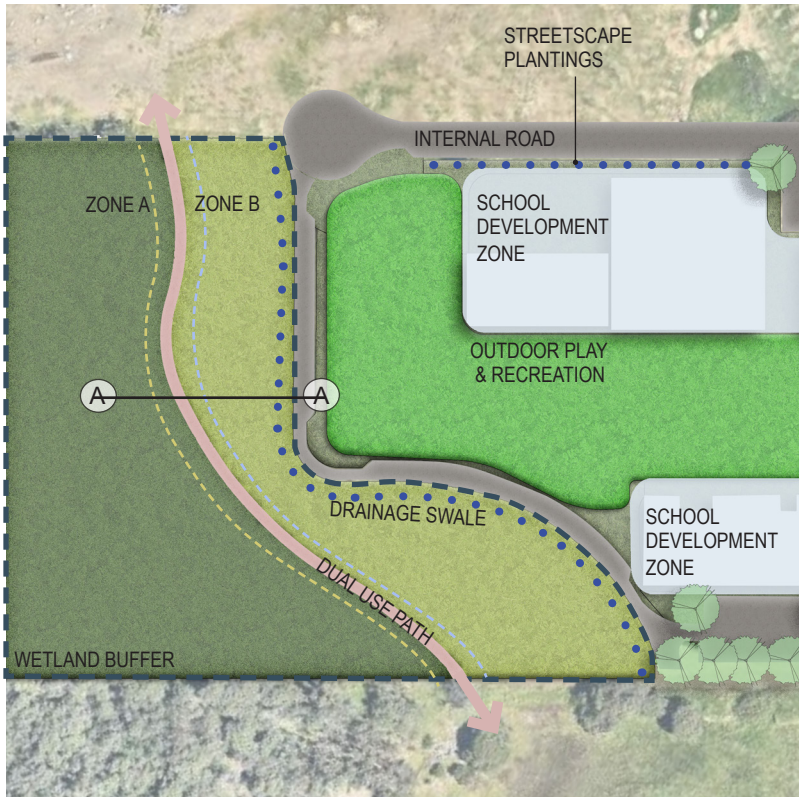
0 25 50 75 100 m

SCALE 1 : 2000 @ A4

emerge ASSOCIATES

CONNECTION BETWEEN SCHOOL AND BOLLARD BULLRUSH SWAMP

SWALE AND WETLAND BUFFER INTERFACE



CONCEPT

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FUNCTIONS

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BOLLARD BULLRUSH SWAMP BUFFER

WETLAND BUFFER - 50m

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ROADSIDE DRAINAGE SWALE

CONSERVATION FENCE AND LIMESTONE TRACK

SCHOOL BOUNDARY FENCE

ZONE A

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- Density of 1 plant mer m^2

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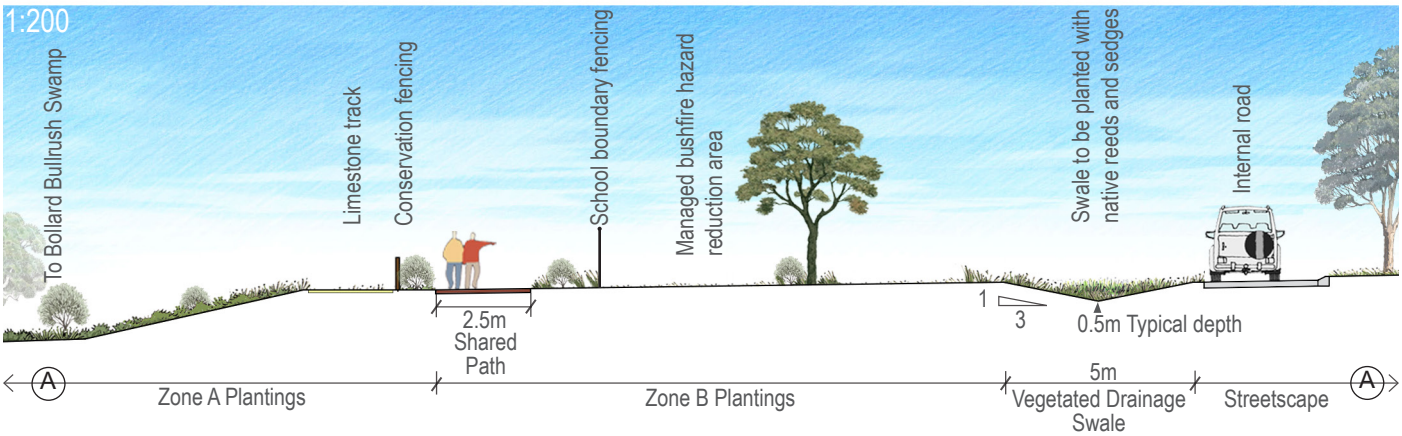
INDICATIVE SECTION



SECTION A - INDICATIVE SECTION WHERE PATH IS LOCATED AT EDGE OF WETLAND BUFFER ZONE

- Sections are conceptual and are subject to change during the detailed design process
- Levels provided are indicative and subject to change during the detail design process

SITE STRUCTURE PLAN

THE KINGS COLLEGE, BERTRAM ROAD WELLARD

DWG ENVIRO-73
REV D
DATE DEC 2020
SCALE 1 : 2000 @ A4

emerge ASSOCIATES

PLANTING CONSIDERATIONS

- A range of native plant species that complement the surroundings have been selected.
- Plants chosen range from low, dense groundcovers to strappy leafed plants, grasses and small to medium sized shrubs.
- Plants native to the local area will provide colourful floral displays throughout the year and attract native birds to the area.
- The use of native plants will minimise maintenance and irrigation requirements and ensure long term plant survival.
- A portion of the 50 m buffer (Zone B) will be designed to achieve 'low threat' vegetation in accordance with Section 2.2.3.2 of AS 3959. and cross referenced with Councils preferred environmental planting suggestions.
- Clear views to the existing wetland trees will be maintained.

Groundcovers


Adenanthos cuneatus


Casuarina glauca


Calothamnus quadrifidus 'Little Ripper'


Calothamnus hirsutus


Convolvulus Moroccan


Erempohila glabra 'Kalbarri Carpet'


Grevillea Gingin Gem


Juniperus conferta


Eremophila glabra


Scaevola 'Purple Passion'

Shrubs


Adenanthos sericea dwarf


Olearia axillaris 'Little Smokie'


Calothamnus quadrifidus 'One-sided Bottlebrush'


Grevillea olivacea


Westringia grey box


Dianella revoluta 'Variegated'


Dianella 'Tas Red'


Melaleuca 'Little Nessie'


Lomandra Tanika


Lomandra wingarra

Trees


Agonis flexuosa


Eucalyptus sideroxylon

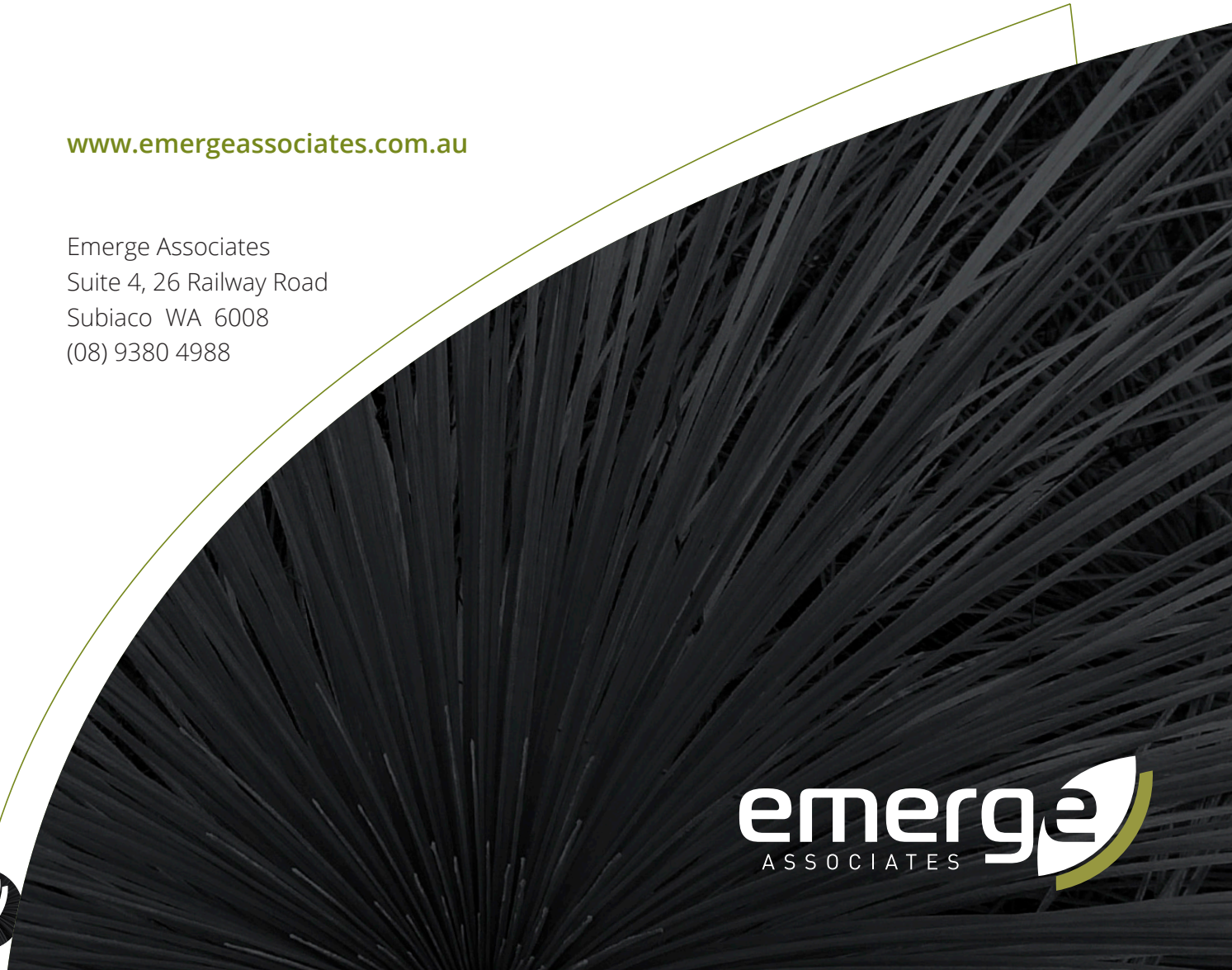

Eucalyptus torquata


Melaleuca quinquenervia


VTipuana tipu

www.emergeassociates.com.au

Emerge Associates
Suite 4, 26 Railway Road
Subiaco WA 6008
(08) 9380 4988



APPENDIX E | BOLLARD BULRUSH EAST LANDSCAPE MASTERPLAN

Local Planning Policy No. 3
Bollard Bulrush East Landscape Masterplan

The purpose of this local planning policy is to:

a) **ensure that a range of recreation facilities and activities are provided in a uniform and coordinated manner within the open space situated in the Bollard Bulrush East Urban Cell; and**
b) **guide the preparation of landscape plans for the open space in the Bollard Bulrush East Urban Cell.**

Adopted:	
Last reviewed:	
Legal Authority	Division 2 of Schedule 2 of the *Planning and Development (Local Planning Schemes) Regulations 2015*

1. APPLICATION

Local Planning Policy No. 3 (LPP 3) applies to all land within the Bollard Bulrush East Urban Cell that is zoned 'Development' under *Town Planning Scheme No. 2.*

This policy is to be applied during the preparation and assessment of:

- local structure plans; and
- subdivision applications.

LPP 3 should be read in conjunction with the *Bollard Bulrush East Landscape Masterplan* (Attachment 1).

The City of Kwinana (the City) acknowledges that *Bollard Bulrush East Landscape Masterplan* includes elements that exceed the requirements for the treatment of POS specified in *Liveable Neighbourhoods* (WAPC). The purpose of LPP 3 is not to enforce the provision of facilities in excess of the minimum standard specified by *Liveable Neighbourhoods*. The purpose of LPP 3 is to ensure that recreation facilities and activities are provided in a uniform and coordinated manner throughout the Bollard Bulrush East Urban Cell in the event they are provided in excess of the minimum requirements of *Liveable Neighbourhoods*.

2. POLICY

The City's requirements at each stage of the land use planning framework, in relation to the implementation of the *Bollard Bulrush East Landscape Masterplan,* are as follows:

LOCAL STRUCTURE PLANNING

Landscape Strategy

A landscape strategy is to be submitted to Council with the local structure plan.

The location and design of the following matters are to be included in the landscape strategy consistent with the *Bollard Bulrush East Landscape Masterplan*:

- a uniform dual use path around the eastern side of Bollard Bulrush Swamp, including pedestrian/cycle connections over the Peel Main Drain;
- uniform playground equipment, fitness equipment, park benches and lighting;
- 'kick about' spaces;
- uniform conservation fencing;
- stormwater detention areas that do not interfere with the function of public open space (POS);
- fire breaks and fire access tracks; and
- wetland revegetation.

SUBDIVISION APPROVAL

When a subdivision application within the Bollard Bulrush east urban cell is received for comment, the City shall recommend the following conditions to the Western Australian Planning Commission:

1. A fence restricting vehicle and pedestrian access to [INSERT VALUE] is to be constructed in accordance with the approved *Bollard Bulrush East Landscape Masterplan* (Dated __), to protect native vegetation. (Local Government)

2. The proposed reserve(s) shown on the approved plan of subdivision being shown on the diagram or plan of survey (deposited plan) as reserve(s) for [INSERT VALUE] and vested in the Crown under Section 152 of the *Planning and Development Act 2005*, such land to be ceded free of cost and without any payment of compensation by the Crown. (Insert clearing agency as applicable)

3. Arrangements being made for the proposed public open space to be developed by the landowner/applicant to a minimum standard and maintained for two summers through the implementation of an approved landscape strategy providing for the development and maintenance of the proposed public open space in accordance with the requirements of *Liveable Neighbourhoods*, the approved *Bollard Bulrush East Landscape Masterplan* (Dated __), and to the specifications of the local government. (Local Government)

3. DISCRETION TO VARY THE POLICY

The City may vary the provisions of this policy when it is satisfied that a proposed local structure plan or subdivision application can be implemented in a coordinated and uniform manner that does not prejudice the implementation of the landscape masterplan.

4. PROCEDURE FOR AMENDING LOCAL PLANNING POLICY NO. 3

This policy may be amended by the City of Kwinana in accordance with Clause 4 of Schedule 2 of the *Planning and Development Regulations 2015.*

DUAL USE PATH
Provides secondary fire access between buffer and POS.
Access points to core firebreak to be provided every 400m.
DUP to align where possible with developers approved LSP plans.
Path alignment adjacent existing trees where possible for shade and interest
DUP to link to future Tramway Trail and possible future trail along Peel Main Drain to create trail loops.
Themed elements will be incorporated into the DUP to indicate the main path of travel around the wetland for users .

PEEL MAIN DRAIN CROSSINGS
Bridge crossings across Peel Main Drain at 2 locations, north and south of the wetland to create a trail loop.

CONSERVATION FENCE
1.2m high reserve fence with ringlock mesh, top wire and galvanised steel picket posts to core edge. 3.5m wide access gates with treated timber posts every 400m.

BUFFER ZONE
Developers to create irregular, 'organic' batter from road to existing buffer/tree levels to create a more natural aesthetic and not to create an 'over-engineered' look.
Revegetation to be focused around areas of retained vegetation to assist with ongoing environmental management
Areas of mulch only to be considered where high quality revegetation provided by developer
Irrigated turf to be permitted within buffer adjacent POS.

FIREBREAK
3m wide firebreak and access track to be located adjacent existing vegetation line, internal of conservation fencing
Overtaking lane provided every 200m (4m wide).
Doubles as walking trail and located adjacent existing trees where possible for users comfort/shade.

PLAY ELEMENTS
A variety of styles and colours to be used to complement the surrounding environment.
Multi user/ age, interpretive and inclusive play opportunities.

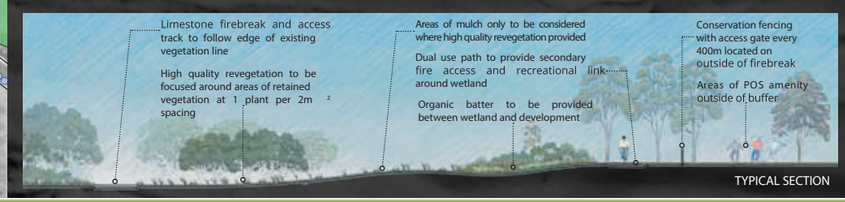
FURNITURE
Clear - anodised aluminium furniture elements.
Mid Grey/Cedar colours to complement the natural environment rather than contrast.

BERTRAM ROAD
RAILWAY
TRAMWAY TRAIL
WATER CORPORATION PEEL MAIN DRAIN
WELLARD ROAD
JOHNSON ROAD
A

Western side of wetland subject to further detailed landscape Master Planning.

LEGEND
- WETLAND CORE BOUNDARY
- 50m BUFFER ZONE
- VEGETATION COMMUNITIES
  - Eucalyptus rudis ssp. rudis
  - Melaleauca rhaphiophylla
  - Low woodland of Melaleauca rhaphiophylla, Eucalyptus rudis ssp. rudis
  - Low Open Forest of Melaleuca rhaphiophylla, Melaleuca preissiana, Eucalyptus rudis ssp. rudis and Bauma articulata
- CONSERVATION FENCE - 1.2m HEIGHT
- FIREBREAK - 3m WIDE LIMESTONE
- PATH - RED ASPHALT DUAL USE PROVIDES SECONDARY FIRE ACCESS
- FUTURE BRIDGE LINK
- PLAYGROUND
- FITNESS EQUIPMENT
- TRAIL HEAD
- FUTURE TRAIL LINKS
- STORMWATER DETENTION AREAS
- KICKABOUT SPACE
- PUBLIC OPEN SPACE AREA
- REVEGETATION PLANTING 'B' WITHIN BUFFER ZONE, AVERAGE DENSITY OF 1 PLANT PER 2M2 BUT CLUMPED AROUND EXISTING VEGETATION INERSPERSED WITH AREAS OF THICK WOODCHIP TO SUPPRESS WEEDS
- REVEGETATION PLANTING 'A' TO WETLAND SIDE, DENSITY OF 1 PLANT PER m
- 400m WALKABLE CATCHMENT BETWEEN JUNIOR PLAYGROUNDS
- WETLAND FIREBREAK ACCESS LINK AND GATE

SIGNAGE
Trail heads to include interpretive and directional signage.
Interpretive signage themes include; vegetation communities, wetland / Peel Main Drain history, native fauna, cultural history.



TYPICAL SECTION

DWG · COK01-LO1
REV · G
DATE · FEB 2017
SCALE · 1:6000 @ A3

BOLLARD BULRUSH EAST
LANDSCAPE MASTER PLAN

City of Kwinana

emerge ASSOCIATES
Integrated Science & Design

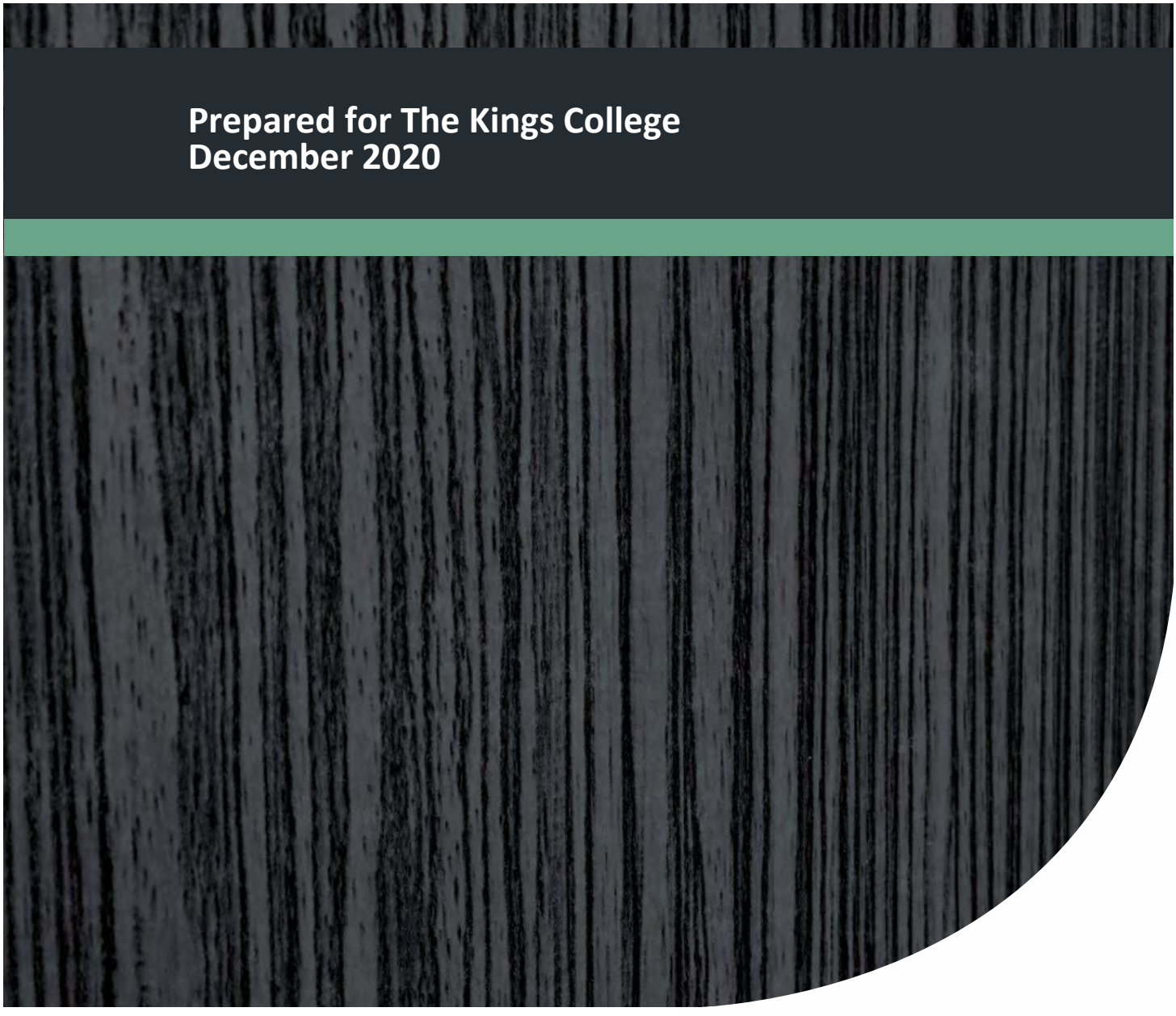
APPENDIX F | ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STRATEGY

Environmental Assessment and Management Strategy

Lot 500 Bertram Road, Wellard Local Structure Plan Amendment

Project No: EP20-047(05)

Prepared for The Kings College
December 2020



Document Control

Doc name:	Environmental Assessment and Management Strategy Lot 500 Bertram Road, Wellard Local Structure Plan Amendment				
Doc no.:	**EP20-047(05)—004A BRB**				
Version	**Date**	**Author**		**Reviewer**	
1	December 2020	Bianca Bertelli	BRB	Jason Hick	JDH
	Report issued to client for review.				
A	December 2020	Bianca Bertelli	BRB	Jason Hick	JDH
	Updated in response to client comments.				

Executive Summary

This *Environmental Assessment Management Strategy* (EAMS) has been prepared on behalf of The Kings College (the proponent) to support an amendment to the existing Local Structure Plan over Lot 500 Bertram Road, Wellard to facilitate the future development of The Kings College primary and secondary school. The existing Structure Plan for Lot 500 and 501, Bertram Road, Wellard, approved in 2017, was prepared in anticipation of the site being developed for residential uses, therefore the proponent is seeking an amendment to enable the proposed alternate land use. The expansion of The Kings College will occur over the northern portion of Lot 500 Bertram Road, Wellard (the site). The site is 5.00 hectares (ha) in size and is located approximately 32 km south of the Perth Central Business District, within the City of Kwinana.

The site is located within a mixed urban and rural-residential area, with Bertram Road and urban development to the north, large rural-residential lots to the east, the Bollard Bulrush Swamp Conservation Category Wetland (CCW) (UFI 15866) and Peel Main Drain to the south, The Kings College buildings and sporting ovals and the Freeway Church to the west. The site is currently zoned 'Urban' under the Metropolitan Region Scheme (MRS), and 'Development', under the City of Kwinana Town Planning Scheme (TPS) No.2.

The proposed structure plan amendment is shown by the *Lots 500 (No.2) & 501 (No.214) Bertram Road, Wellard Local Structure Plan* (Harley Dykstra 2020) (referred to herein as the 'proposed Local Structure Plan (LSP)'), provided in **Appendix A**. The proposed LSP has responded to the requirement for a 50 m wetland buffer for the Bollard Bulrush Swamp CCW. The wetland buffer will be implemented in accordance with the City of Kwinana's Local Planning Policy (LPP) No.3 - *Bollard Bulrush East Landscape Master Plan,* which ensures that it provides an effective wetland buffer function. The wetland buffer will incorporate two landscaping zones; Zone A and Zone B allowing for a combination of outdoor play and recreation and conservation land uses. Zone A encompasses the future 'Parks Recreation and Drainage' reserve abutting the Bollard Bulrush Swamp, which will be revegetated with local native species. The proponent will cede the 'Parks Recreation and Drainage' reserve area to the Crown as development progresses which will provide a consolidated wetland area for protection into the future. Zone B comprises The Kings College outdoor play and recreation open space, which will be appropriately landscaped and maintained to reduce bushfire hazards to the school. This area will form a 'managed interface' between the Kings College and Bollard Bulrush Swamp (and the associated wetland rehabilitation area). The remainder of the proposed LSP is the 'Special Use: Education Establishment' zone incorporating The Kings College development including primary and secondary classrooms, café and kitchen facilities, gym, hardcourts and aquatic centre.

This EAMS has been prepared to address the requirements of the Western Australian Planning Commission's (WAPC) *Structure Plan Framework* (WAPC 2015b) to support the preparation, approval and future implementation of the structure plan, subdivision and development. It provides a synthesis of information from a range of sources regarding the environmental features, attributes and values of the site. It includes technical surveys undertaken as part of MRS Amendment 1188/57, which rezoned the site from 'Rural' to 'Urban deferred':

- *Preliminary Geotechnical Investigation Lot 502 Tambly Place and Lots 500 & 501 Bertram Road, Wellard* (Structerre Consulting Engineers 2015)

- *Wellard Urban Precinct East Environmental Review MRS Amendment 1188/57 (ENV Australia 2013)*
- *District Water Management Strategy, Wellard Urban Precinct East* (Emerge Associates 2015)
- *Bollard Bullrush East - Fauna Assessment* (ENV Australia 2011a)
- *Bollard Bullrush East - Flora and Vegetation Assessment* (ENV Australia 2011b)

It includes technical surveys undertaken as part of the previously approved LSP over Lots 500 & 501 Bertram Road to facilitate residential development:

- *Environmental Assessment Report – Lots 500 and 501 Bertram Road Wellard* (RPS 2017a)
- *Local Water Management Strategy – Lots 500 and 501 Bertram Road Wellard* (RPS 2017c)
- *Bushfire Management Plan – Lots 500 & 501 (Nos 202 & 214) Bertram Road, Wellard* (Smith Consulting Bushfire Consultants 2017)

The above technical surveys are further supplemented by the recent investigations undertaken by Emerge, to support the Lot 500 Bertram Road Wellard Local Structure Plan amendment, including:

- *Bushfire Management Plan – Lot 500 Bertram Road, Wellard Local Structure Plan Amendment (Emerge Associates 2020b)*
- *Local Water Management Strategy – Lot 500 Bertram Road, Wellard Local Structure Plan Amendment (Emerge Associates 2020c)*
- *Reconnaissance Flora and Fauna Survey - Lot 500 Bertram Road, Wellard Local Structure Plan Amendment (Emerge Associates 2020d)*

The relevant environmental attributes and values of the site are summarised as follows:

- Based on historical aerial photography, the site has been historically been cleared of native vegetation, with the exception of scattered remnant trees, to support low-intensity agricultural activities (Landgate 2020).
- Topography across the site ranges from 4 m Australian Height Datum (AHD) in the south-western portion of the site to 8 m AHD in the north-eastern portion of the site.
- The majority of the site is classified as having a 'high to moderate risk' of Acid Sulfate Soils (ASS) occurring within 3 m of the natural soil, with a small area in the eastern corner of the site classified as having 'moderate to low risk' of ASS occurring within 3 m of the natural soil surface.
- Based on a recent survey undertaken by Emerge Associates (2020d), no native plant communities were identified within the site with the entirety of the site mapped as **Parkland Cleared** in 'Completely Degraded' condition. This is not considered to represent an intact native plant community due to the previous clearing of vegetation resulting in a predominantly non-native grassy understory.
- No threatened ecological communities (TECs), or threatened or priority flora species, were identified within the site, nor are any likely to occur, based on the degraded nature of vegetation within the site (Emerge Associates 2020d)
- Seven fauna species of conservation significance have been identified as having potential to utilise broader local area including the site: *Calyptorhynchus baudinii* (Baudin's cockatoo) although it is noted that the site is on the edge of the habitat range for this species, *Calyptorhynchus latirostris* (Carnaby's cockatoo), *Calyptorhynchus banksii naso* (forest red-tailed black cockatoo), *Apus pacificus* (Pacific swift), *Falco peregrinus* (Peregrine falcon), *Oxyura*

australis (Blue-billed Duck) and *Isoodon obesulus fusciventer* (Quenda). No conservation significant fauna was recorded within the site during field surveys (ENV Australia 2011a, Emerge Associates 2020e). In addition, the likelihood that the site would provide important habitat for any fauna species of conservation significance is low, given the site primarily comprises cleared areas with non-native vegetation which support low fauna habitat values.

- Based on the *Geomorphic Wetlands of the Swan Coastal Plain* (DBCA 2020) dataset, the majority of the site is mapped as the Bollard Bullrush Swamp multiple use wetland (MUW) (UFI 13327). The western portion of the site is mapped as the conservation category wetland (CCW) (UFI 15866) extending further to the south, east and west. The mapped MUW and CCW areas extending into the site have experienced a high level of historic disturbance that has significantly reduced the ecological values of the wetland in this area, which now supports vegetation in 'Completely Degraded' condition. The CCW (UFI 15866) which extends within the site supports significantly reduced diversity of native flora species due to human induced disturbances, to the extent that the wetland no longer supports natural attributes and functions representative of a Conservation management category. As part of the EPA's Environmental Review undertaken for MRS Amendment 1188/57, the EPA recommended that the extent of Bollard Bulrush Swamp CCW be retained within the 'Rural' zoned land, outside of which comprises cleared land considered suitable for 'Urban' development purposes. In order to protect the values of the Bollard Bulrush Swamp CCW (UFI 15866), the EPA recommended that a buffer of 50 metres (m) be provided. An investigation was undertaken by Emerge Associates (2020d) to determine the actual boundary of the CCW. One native plant community; **ErMr** ranging from 'Good-degraded' to 'Excellent – Very Good' was identified as occurring within the Bollard Bulrush Swamp CCW (Emerge Associates 2020d). It was determined that the boundary of the intact native plant community **ErMr**, provides an appropriate basis for defining the extent of the CCW, using the existing fence line as a basis for defining the plant community edge. The wetland buffer has been applied from the site-specific wetland boundary, which varies slightly from the MRS zoning based on the extent of intact wetland vegetation accurately representing the CCW.
- No registered Aboriginal or non-indigenous heritage sites were mapped within the site.
- Bushfire hazards associated with bushfire prone vegetation have been identified within and outside the site, associated with the densely vegetated portion of the Bollard Bulrush Swamp CCW (UFI 15866) and unmanaged vegetation within existing private landholdings to the east and west.

The proposed LSP has responded to the above site-specific environmental considerations including the accommodation of a 50 m buffer to the Bollard Bullrush Swamp CCW (and associated vegetation) and providing appropriate separation between future built form (The Kings College school development) and areas of bushfire hazard within and external to the site. The proposed LSP will provide the opportunity to rehabilitate a portion of the Bollard Bullrush CCW 50 m buffer through the provision of a 'Parks Recreation and Drainage' reserve. This reserve encapsulates the significant wetland vegetation values known to provide suitable habitat for a number of conservation significant flora and fauna species.

This EAMS provides an outline of the management requirements that will need to be considered as part of as part of the future subdivision and development process. The key management considerations are summarised as follows.

- **Acid sulfate soils:** The majority of the site is classified as having a 'high to moderate risk' of ASS occurring within 3 m of the natural soil. The implementation of the LSP and subsequent development of school infrastructure, is unlikely to require the level of disturbance (i.e installation of deep sewer, dewatering and/or major excavation) that would have otherwise been required for the previously proposed residential development of the site. It is highly likely that fill will be required to achieve the required separation from groundwater levels and to reduce flooding risk. This will reduce the likelihood of disturbing ASS through reducing the need for dewatering and large-scale excavations. Once detailed earthworks designs and depths of trenching/excavation are known, and therefore the likelihood of disturbance below 3 m of the natural soil as part of the construction process, an investigation to determine the actual presence of ASS may be undertaken. Dependent on the findings of the ASS investigations, and if ASS are found within the areas that are proposed to be developed or detailed designs indicate that ASS is likely to be disturbed due to excavation for the installation of services, then an appropriate ASS and dewatering management plan (ASSDMP) may need to be prepared to support development.
- **Native vegetation:** No intact native plant communities were identified within the site due to historical disturbance resulting in the entirety of the site mapped as **Parkland Cleared** in 'Completely Degraded' condition and therefore contains limited significant flora or vegetation values. Notwithstanding, the proposed LSP will provide an opportunity to rehabilitate the vegetation associated with Bollard Bulrush Swamp CCW (UFI 15866) and the 50 m buffer through the consolidation of a 'Parks Recreation and Drainage' reserve which encapsulates the significant flora and vegetation values of the wetland, including the potential occurrence of a Priority Ecological Community (PEC) and threatened and priority flora. Opportunities to retain the remnant native trees within the school development will be possible, and will be confirmed during final development design and bulk earthworks requirements. Where clearing of remnant native trees within the site is proposed, a clearing permit will need to be attained pursuant to Part V of the *Environmental Protection Act 1986* (unless a valid exemption applies).
- **Native fauna:** Due to the historical removal native vegetation and associated habitat low biodiversity value from a fauna perspective, the proposed LSP is not expected to have a significant impact on fauna. Nevertheless, the proposed LSP will provide an opportunity to enhance and retain the Bollard Bulrush Swamp CCW (UFI 15866) which supports dense cover of remnant native understorey vegetation, known to provide suitable habitat for a number of conservation significant fauna species including the Quenda. The 50 m wetland buffer will provide a separation from the urban land use, limiting the potential to disturb any fauna associated with the Bollard Bulrush Swamp. The proposed LSP will provide opportunities for the retention of native Swamp Paperbark and Flooded Gum trees, which provide potential habitat for the three threatened species of black cockatoo. As part of the future subdivision and development, a Wetland Management Plan (WMP) and Construction Environmental Management Plan (CEMP) will be required to be prepared to manage potential impacts to fauna.
- **Hydrology:** An LWMS has been developed by Emerge Associates (2020d) to support the proposed LSP. The overarching objective for the site is to maintain the pre-development hydrological regime and is based on an at source infiltration approach, and by minimising the potential for nutrient impacts on the Bollard Bulrush Swamp. No drainage from the site will be directly connected or piped into the wetland, and no drainage infrastructure from the site will be

located within the wetland buffer, with the exception of a swale which is proposed within the southern portion of the site, to manage runoff from the dual-use pathway. This will ensure the Urban Water Management criteria for ecological protection is met as part of development within the site. The LWMS will be implemented as part of the future development stage.

- **Wetlands:** Due to close proximity to the Bollard Bullrush Swamp conservation category wetland (CCW) (UFI: 15866), measures will be required to protect the ecological values of wetland. As previously stated, the extent of CCW (UFI 15866) as identified in the *Geomorphic Wetlands of the Swan Coastal Plain* dataset does not accurately represent the extent of the wetland. The CCW (UFI 15866) which extends within the site no longer supports natural attributes and functions representative of a Conservation management category. As part of the EPA's Environmental Review undertaken for MRS Amendment 1188/57, the EPA recommended that the extent of Bollard Bulrush Swamp CCW be retained within the 'Rural' zoned land. In order to protect the values of the CCW (UFI 15866), the EPA recommended that a buffer of 50 metres (m) be provided. Subsequent investigations undertaken by Emerge Associates (2020d) determined that the boundary of the CCW is delineated by the edge of the intact native plant vegetation (**ErMr**), which supports a high level of floristic diversity and accurately encapsulates the significant wetland values. The site-specific wetland boundary varies slightly from the MRS zoning based on the extent of intact wetland vegetation, however the assessment generally found the MRS zoning consistent with the actual extent of the CCW, within the 'Rural' zoned land. The proposed LSP provides a 50 m wetland buffer determined from the site-specific wetland boundary based on the extent of intact wetland vegetation (Emerge Associates 2020d), as described above. The 50 m wetland buffer will comprise two landscaping zones; Zone A and Zone B allowing for a combination of outdoor play and recreation and conservation land uses. Zone A encompasses the future 'Parks Recreation and Drainage' reserve abutting the Bollard Bulrush Swamp, which will be revegetated with local native species and ceded as Crown land for conservation purposes. The remainder of the buffer (Zone B) comprises recreational open space, which will be appropriately landscaped and maintained in such a way as to reduce bushfire hazards to the school. This area will form a 'managed interface' between the Kings College and Bollard Bulrush Swamp wetland rehabilitation area. This separation from the urban land use will reduce the impact of human activities on both the vegetation and fauna of the wetland. No drainage from the site will be directly connected or piped into the wetland and no drainage infrastructure will be located within the wetland buffer, with the exception of a swale to manage runoff from the Dual-use Pathway. A WMP will be prepared at the subdivision or development stage, outlining specific strategies for the preservation the Bollard Bulrush Swamp.
- **Bushfire risks**: From a bushfire hazard management perspective, the key consideration as part of future development within the site is to ensuring future development areas will be able to accommodate the separation necessary to ensure built form is able to achieve a bushfire attack level (BAL) rating of BAL-29 or less without requiring clearing or modification of vegetation in areas where remnant vegetation is proposed to be retained, and allow for revegetation of the wetland buffer. This has been achieved through the strategic location of internal driveway reserves and footpaths and the managed recreational open spaces which will be designed and maintained to low threat in order minimise the hazard to the school development. Vehicle access will accommodate egress to at least two destinations, ensuring the perimeter driveway will connect to the existing public road network, specifically Bertram Road to the north, further

connecting onto Mortimer Road to the east and Challenger Avenue to the west. This will be detailed as part of future bushfire management plans supporting subdivision or development approval.

In conclusion, the proposed LSP will enhance the environmental attributes of the site through the protection of the Bollard Bullrush Swamp CCW through the provision of a 50 m wetland buffer and will enable the revegetation of areas of portions of the site that have been under agricultural land uses for over fifty years. It will necessitate the construction of a contemporary and effective stormwater management and drainage system, which would effectively control and manage stormwater runoff quality and avoid impacts on nearby sensitive environmental values, such as the Bollard Bullrush Swamp.

Overall, the environmental attributes and values of the site can be accommodated through the proposed LSP design, or can be managed appropriately through the future subdivision and development phases in line with the relevant state and local government legislation, policies and guidelines and best management practices.

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List of Abbreviations

Table A1: Abbreviations – General terms

General terms	
AHD	Australian Height Datum
AHIS	Aboriginal Heritage Inquiry System
ASS	Acid Sulfate Soil
ASSDMP	Acid Sulfate Soil and Dewatering Management Plan
BC	Baudin's black cockatoo
CC	Carnaby's black cockatoo
DBH	Diameter at Breast Height
EAMS	Environmental Assessment and Management Strategy
ESA	Environmentally sensitive area
FRTBC	Forest red-tailed black cockatoo
IBRA	Interim Biogeographic Regionalisation of Australia
LWMS	Local Water Management Strategy
PEC	Priority ecological community
PF	Priority flora
PDWSA	Public drinking water source area
TEC	Threatened ecological community
TF	Threatened flora
UWMP	Urban Water Management Plan
WWMS	Wetland and Waterway Management Strategy

Table A2: Abbreviations – Legislation and policies

Legislation and policies	
AH Act	*Aboriginal Heritage Act 1972*
BC Act	*Biodiversity Conservation Act 2016*
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*

Table A3: Abbreviations – Organisations

Organisations	
DAWE	Department of Agriculture, Water and Environment (federal)
DBCA	Department of Biodiversity Conservation and Attractions
DoEE	Department of Environment and Energy (now known as Department of Agriculture, Water and Environment)
DoH	Department of Health
DoW	Department of Water (now known as Department of Water and Environmental Regulation)
DPAW	Department of Parks and Wildlife (now known as Department of Biodiversity Conservation and Attractions)
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
WAPC	Western Australian Planning Commission

Table A4: Abbreviations – Planning and building terms

Planning and building terms	
MRS	Metropolitan Region Scheme
TPS	Town Planning Scheme
LSP	Local Structure Plan

1 Introduction

1.1 Background

The Kings College (the proponent) are progressing with an amendment to the existing Local Structure Plan over Lot 500 Bertram Road, Wellard to facilitate the development of The Kings College primary and secondary school. The existing Structure Plan for Lot 500 and 501, Bertram Road, Wellard, approved in 2017 was prepared in anticipation of the site being developed as for residential development, as such, the proponent is seeking an amendment to enable the proposed land use. The expansion of The Kings College will occur over the northern portion of Lot 500 Bertram Road, Wellard (the site). The site is 5.00 hectares (ha) in size and is located approximately 32 km south of the Perth Central Business District, within the City of Kwinana, as shown in **Figure 1**.

The site is located within a mixed urban and rural-residential area, with Bertram Road and urban development to the north, large rural-residential lots to the east, the Bollard Bulrush Swamp Conservation Category Wetland (CCW) (UFI 15866) and Peel Main Drain to the south, The Kings College buildings and sporting ovals and the Freeway Church to the west. The site is currently zoned 'Urban' under the Metropolitan Region Scheme (MRS), and 'Development', under the City of Kwinana Town Planning Scheme (TPS) No.2., as shown in **Plate 1**.

The proposed structure plan amendment is shown by the *Lots 500 (No.2) & 501 (No.214) Bertram Road, Wellard Local Structure Plan* (Harley Dykstra 2020) (referred to herein as the 'proposed Local Structure Plan (LSP)'), provided in **Appendix A**. The proposed LSP has responded to the requirement for a 50 m wetland buffer for the Bollard Bulrush Swamp CCW, which will be implemented in accordance with the City of Kwinana's Local Planning Policy (LPP) No.3.

The site has historically been cleared of native vegetation prior to 1953 with the exception of scattered remnant trees and utilised for agricultural land uses associated with dairy farming (Landgate 2020). The northern portion of the site currently supports several sheds, horse stables and cultivated gardens. Areas of relatively undisturbed intact remnant native vegetation exist to the south of the site within the Bollard Bulrush Swamp, while more disturbed vegetation (i.e. remnant native trees over paddock grasses) occurs within the site.

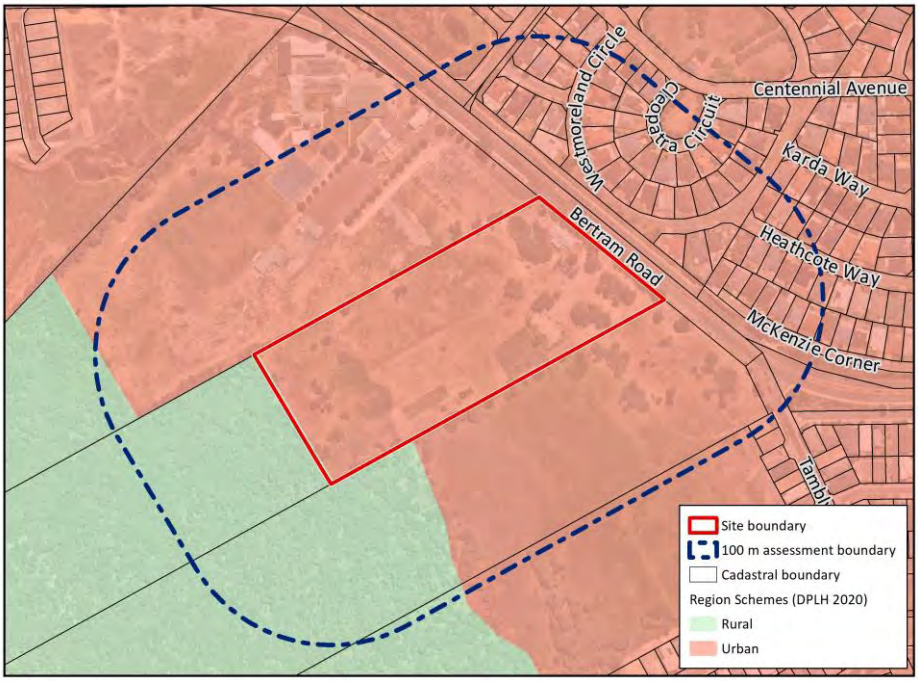

Plate 1: Metropolitan Region Scheme (MRS) zones and reserves within and surrounding the site.

1.2 Purpose of this report

The purpose of this Environmental Assessment and Management Strategy (EAMS) is to provide a synthesis of information regarding the environmental values and attributes of the site. Specifically, this report:

- Discusses the land use and environmental planning context for the structure plan area (**Section 2**).
- Identifies the existing environmental values and attributes of the site (**Section 3**).
- Discusses how the structure plan layout responds to the existing environmental features and values, and future environmental management requirements as part of the future planning and development process (**Section 4**).
- Provides an implementation framework for future environmental management requirements as part of the future planning and development process (**Section 5**).

The EAMS is the key supporting environmental document for the structure plan, enabling the consideration of relevant environmental issues by the local government and various state government agencies and authorities. It is consistent with the requirements for environmental reporting as outlined in the Western Australian Planning Commission's (WAPC's) *Structure Plan Framework* (WAPC 2015b).

1.3 Assessment scope

Emerge Associates (Emerge) was engaged to undertake this environmental assessment to document the existing environmental attributes and values of the site and ensure that any relevant environmental values can be accommodated within the structure plan, and/or managed through future stages of planning and development of the site. This involved utilising a range of information

sources including local and regional reports. This includes technical surveys undertaken as part of MRS Amendment 1188/57, which rezoned the site from 'Rural' to 'Urban deferred and surveys undertaken as part of the previously approved LSP over Lots 500 & 501 Bertram Road to facilitate residential development. These, and other information sources which have informed the EAMS have been outlined below:

- Various publicly available databases and information sources
- *Environmental Assessment Report – Lots 500 and 501 Bertram Road Wellard* (RPS 2017a)
- *Local Water Management Strategy – Lots 500 and 501 Bertram Road Wellard* (RPS 2017c)
- *District Water Management Strategy, Wellard Urban Precinct East* (Emerge Associates 2014)
- *Southern Bollard Bulrush Swamp Wetland Management Plan* (PGV Environmental 2014)
- *Preliminary Geotechnical Investigation Lot 502 Tambly Place and Lots 500 & 501 Bertram Road, Wellard* (Structerre Consulting Engineers 2015)
- *Wellard Urban Precinct East Environmental Review MRS Amendment 1188/57 (ENV Australia 2013)*
- *Bollard Bullrush East - Fauna Assessment* (ENV Australia 2011a)
- *Bollard Bullrush East - Flora and Vegetation Assessment* (ENV Australia 2011b)
- *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* WAPC (2009).
- *Draft North-East Sub-Regional Planning Framework* WAPC (2015)
- *Draft Perth and Peel @ 3.5 Million* WAPC (2015).

Emerge have also conducted a number of site-specific investigations (outlined further below), as well as a comprehensive desktop review of the available information on environmental conditions within and surrounding the site. The outcomes of these findings have provided context for the following within the site:

- Landforms, topography and soils
- Flora and vegetation
- Terrestrial fauna
- Surface and groundwater hydrology
- Aboriginal and non-indigenous heritage
- Historical and existing land uses within and surrounding the site
- Bushfire hazards.

The investigations undertaken by Emerge, to support the proposed LSP, include:

- *Bushfire Management Plan – Lot 500 Bertram Road, Wellard Local Structure Plan Amendment (Emerge Associates 2020b)*
- *Local Water Management Strategy – Lot 500 Bertram Road, Wellard Local Structure Plan Amendment (Emerge Associates 2020c)*
- *Reconnaissance Flora and Fauna Survey - Lot 500 Bertram Road, Wellard Local Structure Plan Amendment (Emerge Associates 2020d)*

2 Planning Framework and Proposal

2.1 Historic planning and environmental assessment context

The proposed LSP is consistent with the established planning framework for the site, including the Western Australian Planning Commission (WAPC) Draft South Metropolitan Peel Sub-regional Planning Framework. the City of Kwinana Town Planning Scheme No.2 and the Local Planning policy No.3 – *Bollard Bulrush Landscape Masterplan*. The historical planning framework and the associated environmental assessment context relevant to the site has been discussed in further detail below.

2.1.1 Metropolitan Region Scheme

In 2014, MRS Amendment 1188/57 for the Wellard Urban East Precinct rezoned approximately 70 ha of land, including the site, from 'Rural' to 'Urban deferred', retaining the Bollard Bullrush Swamp in the 'Rural' zone. The amendment proposed to delineate the boundary between future urban development and Bollard Bulrush Swamp, which was protected under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lakes) and mapped as a Conservation Category Wetland (CCW). MRS amendment 1188/57 was referred to the Environmental Protection Authority (EPA) in March 2010 who determined the scheme amendment required formal assessment and issued final instructions for the preparation of an Environmental Review pursuant to the *Environmental Protection Act 1986*. An Environmental Review (ENV Australia 2013) was prepared for Wellard Landowners Group in conjunction with the EPA and the City of Kwinana to address the EPA's instructions.

The EPA concluded the extent of the Bollard Bulrush Swamp CCW is contained within the MRS zoned 'Rural' land, outside of which comprises the cleared land outside of the boundary of the CCW. In order to protect the values of the Bollard Bulrush Swamp CCW (UFI 15866), the EPA recommended a buffer of 50 metres (m), consistent with the *WAPC draft Guideline for the Determination of Wetland Buffer Requirements* (2005) and the *EPA's Guidance Statement No. 33 Environmental Guidance for Planning and Development* (2008).

The EPA noted that Bollard Bulrush Swamp will remain under the 'Rural' zone and MRS Amendment 1188/57 did not address the conservation reservation of the Bollard Bulrush Swamp as a whole. As such, the intent was to cede the Bollard Bulrush Swamp to the Crown free of cost as development progresses to provide a consolidated wetland reserve. Management of the wetland will initially be undertaken by the developer and it is expected that the responsibility will be assumed by the local authority or the DBCA. The EPA concluded that the consolidation and rehabilitation of a central conservation area within the 'Rural' land use zone will provide a more cohesive vegetated area and habitat.

The site was subsequently rezoned from 'Urban Deferred' to its current 'Urban' MRS zoning in 2015 under MRS Amendment 1296/27. Upon Gazettal of the Urban zone, the site was concurrently zoned 'Development' under the City of Kwinana Town Planning Scheme No. 2, by resolution of the WAPC and notice in the Government Gazette.

2.1.2 City of Kwinana Town Planning Scheme No.2

The site is zoned 'Development' under the City of Kwinana Town Planning Scheme No. 2 (TPS 2). No formal assessment of the scheme was undertaken by the EPA, it is considered to be an assessed scheme, and as such no further referral of future associated proposals is required, provided they are compliant with the scheme and its requirements.

In accordance with the provisions of the 'Development' zone under the Scheme, a LSP is required as a precursor to subdivision and development. The proposed LSP has therefore been prepared in accordance with provisions of Clause 6.17 of the Scheme.

2.1.3 City of Kwinana Local Planning Policy No.3 – Bollard Bulrush Landscape Masterplan

The City of Kwinana's Local Planning Policy (LPP) No.3 - *Bollard Bulrush East Landscape Masterplan* provides an integrated plan for the treatment of the interface of the Bollard Bulrush Swamp in the different structure plan areas surrounding the wetland. The City of Kwinana's LPP No.3 applies to all land within the Bollard Bulrush West urban cell zoned 'Development' under TPS No.2, which includes the site. The policy is intended to be applied during the preparation and assessment at the local structure planning stage of development.

The proposed LSP is supported by a Landscape Master Plan (**Appendix C**) which outlines the landscape design and appropriate land uses within the 50 m buffer to the Bollard Bullrush Swamp CCW. The plan identifies the requirement for a balanced approach to ensure the social and recreational requirements of the future students and the ecological values of the Bollard Bulrush Wetland.

2.2 Proposed local structure plan

In 2017, an LSP over Lots 500 & 501 Bertram Road, Wellard (the existing LSP) was prepared to facilitate residential development over the site. The proponent is seeking to amend the existing LSP prepared in anticipation of the site being developed for residential purposes, to allow for the proposed educational land-uses.

The proposed LSP prepared by Harley Dykstra (2020) (**Appendix A**) extends over the northern portion of Lot 500 Bertram Road applying to the land zoned 'Urban' under the MRS and 'Development' under the City of Kwinana TPS No.2, and proposes the following land uses:

- A 'Special Use: Education Establishment' zone incorporating The Kings College primary and secondary educational establishment buildings, café and kitchen facilities, gym, hardcourts and aquatic centre.
- A 50 m buffer for Bollard Bullrush Swamp CCW (UFI 15866) comprising:
  - A 'Park Recreation and Drainage' conservation reserve abutting the Bollard Bulrush Swamp (**Zone A**) which will be revegetated with local native species. The proponent will cede the 'Parks Recreation and Drainage' reserve area to the Crown as development progresses which will provide a consolidated wetland area for protection into the future.
  - The Kings College recreational open space (**Zone B**) will be landscaped and maintained to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959. This area will

form a 'managed interface' between the Kings College and Bollard Bulrush Swamp (and the associated wetland rehabilitation area).

Table 1 outlines the land uses proposed in the proposed LSP, including identifying which land use types are intended to comprise the future development footprint and the areas intended for the future retention and protection of existing environmental values. The proposed land uses are shown in **Figure 9**, in addition to the extent of the proposed future development footprint and proposed future environmental retention areas.

Table 1: Proposed local structure plan land uses

Proposed LSP land use	Intended purpose	Total (ha)
Within proposed development footprint		
The Kings College development	Will provide for proposed educational establishment buildings, including Kings College primary and secondary classrooms, perimeter driveway, café and kitchen facilities, gym, hardcourts and aquatic centre.	3.62 ha
Outdoor play and recreation area	Passive open spaces, incorporating native planting to a low-threat bushfire standard. The space will include informal seating spaces on walls or boulders for recreational uses compatible with the wetland buffer.	0.53 ha
Within proposed environmental retention area		
Parks Recreation and Drainage Reserve	A conservation reserve which will be revegetated with native species, incorporating the Bollard Bulrush Swamp CCW extent. This area will be intersected by a Dual Use Path (DUP) for public use, which will also provide secondary fire access. Conservation fencing will be implemented ensuring a 'hard edge' between the conservation reserve and the school development.	0.54 ha

2.3 Future planning approval process

2.3.1 Subdivision and Development Approvals

Subject to approval and endorsement of the proposed LSP by the City of Kwinana and the WAPC, development of the site would be progressed through future subdivision and development approvals.

The key environmental values and attributes that require further consideration as part of future planning stages have been outlined in **Section 2** and **Section 4** of this report and include:

- Acid sulfate soils, and management during construction
- Native vegetation, including retention, protection and enhancement of identified vegetation
- Native fauna, including protection and retention of fauna habitat and management of fauna during construction
- Hydrology, both groundwater and surface water
- Bushfire risks, provision of appropriate setbacks and managed landscape treatments.

3 Existing Environment

3.1 General location and site context

The site is located within the central-western Swan Coastal Plain (SCP), approximately 32 km south of the Perth CBD and 2.5 km south-east of the Kwinana Town Centre. The site is within an area which has historically supported agricultural activities and is situated adjacent to a wetland feature known as the 'Bollard Bullrush Swamp'.

The site was cleared of remnant native vegetation prior to 1953 (based on available historic aerial photography) with the exception of scattered *Eucalyptus rudis* (Flooded gum) and *Melaleuca raphiophylla* (Swamp Paperback) trees and utilised for agricultural land uses associated with dairy farming. The northern portion of the site currently supports several sheds, horse stables and cultivated gardens. An area of relatively undisturbed intact remnant native vegetation exists to the south of the site within the Bollard Bulrush Swamp, while more disturbed vegetation (i.e. remnant native trees over paddock grasses) occurs within the site.

Land uses surrounding the site include:

- Bertram Road and exiting residential development zoned 'Urban' under the MRS and 'Residential' under the City of Kwinana TPS No.2 to the north of the site
- Broad acre rural landholdings zoned 'Urban' under the MRS and 'Development' under the City of Kwinana TPS No.3 to the east of the site, which forms part of the Lot 500, 501 Bertram Road Local Structure Plan (Approved WAPC 2016).
- Bollard Bulrush Swamp CCW (UFI 15866) and associated remnant native vegetation, zoned 'Rural' under the MRS and 'Parks Recreation and Drainage' and 'Rural A' under the City of Kwinana TPS No.2 to the south of the site. Further to the south is the Peel Main Drain, a Water Corporation drain discharging to the Serpentine River at Kerulup Pool.
- The Kings College pre-kindy to Year 12 school facilities and The Kings Chapel (Freeway Church) to the west of the site.

3.2 Landform and soils

3.2.1 Topography

Existing topographic contours across the site range from 4 m Australian Height Datum (AHD) in the western portion of the site to 8 m AHD in the eastern portion of the site (DoW 2008). Topographic contours across the site are shown in **Figure 2.**

3.2.2 Soils and Geology

Landforms and soils influence vegetation types at regional and local scales. The site occurs on the Swan Coastal Plain, which is the geomorphic unit that characterises much of the Perth metropolitan area.

Examination of broad scale soil mapping undertaken by Geological Survey of Western Australia, as documented in *Perth Metropolitan Region 1: 50,000 Environmental Geology Series Perth Sheet 2034*

II & Part of 2034 III & 2134III (Jordan 1986), indicates the site is underlain by the Herdsman unit described as 'Peaty swamps associated with Bassendean and Karrakatta units'.

Detailed DMIRS (2018) soil mapping shows that the site comprises the following soil types, as shown on **Figure 2**:

- Sandy Silt (Ms5). This unit is described as 'dark brownish grey silt, with disseminated fine-grained quartz sand, firm, variable clay content, of lacustrine origin'.
- Sand (S8). This unit is described as 'very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin as relatively thin veneer over C2, M4 and Mc2'.

Geotechnical investigations were conducted by Structerre Consulting Engineers (2015) at ten test pit locations within and in close proximity to the site. The geotechnical investigation involved the installation of several subsurface soil bores for soil profiling and percolation tests to determine the permeability of soils. The subsurface soils encountered comprised of topsoil to 0.1 m, silty sand to sand fill to 0.3m, underlain by loose to medium dense sand to the investigated depth of 4 m (Structerre Consulting Engineers 2015). The soils encountered during the geotechnical survey are generally consistent with the regional mapping. Groundwater was encountered at depths of 0.8m to 1.5m below existing ground surface level.

3.2.3 Acid sulfate soils

Acid sulfate soils (ASS) is the name commonly given to naturally occurring soils and sediment containing iron sulphide (iron pyrite) materials. In their natural state, ASS are generally present in waterlogged and/or anoxic conditions and do not present any risk to the environment. ASS can pose issues when oxidised, producing sulphuric acid, which can present a range of risks for the surrounding environment, infrastructure and human health.

The Department of Water and Environment Regulation (DWER) provides broad-scale mapping indicating areas of potential ASS risk (DWER 2019). A review of the DWER mapping indicates that the majority of the site is classified as having a 'high to moderate risk' of ASS occurring within 3 m of the natural soil surface, with a small area in the eastern corner of the site classified as having 'moderate to low risk', of ASS occurring within 3 m of the natural soil surface, as shown within **Figure 3.**

3.3 Biodiversity and natural area assets

3.3.1 Flora and vegetation

3.3.1.1 Regional context

Native vegetation is described and mapped at different scales in order to illustrate patterns in its distribution. At a continental scale, the *Interim Biogeographic Regionalisation of Australia* (IBRA) divides the Swan Coastal Plain into two floristic subregions (Environment Australia 2000). The site is located within the Perth subregion of the Swan Coastal Plain, which is characterised as mainly containing *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; and woodland of *Eucalyptus gomphocephala* (tuart), *E. marginata* (jarrah) and *Corymbia calophylla*

(marri) on less leached soils (Beard *et al.* 2013). This subregion is recognised as a biodiversity hotspot and contains a wide variety of endemic flora and vegetation types.

Regional vegetation complex mapping for the Swan Coastal Plain undertaken by Heddle *et al.* (1980) delineates the various vegetation complex types which would have occurred across the region prior to European settlement in Western Australia. Based on this mapping, the site occurs within the Herdsman Complex, the description of which is described as 'Sedgelands and fringing woodland of *Eucalyptus rudis - Melaleuca spp*.' In 2018, there was estimated to be 32.11% of the pre-European extent of the Herdsman Complex remaining on the Swan Coastal Plain (Government of Western Australia 2018).

The EPA'S *Guidance Statement No. 10. Guidance for the Assessment of Environmental Factors – Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region* (EPA 2006) outlines the following objectives for regional vegetation complexes:

- Retain at least 10% of the original extent of vegetation complexes within 'constrained areas', which the EPA (2008) define as 'an area where there is a reasonable expectation that development will be able to proceed. This may include urban, urban deferred or industrial zoned land or land with existing development approvals.'
- Retain at 30% of the original extent of vegetation complexes within 'unconstrained areas', the Darling Plateau and rural zoned land of the Peel region.

On the Swan Coastal Plain, which is considered a 'constrained area', the EPA has previously applied an objective of retaining 10% of each vegetation complex (EPA 2006). The Herdsman complex 2018 extent remaining is above the EPA's retention objective.

Intact vegetation determined to be in 'good' or better condition is considered to be representative of the overarching vegetation complex. Based on the most recent reconnaissance flora and fauna survey (Emerge Associates 2020e), vegetation within the site is no longer representative of the mapped regional vegetation complex, given the vegetation is in 'completely degraded' condition and resultant absence of intact ecological communities.

3.3.1.2 Site specific surveys and investigations

A number of historical terrestrial flora and vegetation studies and investigations have occurred across the site and the broader Bollard Bullrush Swamp. These have supported the strategic land use planning process completed to date and aided the understanding of the environmental attributes and values of the site.

The 'level 2' targeted flora and vegetation survey was conducted by ENV Australia (2011b) consistent with EPA's *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2004a).* One botanist from ENV Australia undertook a spring survey over Lots 500 and 501 Bertram Road on 29 September 2010. Detailed sampling of vegetation was undertaken using three non-permanent quadrats, established over a 10 x 10 m area and one relevé. Areas of suitable habitat for threatened and priority flora species with potential to occur in the site were identified and searched.

Subsequent to this, a 'Reconnaissance' flora and vegetation survey in accordance with EPA's *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016b) was undertaken by Emerge Associates (2020c). One botanist from Emerge visited the broader Lot 500 Bertram Road on 4 May 2020. Opportunistic records were made of flora and fauna species and the structure, composition and condition of vegetation was recorded. The locations of TECs and/or PECs within the site according to the DBCA database and previous surveys (ENV Australia 2011b) were reviewed using recent aerial photography and the field visit.

The findings of the most recent *Reconnaissance Flora and Fauna Survey - Lot 500 Bertram Road, Wellard Local Structure Plan Amendment* (Emerge Associates 2020c), are referred to in this EAMS herein, given they provide the most up to date and comprehensive information and build on the findings of the previously undertaken surveys. The survey report is provided in **Appendix C.**

3.3.1.3 Plant communities

One vegetation type was identified as occurring over the entirety of the site; **Parkland Cleared**, described as '*Scattered Eucalyptus rudis* and *Melaleuca raphiophylla* over non-native grassland or bare ground with scattered native shrubs and forbs'. This was not identified as a native plant community due to understory clearing resulting in a predominantly non-native grassy understory (Emerge Associates 2020c). A representative photo is shown in **Plate 2** and extent shown in **Figure 4.**

*Plate 2: **Parkland cleared** in 'completely degraded' condition.*

3.3.1.4 Vegetation condition

The vegetation condition was assessed using methods from Keighery (1994). The site supports primarily non-native vegetation in 'completely degraded' condition due to the low number and cover

of native species. Disturbances activities include invasive weeds, livestock grazing and trampling and historical clearing.

The extent of vegetation by condition category is detailed in **Table 2** and shown in **Figure 6.**

Table 2: Extent of vegetation condition categories within the site (Emerge Associates 2020d)

Condition category	Total Area (ha)
Pristine	0
Excellent	0
Excellent – very good	0
Very Good	0
Very Good - good	0
Good	0
Good - degraded	0
Degraded	0
Completely Degraded	5.00
Total	**5.00**

3.3.1.5 Floristic community type assessment

The identified plant communities were compared to the regional 'floristic community type' (FCT) dataset *A Floristic survey of the southern Swan Coastal Plain* by Gibson *et al.* (1994). The sample data (presence/absence) collected within the amendment area was reconciled with Gibson *et al*. by standardising the names of taxa with those used in earlier studies. Where the sample tended to cluster with a grouping of different FCTs, individual quadrat similarity was assessed separately to differentiate between FCTs. Ultimately a cluster analysis, as well as contextual information relating to the soils, landforms and known locations of FCTs within the region, was considered in the final determination of an FCT for vegetation within the site.

As outlined in **Section 3.3.1.4**, the **Parkland Cleared** vegetation has been subject to a high level of historical disturbance through vegetation clearing and stock grazing, and the entirety is in a 'completely degraded' condition. As such it is no longer representative of an intact native ecological community. Given the plant community identified within the site is not intact, a comparison to regional floristic community types (FCTs) could not be undertaken (Emerge Associates 2020e).

3.3.1.6 Threatened and priority ecological communities

Generally, ecological communities can be described as vegetation communities that are assemblages of species that occur together in a particular type of habitat. An ecological community's structure, composition and distribution are determined by a range of environmental factors. 'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant protection.

Selected TECs are afforded statutory protection at a Commonwealth level under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). TECs listed under the EPBC Act are categorised as either 'critically endangered', 'endangered' or 'vulnerable'. Any action likely to have a significant impact on a critically endangered or endangered TEC listed under the EPBC Act requires approval from the Commonwealth Minister for the Environment.

Within Western Australia, state-listed threatened flora and TECs (once declared) are statutorily protected through the *Biodiversity Conservation Act 2016* (BC Act), and licences (or similar) may be required where these values are proposed to be disturbed or modified.

In addition to the BC Act, impacts to TECs are considered under the EP Act. The Environmental Protection Authority (EPA) produces environmental factor guidelines to outline how environmental factors are considered by the EPA in the environmental impact assessment process. Under the flora and vegetation environmental factor guideline (EPA 2016) TECs are considered to be significant values, and approval may be required from the EPA in order to impact a TEC.

An ecological community under consideration for listing as a TEC in Western Australia, but which does not yet meet survey criteria or has not been adequately defined, or which is rare but not currently threatened, is referred to as a 'priority ecological community' (PEC). Whilst PECs are not afforded statutory protection in Western Australia, they are considered during the approval process.

Known locations of TECs and PECs within 5 km of the site were searched for using the publicly available *Protected Matters Search Tool* (Department of Environment and Energy (DoEE) 2020. These search results indicate that three TECs occur within 5 km of the site.

As previously stated in **Section 3.3.1.4**, the flora and vegetation survey determined that all plant communities within the site was subject to a high level of historical disturbance through vegetation clearing and stock grazing and are present in a 'completely degraded' condition. The flora and vegetation survey concluded that the plant communities within the site have been altered, are no longer intact and do not represent a listed community. Therefore, no TECs or PECs occur within the site (Emerge Associates 2020e).

3.3.1.7 Significant flora

Certain flora species that are considered to be rare or under threat warrant protection under Commonwealth and/or State legislation. At a Commonwealth level, flora species may be listed as 'threatened' pursuant to the EPBC Act and any action likely to have a significant impact on a listed threatened species requires approval from the Commonwealth Minister for the Environment.

At a State level, plant species may also be classed as 'threatened' under the BC Act. Species which are potentially rare or threatened, or meet the criteria for near threatened, or have recently been removed from the threatened species list are classed as 'priority' flora species. However, priority flora species are not afforded statutory protection.

A search was conducted for threatened and priority flora within a 5 km radius of the site using the *Protected Matters Search Tool* (DoEE 2019) and *NatureMap* (DBCA 2019). A total of nine threatened and ten priority flora species were identified as occurring or potentially occurring in the wider local area. This list was refined further, and only those species known to have habitat preferences aligned

with site conditions, were identified as potentially occurring within the site. As such, only eight conservation significant flora species were considered to potentially to occur within the site:

- Six species listed as threatened under the EPBC Act; *Andersonia gracilis* (Slender Andersonia), *Caladenia huegelii* (King Spider-orchid), *Diuris purdiei* (Purdie's Donkey-orchid), Drakaea elastica (Glossy-leafed Hammer Orchid), *Eleocharis keigheryi* (Keighery's Eleocharis) and *Synaphea sp. Fairbridge Farm* (D. Papenfus 696).
- Two species listed as Priority 3 and Priority 4 respectively under the BC Act*; Cyathochaeta teretifolia* and *Stylidium longitubum* (Jumping Jacks).

No threatened or priority flora species were recorded within the site during recent or historical surveys (ENV Australia 2011b; Emerge Associates 2020d). It was considered unlikely that the site supports flora of conservation significance a result of the reduced condition of the vegetation as well as trampling and grazing by cattle.

As outlined in the assessment reports the methodology, timing and level of effort applied during the flora, vegetation and fauna surveys were considered to be suitable for the site and did not limit the survey outcomes. The ENV Australia (2011b) survey was undertaken at the appropriate time of year (spring) and the entire site was adequately searched for species of conservation significance.

3.3.2 Bush Forever

The Government of Western Australia's *Bush Forever Policy* (Government of WA 2000) is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of Bush Forever is to protect comprehensive representations of all original vegetation complexes by targeting a minimum of 10% of each for protection. Bush Forever sites are representative of regional ecosystems and habitat and have a role in the conservation of Perth's biodiversity.

There are no Bush Forever sites within the site.

3.3.3 Ecological linkages

Ecological linkages are linear landscape elements that allow the movement of fauna, flora and genetic material between areas of remnant habitat. The movement of fauna and the exchange of genetic material between vegetation remnants improve the viability of those remnants by allowing greater access to breeding partners and food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are ideally continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

The Perth Biodiversity Project, supported by the Western Australia Local Government Association (WALGA), have identified and mapped regional ecological linkages within the Perth Metropolitan Region (WALGA and PBP 2004). The study was extended beyond the Perth Metropolitan Region through the South West Biodiversity Project, resulting in the identification and mapping of the South West regional ecological linkages (Molloy *et al.* 2009).

There are no mapped ecological linkages within the site. One regional ecological linkage occurs to the north of the site, connecting vegetation in Bush Forever Site 272 to Bush Forever Site 269. The location is shown in **Figure 7.**

3.3.4 Environmentally sensitive areas

'Environmentally sensitive areas' (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding significant, threatened or scheduled flora, vegetation communities or ecosystems. Exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply within ESAs. However, exemptions under Schedule 6 of the EP Act still apply, including any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the EP Act).

One ESA has been mapped as occurring within the site based upon a review of the *Clearing Regulations – Environmentally Sensitive Areas* dataset (DWER 2020). This mapped ESA is likely associated with Bollard Bullrush Swamp CCW to the south west of the site. The location of Environmentally sensitive areas within the site or within close proximity to the site are shown in **Figure 7.**

3.3.5 Terrestrial fauna

3.3.5.1 Regional context

The site is located in the eastern margin of the Swan Coastal Plain, which is typically characterised by areas largely cleared of remnant vegetation to facilitate rural land uses. Notwithstanding, the region does contain some large areas of remnant vegetation, in addition to other environmental features such as mature trees, waterways and wetlands, all of which provide fauna habitat values.

A range of conservation significant fauna species are known to occur within the broader region encompassing the site. This includes three species of threatened black cockatoo, namely Carnaby's cockatoo (CC), forest red-tailed black cockatoo (FRTBC) and a lesser extent Baudin's black cockatoo (BBC) (given the site is located on the edge of the BBCs distribution range).

Regional scale habitat mapping published by the Department of Planning (2011) delineates likely CBC habitat used for feeding, night roosts and breeding areas across the Swan Coastal Plain. The regional mapping indicates that the south-western portion of the site is identified as potentially suitable black cockatoo foraging habitat which extends further to the south of the site associated with the Bollard Bulrush Swamp, which contains areas of extensive remnant vegetation, as shown in **Figure 7.**

Records of black cockatoo roosting sites across south-west Western Australia are maintained by Birdlife Australia, and are based on annual community surveys as part of the *Great Cocky Count* (GCC). Based on the most recently published 2018 GCC report, the site does not contain any confirmed black cockatoo roosting sites. The nearest known roost, as identified in the GCC is located approximately 2 km to the south-west of the site within Leda Nature Reserve and has recently (2019) recorded forest red-tailed black cockatoo roosting activity. The nearest breeding habitat, as identified in the Department of Planning data, is approximately 10 km to the east of the site within the Swan Coastal Plain.

3.3.5.2 Site specific surveys and investigations

A number of historical fauna surveys and investigations have occurred across the site and broader area which have supported the strategic land use planning process completed to date and aided the understanding of the environmental attributes and values of the site.

A 'level 1' fauna assessment was undertaken over broader Lots 500 and 501 Bertram Road, Wellard in June 2010 to support MRS Amendment 1188/57 (ENV Australia 2010), consistent with EPA's *Technical Guidance No. 56 – Terrestrial Fauna Surveys* (EPA 2004b). Transects were traversed across the site, during the day, and the characteristics of fauna habitat and presence of fauna species was recorded. A vertebrate fauna list was compiled and fauna habitat values were described, with particular reference to 'threatened' and 'priority' fauna species with potential to occur within the site.

Subsequent to this, a 'Reconnaissance' fauna survey was undertaken over the broader Lots 500 Bertram Road in May 2020 (Emerge Associates 2020e) in accordance with EPA's *Technical Guidance – Terrestrial Fauna Surveys* (EPA 2016a). As a part of this survey, an opportunistic fauna species list was compiled and information on the habitat preferences of conservation significant fauna identified from database searches was reviewed.

The findings of the most recent *Reconnaissance Flora and Fauna Survey - Lot 500 Bertram Road, Wellard Local Structure Plan Amendment* (Emerge Associates 2020e), will be referred to in this EAMS from herein, given they provide the most up to date and comprehensive information and build on the findings of the previously undertaken surveys. The survey report is provided in **Appendix C.**

3.3.5.3 Species of conservation significance

Certain fauna species that are considered to be rare or under threat warrant special protection under state and/or federal legislation. At a federal level, fauna species may be listed as 'threatened' pursuant to the EPBC Act and any action likely to have a significant impact on a listed threatened species requires approval from the Commonwealth Minister for the Environment.

In Western Australia, fauna taxa may be classed as 'specially protected' under the BC Act which is enforced by DBCA. Specially protected fauna species are listed under Schedules 1 to 7 according to their conservation status. It is an offence to 'take' or 'disturb' threatened fauna without Ministerial approval.

Fauna species that do not currently meet the criteria for listing as threatened but are potentially rare or threatened may be added to the DBCA's *Priority Fauna List*. These species are classified into 'priority' levels based on threat. Whilst priority species are not under direct statutory protection, they are considered during State approval processes.

A search was conducted for threatened, priority and other conservation significant fauna within a 5 km radius of the site of State and Commonwealth listed databases. Seven conservation significant fauna species were considered to have potential to occur within the application area, however the likelihood that the application area would provide important habitat for these species was considered to be low, due to the poor condition and limited extent of habitat within the site (ENV Australia 2010). These species include:

- *Apus pacificus* (Pacific swift)
- *Calyptorhynchus banksii naso* (Forest red-tailed black cockatoo)
- *Calyptorhynchus baudinii* (Baudin's cockatoo)
- *Calyptorhynchus latirostris* (Carnaby's cockatoo)
- *Falco peregrinus* (Peregrine falcon)
- *Isoodon fusciventer* (Quenda)
- *Oxyura australis* (Blue-billed Duck)

A total of 13 fauna species were recorded during the survey, the majority of which were common, widespread bird species. No conservation significant fauna was recorded within the site during recent or historical field surveys (ENV Australia 2011a, Emerge Associates 2020e). In addition, the likelihood that the site would provide important habitat for any fauna species of conservation significance is low, given the site primarily comprises cleared areas and non-native vegetation which support low fauna habitat values.

3.3.5.4 Fauna habitat

Based on the results of the fauna assessment, fauna habitat values within the site are generally limited, primarily providing habitat that is suitable for common and widespread native species with non-specific habitat requirements. The fauna assessment also determined that for the majority of the site, habitat values are compromised by the removal of most of the native vegetation and impacts of historical degradation (ENV Australia 2011a, Emerge Associates 2020e).

The remnant native swamp paperbark and flooded gum trees may provide habitat for native fauna species but is considered to be of low value. The scattered native trees could provide shelter and foraging opportunities for a number of different species including arboreal reptiles and mammals and the three threatened species of black cockatoo species; Carnaby's black cockatoo (CBC), forest red-tailed black cockatoo (FRTBC) and to a lesser extent Baudin's black cockatoo (BBC) (given the site is located on the edge of the BBCs distribution range). With the exception of black cockatoos, these species however would be commonly recorded urban species and none would have any conservation significance.

3.3.5.5 Black cockatoo habitat

Breeding habitat

Trees of species known to support breeding by black cockatoos that are located within the known range of black cockatoos and either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to support future hollow formation, are considered breeding habitat trees (from herein referred to as 'habitat trees').

The scattered flooded gum trees within the site have the potential to support black cockatoo breeding habitat values, however an assessment of the suitability of the trees for black cockatoo breeding purposes was not undertaken as part of historical or recent fauna surveys. No evidence of black cockatoo breeding activity was observed within the site during the recent fauna survey (Emerge Associates 2020e).

No confirmed Carnaby's cockatoo breeding sites, as mapped by DEC (2011) with a 12 km buffer, are located near the site. The closest confirmed Carnaby's cockatoo breeding site buffer is located approximately 20 km north-east of the site.

Roosting habitat

The site contains only a very limited number of trees that could provide potential roosting habitat for black cockatoos. No evidence of roosting was observed during the recent fauna survey (Emerge Associates 2020e).

Records of black cockatoo roosting sites across south-west Western Australia are maintained by Birdlife Australia, utilising annual community surveys as part of the *Great Cocky Count* (GCC). Based on the most recently published 2019 GCC report, the site does not contain any confirmed black cockatoo roosting sites.

A number of potential roost sites are mapped as occurring near the site. However, no birds have been recorded at most of these sites. The closest known roost sites where birds have been recorded are located approximately 1.5 km and 2 km north of the site. These roost sites are associated with forest red-tailed black cockatoos. The closest roost site where Carnaby's cockatoos were recorded is located approximately 5 km south-east of the site. It is considered unlikely that roosting would occur, given there is no historical roosting and that only a small extent of potential roosting habitat is present.

Foraging habitat

Foraging habitat within the site is generally limited and patchily distributed, confined to the stands of flooded gum trees which are consumed by all three species of black cockatoo. Whilst these trees may be foraged upon by black cockatoos opportunistically, these species do not represent an important foraging resource for any of the three species of black cockatoo and therefore have limited foraging habitat values.

It is not considered that the site provides important foraging habitat, given its small extent and presence of extensive areas of higher quality foraging habitat near the site within the Darling Scarp.

3.3.6 Bollard Bullrush Swamp flora, vegetation and fauna values

Areas of relatively undisturbed intact remnant native vegetation exist to the south-west of the site within the Bollard Bulrush Swamp CCW (UFI 15866). The Bollard Bulrush Swamp has been the subject to a historical and recent flora and fauna surveys, including but not limited to the following:

- *Fauna Survey (Level 2) East Rockingham WWTP Site* (Harewood 2009).
- *Fauna Survey (Level 1) East Rockingham WWTP Site* (Harewood 2008).
- *Fauna Assessment of Bush Forever Site 355* (Bamford 2005).
- *Fauna Assessment of a Portion of the Sepia Depression Ocean Outlet Landline, Lake Richmond* (ENV 2005).
- *Bollard Bullrush East - Flora and Vegetation Assessment* (ENV Australia 2011b)
- *Reconnaissance Flora and Fauna Survey - Lot 500 Bertram Road, Wellard Local Structure Plan Amendment (Emerge Associates 2020d)*

With respect to flora and vegetation values, one native plant community; **ErMr** ranging from 'Good-degraded' to 'Excellent – Very Good' was identified as occurring within the Bollard Bulrush Swamp CCW (Emerge Associates 2020d). The plant community **ErMr** was considered to potentially represent two FCTs from Gibson et al. (1994), described below:

- FCT 11 Wet forests and woodlands. FCT 11 is well reserved and considered to be at Low risk (Gibson et al., 1994).
- FCT 15 Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain. FCT 15 is a State listed TEC ('Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain'). This TEC is not listed at the Commonwealth level.

The **ErMr** plant community was considered to potentially FCT 15 ('Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain') which is a State listed TEC.

With respect to fauna values, twenty-eight species of conservation significance have been previously recorded within the Bollard Bullrush Swamp. This includes three reptile species, 18 bird species and seven mammal species. One fauna habitat type; **melaleuca dampland** was identified associated the extent of CCW wetland vegetation. This fauna habitat supports dense cover of wetland native understorey vegetation which may provide habitat for native ground dwelling fauna (ENV Australia 2010). One fauna species of conservation significance; the Quenda, was positively identified as utilising the densely vegetated Bollard Bulrush Swamp. The presence of quenda within the site was identified through scats and burrows (Emerge Associates 2020e).

3.4 Hydrology

3.4.1 Groundwater

3.4.1.1 Groundwater resources

The *Water Register* (DWER 2020e) indicates that the site is located in the Jandakot groundwater area. Aquifers beneath the site comprise of the following:

- Superficial Swan (unconfined).
- Leederville (confined).
- Yarragadee North (confined).

At the time of preparing this report (December 2020), allocation is available within the Superficial Swan aquifer, however the Leederville aquifer has been over-allocated and requires compensation via the Superficial Swan allocation allowance. Requirements for a non-potable source are currently being investigated by the proponent and will be outlined in future urban water management plans (UWMPs).

3.4.1.2 Groundwater levels

The *Perth Groundwater Map* (DWER 2020b) indicates that groundwater levels across the site are a maximum of 8 m AHD (i.e. 2 m BGL), and flow in a south-westerly direction towards the Bollard Bulrush Swamp.

During geotechnical investigations conducted by Structerre (2015) in March 2015, groundwater was encountered within the site at depths of between 1.1 m to 1.5 m BGL. Groundwater monitoring was also undertaken from October to November 2015 within the site from two bore (BH01 and BH02). Measured groundwater levels contours were generated by RPS (2017b) using a range of monitoring data both within and in proximity to the site. Generated average annual maximum groundwater levels (AAMGL) were found to be between 0-2.2 m BGL, hence subsoil drains will likely to be utilised beneath the site to set a controlled groundwater level (CGL).

Due to the low clearance to groundwater, coupled with the expected increase in groundwater levels expected from development, subsoils will need to be utilised beneath the site to set a controlled groundwater level (CGL). Further information pertaining to groundwater conditions within the site can be found within the *Local Water Management Strategy* (Emerge Associates 2020c) (**Appendix C**).

3.4.2 Surface water

The site is located in the Murray River catchment area as identified through the DWER *Hydrographic Catchments* dataset. At a local level, the site is located within the Serpentine River catchment, which drains to the south-east of the site, into the Swan River. Review of the DWER *Hydrography Linear dataset* indicates the presence of the perennial Bollard Bulrush Swamp which has a 'subject to inundation' buffer placed around it that covers the majority of the lot.

The Peel-Main Drain (PMD) is located to the south west of the site which is managed by the Water Corporation (WC). The PMD flows in a southerly direction connecting to the Serpentine River and discharges to the Peel-Harvey estuary. The PMD is typically 20-25 m wide, trapezoidal in shape with a low grade (RPS 2017b).

3.4.3 Wetlands

Wetlands are areas which are permanently, seasonally or intermittently waterlogged or inundated with water. Naturally occurring wetland features are common across the Swan Coastal Plain and can contain fresh or salty water, which may be flowing or still. Wetlands can be further categorised based on their hydrological characteristics and physical structure.

The location, mapped boundaries and management categories of wetlands across the Swan Coastal Plain were originally identified in the *Wetlands of the Swan Coastal Plain: Wetland Mapping, Classification and Evaluation* (Hill et al. 1996). This information was subsequently converted into the publicly available *Geomorphic Wetlands of the Swan Coastal Plain* database, which is maintained by the Department of Biodiversity, Conservation and Attractions (DBCA). The management categories of wetlands are conservation, resource enhancement and multiple use, and are detailed in **Table 3**.

Table 3: Geomorphic Wetlands of the Swan Coastal Plain management categories (Hill et al. 1996)

Management category	Description of wetland	Management objectives
Conservation (CCW)	Support high levels of attributes	Preserve wetland attributes and functions through reservation in national parks, crown reserves and state-owned land. Protection provided under environmental protection policies.
Resource Enhancement (REW)	Partly modified but still supporting substantial functions and attributes	Restore wetland through maintenance and enhancement of wetland functions and attributes. Protection via crown reserves, state or local government owned land, environmental protection policies and sustainable management on private properties.
Multiple Use (MUW)	Few wetland attributes but still provide important hydrological functions	Use, development and management considered in the context of water, town and environmental planning through land care.

A review of the Geomorphic Wetlands on the Swan Coastal Plain dataset (DBCA 2020) indicates that the majority of the site is mapped as a multiple use wetland (UFI 13327). The MUW has been previously cleared for agricultural purposes and contains pasture species with scattered paddock trees. The western portion of the site is mapped as a CCW wetland (UFI 15866), associated with Bollard Bulrush Swamp extending further to the south west of the site. The mapped MUW and CCW extending into the site have experienced a high level of disturbance that has reduced the ecological values of the wetland, which now supports vegetation in 'Completely Degraded' condition. The existing geomorphic wetland mapping is shown in **Figure 4**.

The extent of the CCW (UFI 15866) as identified in the *Geomorphic Wetlands of the Swan Coastal Plain* dataset does not accurately represent the actual extent of the wetland. Wetlands supporting a high level of values, attributes and functions are assigned to a Conservation management category. As previously stated, the CCW (UFI 15866) which extends within the site supports significantly reduced diversity of native flora species due to human induced disturbances, to the extent that the wetland no longer supports natural attributes and functions.

As part of the EPA's Environmental Review undertaken for MRS Amendment 1188/57, the EPA recommended that the extent of Bollard Bulrush Swamp CCW be retained within the 'Rural' zoned land, outside of which comprises cleared land considered suitable for 'Urban' development purposes. In order to protect the values of the Bollard Bulrush Swamp CCW (UFI 15866), the EPA recommended that a buffer of 50 metres (m) be provided, that would extent into the Urban zoned land.

A site investigation was undertaken by Emerge Associates (2020d) to determine the specific boundary of the CCW. It was determined that the boundary of the intact native plant community **ErMr**, provides an appropriate basis for defining the extent of the CCW, using the existing fence line as a basis for defining the plant community edge. As discussed in **Section 3.3.6**, the **ErMr** plant community identified within the Bollard Bulrush Swamp ranges from 'Degraded - good' to 'Good - excellent' condition and supports a high level of floristic diversity representative of a Conservation wetland management category.

The site-specific wetland boundary varies slightly from the MRS zoning based on the extent of intact wetland vegetation, as shown in **Plate 3** below. However, the assessment generally found the MRS zoning generally consistent with the actual extent of the CCW, within the 'Rural' zoned land.

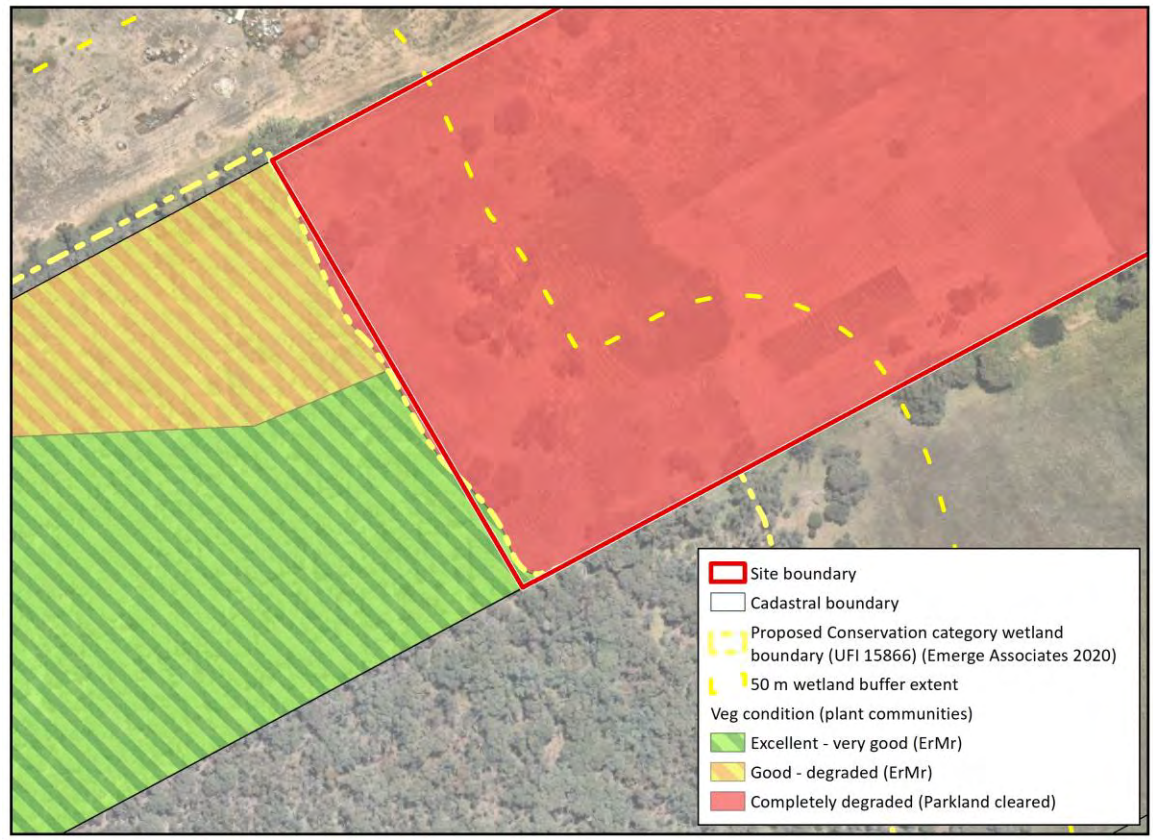

Plate 3: Site specific Conservation Category Wetland boundary (UFI 15866) as determined by Emerge Associates (2020) based on intact native plant community mapping

Consistent with the EPA recommendation to provide a 50 m buffer to wetland, the wetland buffer should be determined from the site-specific wetland boundary, as this was determined as the appropriate edge of the CCW significant wetland values.

3.4.4 Public drinking water source areas

Public drinking water source areas (PDWSAs) are proclaimed by the Department of Water and Environmentally Regulation (DWER) to protect identified drinking water sources, including surface water and groundwater sources (DoW 2009). They are proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947* as Water Reserves, Catchment Areas or Underground Water Pollution Control Areas. PDWSAs provide the population with the majority of its drinking water supplies and can be vulnerable to contamination from a range of land uses. Once an area is identified as a PDWSA, consideration needs to be given to the intended land use and associated activities to ensure that they are appropriate in meeting the water protection quality objectives of the area.

There are no PDWSAs or wellhead protection zones (where public drinking water is extracted from) located within the site.

3.5 Heritage

3.5.1 Indigenous heritage

The Aboriginal Heritage Inquiry System (AHIS) is maintained pursuant to Section 38 of the *Aboriginal Heritage Act 1972* (AHA) by the Department of Planning, Lands and Heritage, containing information on Registered Aboriginal Heritages Sites and Other Heritage Places throughout Western Australia.

In accordance with the *Aboriginal Heritage Due Diligence Guidelines* (DAA 2013), a search of the AHIS online database (DPLH 2020) was undertaken. No Registered Aboriginal Heritage Sites or Other Aboriginal Heritage Places have been identified within the site however, one Other Heritage Place (Bellway Sand Quarry, Wellard, Site ID: 3646) was identified approximately 185 m east of the site, as shown in **Figure 8.** The site is associated with artefacts/scatter.

3.5.2 Non-Indigenous heritage

A desktop search of the Australian Heritage Database (Department of the Environment 2019), the State Heritage Office database (Heritage Council 2019) and the City of Kwinana Local Government Inventory (City of Kwinana 2016) did not identify any heritage features as being mapped within the site, however one registered heritage site, 'Wellard Swamp / Bollard Bullrush Swamp' (Place Number: 12107) is identified to the south-west of the site.

The site's physical description is described as the following under the Heritage Council (2019):

'*Bollard Bulrush swamp is the southernmost swamp of the eastern chain of wetlands, at the interface of the Spearwood and Bassendean dunes. The place has suffered some clearing and has been grazed, however there is still dense growth of paperbarks and flooded gums, with bulrushes through the very wet areas. The drains constructed during the Inter-War period still pass through the swamp and can be seen on Bertram Road, comprising narrow but deep drains, marked by their mounded earth banks*.'

3.6 Other land use considerations

3.6.1 Changes in land use

A review of historical aerial imagery for the site between 1953 to present (Landgate 2020) was completed to understand temporal changes in land use. Historical Landgate aerial photography shows that the land has been cleared and grazed since at least 1965 and that no other land uses have occurred on the property since that time.

3.6.2 Potential site contamination

A review of the DWER *Contaminated Sites Database* indicates that the site is not registered as a contaminated site pursuant to the *Contaminated Sites Act 2003*, nor are other registered sites located nearby.

Historic agricultural land uses, primarily low-intensity activities such as grazing, and plantations, are considered unlikely to raise any significant contamination risk concerns for the site.

3.6.3 Surrounding land uses

The site is located within the central-western Swan Coastal Plain (SCP), approximately 32 km south of the Perth CBD and 2.5 km south-east of the Kwinana Town Centre. The site is within an area which

has historically supported agricultural activities and is situated adjacent to a wetland feature known as the Bollard Bullrush Swamp. The current land uses and zoning surrounding the site include:

- Bertram Road and exiting residential development zoned 'Urban' under the MRS and 'Residential' under the City of Kwinana TPS No.2 to the north of the site
- Broad acre rural landholdings zoned 'Urban' under the MRS and 'Development' under the City of Kwinana TPS No.3 to the east of the site, which forms part of the Lot 500, 501 Bertram Road Local Structure Plan (Approved WAPC 2016).
- Bollard Bulrush Swamp CCW (UFI 15866) and associated remnant native vegetation, zoned 'Rural' under the MRS and 'Parks Recreation and Drainage' and 'Rural A' under the City of Kwinana TPS No.2 to the south of the site. Further to the south is the Peel Main Drain, a Water Corporation drain discharging to the Serpentine River at Kerulup Pool.
- The Kings College pre-kindy to Year 12 school facilities and The Kings Chapel (Freeway Church) infrastructure to the west of the site.

A review of available information and consideration of nearby land uses indicates that no land uses have been identified within at least 1000 m of the site that are likely to impact on future land uses or require separation distances to be accommodated in order to mitigate potential impacts on health and/or amenity.

3.7 Bushfire hazards

The southern portion of the site is currently designated as a 'bushfire prone area' under the state-wide Map of Bush Fire Prone Areas as prepared by the Office of Bushfire Risk Management (OBRM 2019), as shown in **Plate 2**. Strategic planning proposals, including local structure plans require a bushfire hazard level assessment under the *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (the Guidelines) (WAPC and DFES 2017).

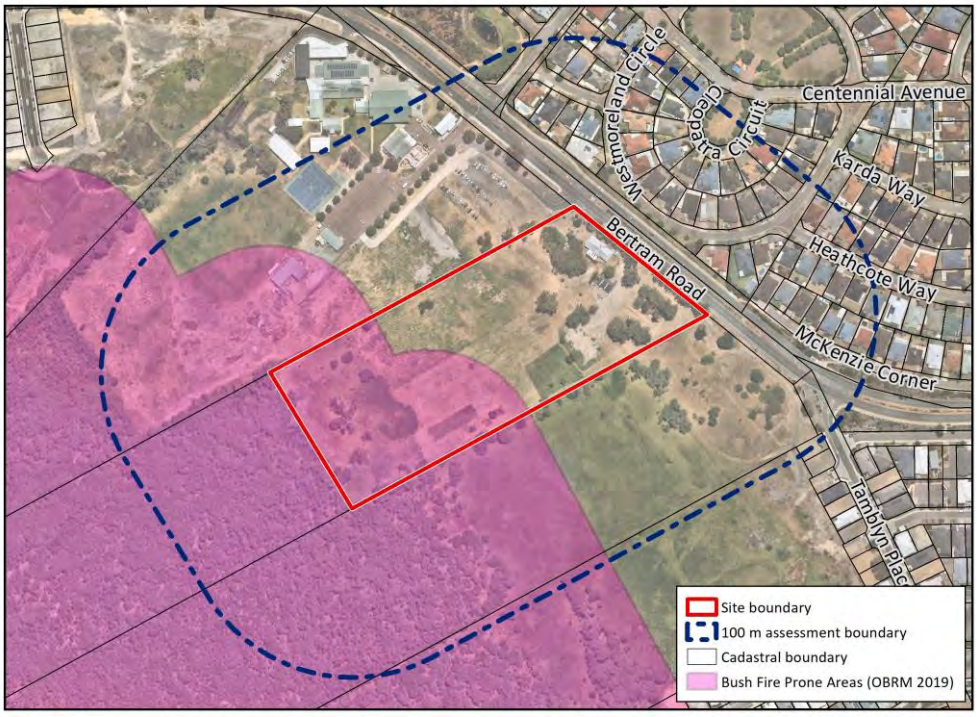

Plate 4: Areas within and surrounding the school site identified as 'bushfire prone areas' (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2019).

A Bushfire Management Plan (BMP) has been prepared by Emerge Associates (2020c) to support the SP, which includes an assessment of vegetation within and surrounding the site to determine applicable bushfire hazards, in accordance with *Australian Standard 3959:2018 Construction of buildings in bushfire-prone areas* (AS 3959) (Standards Australia 2018), and an assessment of the bushfire protection criteria outlined in the Guidelines. The BMP has determined that the SP can satisfy the requirements of SPP 3.7 and the Guidelines.

As part of the BMP, a post-development vegetation classification scenario has been determined to assist in understanding whether the proposed development can satisfy SPP 3.7, and whether any separation distances to achieve a bushfire attack level of BAL-29 or less will need to be accommodated within the LSP area.

The bushfire hazards likely to affect The Kings College future development (in the post-development scenario) will largely be associated with the Forest (Class A) vegetation classification within the portion of the 50 m wetland buffer to be revegetated to a similar standard to the existing wetland vegetation and ceded to the State under a 'Park Recreation and Drainage' reserve.

The proposed LSP will need to provide appropriate separation from bushfire hazards to the south of the site to ensure a BAL rating of BAL-29 or less can be achieved at future habitable buildings (built form). This can be achieved through the strategic location of internal driveway reserves and footpaths, in addition to ensuring that outdoor play and recreation open space is appropriately designed and implemented to achieve low threat standards in accordance with AS 3959, to support the use of this area as part of an asset protection zone.

The anticipated environmental impacts of the LSP, as outlined in **Section 4** have specifically considered any bushfire management requirements. No further environmental impacts (such as clearing of vegetation) beyond those outlined in Section 4 will be required in order to implement urban development across the site, consistent with the proposed LSP.

This is discussed further in the BMP.

4 Environmental Assessment and Management Strategy

This section outlines spatial layout considerations that have been accommodated within the structure plan to respond to environmental attributes and values within the site, as well as any future environmental management requirements that will need to be accommodated within future planning and development stages. Only those environmental values and attributes that require specific consideration based on their presence within the site, and/or the applicable legislation and policy requirements have been included in this section.

4.1 Acid sulfate soils

4.1.1 Policy framework, site context and management objectives

The Department of Water and Environmental Regulation (DWER), through the WAPC, ensures ASS are adequately managed during the land use planning and development process. The objective of the DWER's ASS policy framework is to manage ASS appropriately to prevent the release of metals, nutrients and acidity into the soil and groundwater system that may adversely affect the natural and built environment and human health.

The principal management objective for acid sulfate soils within the site is to ensure that any future development that may disturb acid sulfate soils is appropriately managed to avoid impacts on the environment.

4.1.2 Structure plan layout considerations for acid sulfate soils

A review of the DWER mapping indicates that the majority of the site is classified as having a 'high to moderate risk' of ASS occurring within 3 m of the natural soil, with a small area in the eastern corner of the site classified as having 'moderate to low risk', of ASS occurring within 3 m of the natural soil surface, as shown within **Figure 3.**

The implementation of the LSP and subsequent development of school infrastructure, is unlikely to necessitate the level of disturbance (i.e installation of deep sewer, dewatering or major excavation) that would have been required for the previously proposed residential development of the site. It is likely that fill will be required during development to achieve the required separation from groundwater levels and to reduce flooding risk. This will reduce the likelihood of disturbing ASS through reducing the need for dewatering and large-scale excavations.

4.1.3 Future acid sulfate soils management requirements

Once detailed earthworks designs and depths of trenching/excavation are known, and therefore the likelihood of disturbance below 3 m of the natural soil as part of the construction process, an investigation to determine the actual presence of ASS will be undertaken. Dependent on the findings of the ASS investigations, and if ASS are found within the areas that are proposed to be developed or detailed designs indicate that ASS is likely to be disturbed due to excavation for the installation of services, then an appropriate ASS and dewatering management plan (ASSDMP) may need to be prepared to support future subdivision or development.

For subdivision applications where the subject land is identified as having a high to moderate risk of ASS occurring within 3 m of the natural soil surface (based on regional ASS risk mapping), the WAPC imposes model subdivision condition EN8 (WAPC and DPLH 2017) which states:

"An acid sulphate soils self-assessment form and, if required as a result of the self-assessment, an acid sulphate soils report and an acid sulphate soils management plan shall be submitted to and approved by the Department of Water and Environmental Regulation before any subdivision works or development are commenced. Where an acid sulphate soils management plan is required to be submitted, all subdivision works shall be carried out in accordance with the approved management plan. (Department of Water and Environmental Regulation)"

Model subdivision condition EN8 may be imposed by the WAPC if activities with a high risk of encountering ASS are proposed, including extensive excavation below seasonally dry soils, dewatering or installation of deep sewer.

4.2 Flora and vegetation

4.2.1 Policy framework, site context and management objectives

In the context of environmental impact assessment, the EPA objective for flora and vegetation is '*to protect flora and vegetation so that biological diversity and ecological integrity are maintained*' (EPA 2016a). Where a proposal may potentially impact upon flora and vegetation values, the following mitigation hierarchy should be applied to minimise potential impacts:

1. **Avoid** impacts
2. **Minimise** impacts
3. **Offset** impacts.

The site is largely dominated by areas of 'Parkland Cleared' comprising scattered *Eucalyptus rudis* and *Melaleuca raphiophylla* over non-native grassland. No vegetation within the site has been identified as conservation significant (i.e. TEC or threatened flora) or of regional or local significance. Given this, the impact of future development within the site is likely to be minimal on flora and vegetation values.

Therefore, the objective for future management of flora and vegetation within the site will be principally focused around protecting and rehabilitating areas of relatively undisturbed intact remnant native vegetation associated with Bollard Bulrush Swamp CCW (UFI 15866) to the south of site. In addition to opportunistically retaining paddock trees where possible as part of the future development.

4.2.2 Structure plan layout considerations for flora and vegetation

While the majority of the site is completely degraded and contains limited significant flora or vegetation values. The objective of the development is to maximise and rehabilitate the vegetation associated with Bollard Bulrush Swamp CCW (UFI 15866) and the 50 m buffer which extends within the site, the following spatial considerations have informed the preparation of the development concept:

- The proposed LSP will provide an opportunity to rehabilitate a portion of the 50 m buffer through the implementation of a 'Parks Recreation and Drainage' reserve which encapsulates the significant flora and vegetation values of the wetland, including the potential occurrence of a Priority Ecological Community (PEC) and threatened and priority flora. The proponent will cede the 'Parks Recreation and Drainage' reserve to the Crown as development progresses which will provide a consolidated wetland area for protection into the future.
- The remainder of the wetland buffer will be utilised for active/passive recreational purposes and will be appropriately landscaped in alignment with the City of Kwinana's LPP No.3. This area will provide an opportunity to further retain remnant trees.

4.2.3 Future flora and vegetation management requirements

A Wetland Management Plan (WMP) will be required to be prepared and implemented as a condition of subdivision or development. The WMP will detail the management of the impacts of the proposed development on the wetland, and its flora and fauna values. The WMP will facilitate the enhancement of the wetland core habitat, vegetation and function, including the reduction of weed species. The preparation and implementation of a WMP in consultation with the City of Kwinana will ensure that the EPA's objective for the environmental quality of Bollard Bulrush Swamp will be met.

Opportunities to retain the remnant native trees within the school development will be possible, and will be confirmed during final development design and bulk earthworks requirements. Where clearing of remnant native trees within the site is proposed, a clearing permit will need to be attained pursuant to Part V of the *Environmental Protection Act 1986* (unless a valid exemption applies).

4.3 Native fauna

4.3.1 Policy framework, site context and management objectives

In the context of environmental impact assessment, the EPA's objective for terrestrial fauna is *'to protect fauna so that biological diversity and ecological integrity are maintained'* (EPA 2016b). The application of the mitigation hierarchy should be applied to avoid or minimise impacts to terrestrial fauna where possible.

The EPBC Act also provides protection for listed 'threatened' species, including black cockatoos, which may potentially use habitat within the site.

The site is considered to have overall low biodiversity value from a fauna perspective due to the historical removal of a majority of the original native vegetation and the degraded nature of the existing vegetation (i.e. completely degraded) and associated habitat.

Whilst the site may provide opportunistic potential habitat values for black cockatoos (primarily CBC and FRTBC based on their regional distributions), the small extent and limited quality of availably habitat suggests it is unlikely that the site provides significant habitat. The residual impacts of the proposed clearing are not considered to be significant for any species of fauna, including black cockatoos, on the basis that fauna habitat values within the site have been determined to be limited

(both in terms of quality and quantity) and also given extensive areas of fauna habitat occur in surrounding areas (of a higher quantity and also likely of a higher quality than that within the site).

The management objective for fauna within the site will be principally focused around protecting and rehabilitating vegetation associated with Bollard Bulrush Swamp CCW (UFI 15866) to the south of site, in addition the retention of remanent trees (where appropriate) within the site and ensuring development works are undertaken in a manner that minimises harm to native fauna.

4.3.2 Structure plan layout considerations for terrestrial fauna

Due to the predominantly cleared nature of vegetation within the site, limited fauna habitat values exist, and any habitat that is present is not considered high quality habitat for conservation significant species. Nevertheless, the structure plan aims to minimise the potential to impact on fauna and fauna habitat through:

- Providing for the retention of the remnant vegetation associated with Bollard Bulrush Swamp CCW (UFI 15866) which supports dense cover of wetland native understorey vegetation, known to provide suitable habitat for a number of conservation significant species including the Quenda. The rehabilitation of a portion of the wetland buffer will provide additional habitat for conservation significant fauna species. The LSP provisions will require this area to be placed under a 'Parks Drainage and Recreation' reserve and ceded to the State for the protection of the Bollard Bulrush Swamp CCW vegetation.
- The wetland buffer will provide a suitable separation from the school development, limiting the potential to disturb fauna associated with the Bollard Bulrush Swamp. This will occur through limiting exposure to the following:
    - Passive and active recreation by nearby residents which have the potential to disturb waterbirds and vegetation of the wetland;
    - Domestic animals;
    - Construction effects such as noise and vibration; and
    - Effects of habitable buildings such as noise, movement and light.
- Provide opportunities for the retention of native Swamp Paperbark and Flooded Gum trees within The Kings College outdoor play and recreation open spaces, which also provide potential habitat for the three threatened species of black cockatoo.

4.3.3 Future terrestrial fauna management requirements

As part of the future subdivision and development, a Wetland Management Plan (WMP) and Construction Environmental Management Plan (CEMP) will be required to be prepared in order to minimise impacts to fauna through the clearing and construction process.

4.4 Wetlands

4.4.1 Policy framework, site context and management objectives

In the context of environmental impact assessment, the EPA's objective for inland waters is *'to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected'* (EPA 2018).

In the context of the site, there is one inland water feature to be considered as part of future development; the Bollard Bulrush Swamp CCW (UFI 15866). Based on the *Geomorphic Wetlands of the Swan Coastal Plain* (DBCA 2020) dataset, the majority of the site is mapped as the Bollard Bullrush Swamp multiple use wetland (MUW) (UFI 13327). The western portion of the site is mapped as the conservation category wetland (CCW) (UFI 15866) extending further to the south, east and west.

Both the MUW and CCW extending into the site has experienced a high level of disturbance that has reduced the ecological value of the wetlands, which supports vegetation in 'Completely Degraded' condition. The extent of CCW (UFI 15866) as identified in the *Geomorphic Wetlands of the Swan Coastal Plain* dataset does not accurately represent the actual extent of the wetland. The CCW (UFI 15866) which extends within the site supports significantly reduced diversity of native flora species due to human induced disturbances, to the extent that the wetland no longer supports natural attributes and functions representative of a Conservation management category.

As part of the EPA's Environmental Review undertaken for MRS Amendment 1188/57, the EPA recommended that the extent of Bollard Bulrush Swamp CCW be confined within the 'Rural' zoned land, outside of which comprises cleared land considered suitable for 'Urban' land uses. In order to protect the values of the Bollard Bulrush Swamp CCW (UFI 15866) the EPA recommended that a buffer of 50 metres (m) be provided.

Subsequent investigations undertaken by Emerge Associates (2020d) determined that the boundary of the CCW is delineated by the edge of the intact native plant vegetation (**ErMr**), which supports a high level of floristic diversity. This boundary accurately encapsulates the significant wetland values, as further discussed in **Section 3.4.3**.

The site-specific wetland boundary varies marginally from the MRS zoning, as shown on **Figure 4**, however the assessment generally found the MRS zoning consistent with the actual extent of the CCW. The proposed LSP has responded to the requirement for a 50 m wetland buffer to the Bollard Bulrush Swamp CCW based on this site-specific wetland boundary, as discussed in further detail below.

4.4.2 Structure plan layout considerations for wetland values

The proposed LSP has provided 50 m wetland buffer determined from the site-specific wetland boundary, which is considered as the actual extent of the CCW and appropriately encapsulates the wetlands values, as shown in **Plate 5** below. The buffer will be designed and implemented in accordance with the City of Kwinana's LPP No.3, which also ensures that it provides an effective wetland buffer function. Conservation fencing will be implemented along the boundary of the wetland reserve to restrict access to authorised motorised vehicles.

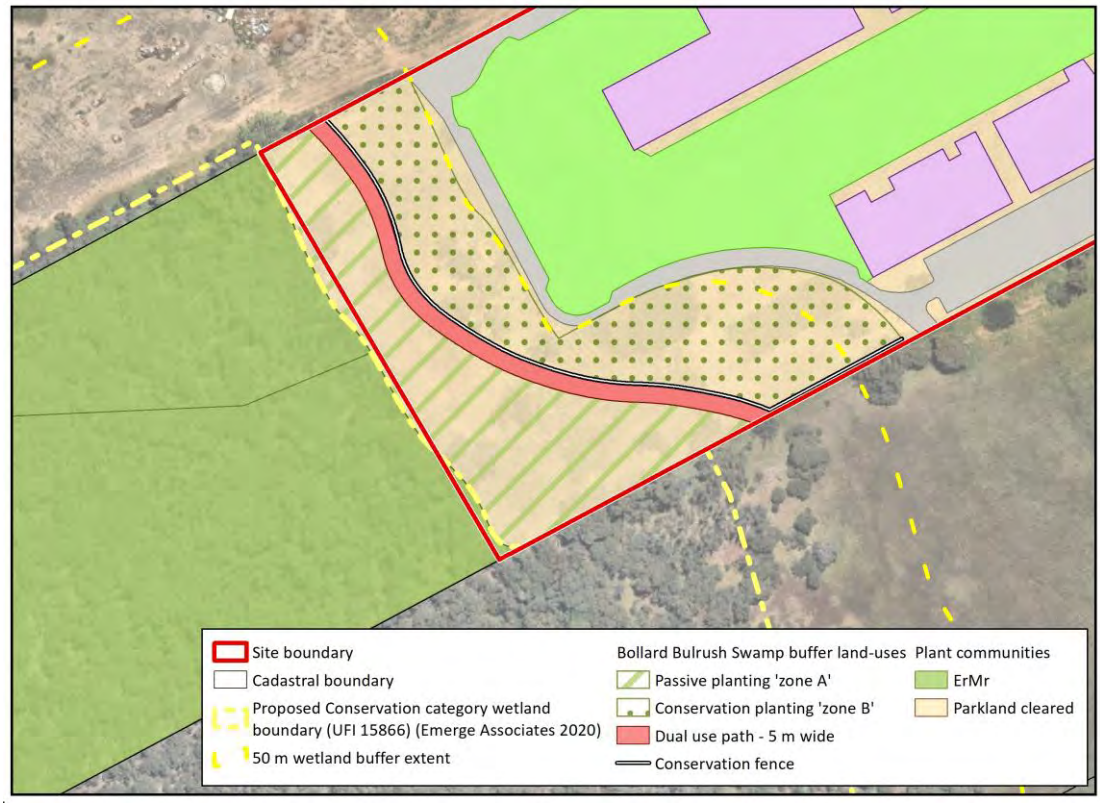

Plate 5: Local Structure Plan Response to Wetland Features

The Bollard Bulrush Swamp is currently not reserved for conservation under the MRS. As a result, the wetland is under private ownership which does not provide adequate mechanisms for conservation management. As part of the future subdivision and development in accordance with the proposed LSP, the Bollard Bulrush Swamp will be ceded as a 'Parks Recreation and Drainage' reserve to the Crown, which will provide a consolidated wetland area for protection into the future.

An LWMS has been developed by Emerge Associates (2020c) to support the proposed LSP outlining the management mechanisms to minimise the impacts of the proposed development on the wetland. The management strategies proposed to protect hydrology of the Bollard Bulrush Swamp include:

- Maintaining the existing hydrology of the Bollard Bulrush Swamp by directing major event stormwater runoff as overland flow to the Peel Main Drain in the existing environment
- Minimising pollutant loads within stormwater runoff and infiltrating to shallow groundwater
- Treating the small event stormwater runoff within the developable portion of the site.

The road network, footpaths and opens space areas will be graded towards bioretention swales and eventually overflow as sheet flow via the discharge flow pathways into the Bollard Bulrush Swamp. No drainage from the site will be directly connected or piped into the wetland, and no drainage infrastructure from the site will be located within the wetland buffer, with the exception of a swale which is proposed within the southern portion of the side, to manage runoff from the dual-use pathway. These treatments are consistent with advice provided in *Draft guideline for the determination of wetland buffer requirements* (WAPC 2005).

4.4.3 Future management requirements for the hydrological values

A Wetland Management Plan (WMP) will be required to be prepared and implemented as a eirther a condition of subdivision or development approval. The WMP will detail the management of the impacts of the proposed development on the wetland, and its flora and fauna values. The WMP will facilitate the enhancement of the wetland core habitat, vegetation and function, including the reduction of weed species. The preparation and implementation of a WMP in consultation with the City of Kwinana will ensure that the EPA's objective for the environmental quality of Bollard Bulrush Swamp will be met. The development of any future water management plan (WMP) should follow the guidance provided in Urban Water Management Plans: *Guidelines for Preparing Plans and for Complying with Subdivision Conditions* (DoW 2008b).

Surface water and groundwater impacts to the CCW can be managed through engineering and design in the preparation and implementation of future water management plans. The requirement to undertake preparation of more detailed water management plans to support the development is generally imposed as a condition of development.

4.5 Hydrology

4.5.1 Policy framework, site context and management objectives

In the context of environmental impact assessment, the EPA's objective for inland waters is *'to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected'* (EPA 2018).

In addition, the *State Water Strategy for Western Australia* (Government of WA 2003) and *Better Urban Water Management* (WAPC 2008) endorses the promotion of integrated water cycle management and application of water sensitive urban design (WSUD) principles to provide improvements in the management of stormwater, and to increase the efficient use of other existing water supplies. Of particular relevance to the wetland and waterway within the site is the *Better Urban Water Management* criteria for ecological protection, which requires development to maintain or restore desirable environmental flows and/or hydrological cycles.

An LWMS has been developed by Emerge Associates (2020c) to support the proposed LSP. The overarching objective for the site is to maintain the pre-development hydrological regime and is based on an at source infiltration approach, and by minimising the potential for nutrient impacts on the Bollard Bulrush Swamp. This will ensure the *Urban Water Management* criteria for ecological protection is met as part of development within the site.

4.5.2 Structure plan layout considerations for hydrological values

The structure plan responds to the requirements for flood mitigation, flow management and treatment of surface water within road reserves and open space.

4.5.2.1 Groundwater

Due to the proximity of the groundwater table to the existing surface, the inclusion of sand fill and subsoil drainage will be required over the site. Groundwater quality will be addressed primarily through the use of vegetated bio-retention areas and median swales, which treat stormwater runoff

before infiltration occurs. To maintain the quality of water prior to infiltration into the underlying groundwater the following measures will be achieved:

- Treatment of stormwater within bio-retention swales, designed to retain and treat the small event (15 mm) runoff, consistent with best management practices.
- Minimising fertiliser use to establish and maintain vegetation/turf.
- Utilising drought tolerant turf species that require minimal water and nutrients.
- Roll-on turf will be used within open space areas (where turf is to be used) to prevent the high nutrient input requirement during establishment of turf.

Further detail on the groundwater and surface water management strategy for the LSP area is provided in the LWMS (Emerge Associates 2020c).

4.5.2.2 Stormwater

The underlying principles of the stormwater management strategy for the site are to retain and treat runoff from small events (first 15 mm) as close to the source as possible and reinfiltrated on site prior to subsequent flows discharging into infiltration basins or roadside swales. Education buildings will retain and treat the small rainfall event within soakwells. Runoff from roof areas will therefore infiltrate into the underlying soil profile and ultimately to groundwater. With regards to major rainfall events, the site grades towards the Bollard Bulrush Swamp and runoff following a major rainfall event will discharge via overland flow to the Peel Main Drain in the existing environment.

To facilitate the stormwater management strategy, the structure plan provides for vegetated bio-retention areas across the development to capture and treat the small event runoff (i.e. first 15 mm) from other impervious areas (e.g. road pavement/footpaths). Runoff from rainfall events greater than the capacity of the swales will be conveyed via overland flow through the buffer to the downstream Bollard Bullrush Swamp, as outlined above.

4.5.3 Future management requirements for the hydrological values

The LWMS provides a framework for the future delivery of a best practice approach to integrated water cycle management utilising water sensitive urban design (WSUD) principles and provides for the management of groundwater and surface water within the site. It has been prepared in accordance with relevant DWER requirements and considers the site-specific values. The LWMS will be a key document guiding future development and can be referred to for further detail, particularly with regard to determined water management criteria and water quality management objectives.

The requirement to undertake preparation of more detailed water management plans to support the development is generally imposed as a condition of development. The WAPC can include a standard condition on subdivision applications (model subdivision condition D2 (WAPC and DPLH 2019)), requiring the preparation of an Urban Water Management Plan (UWMP) which states:

Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water and Environmental Regulation, consistent with any approved Local Water Management Strategy. (Local Government).

Generally, an UWMP will address the following considerations:

- The detailed drainage design based on civil designs
- Imported fill specifications and requirements
- Implementation of water conservation strategies
- Non-structural water quality improvement measures
- Management and maintenance requirements
- Construction period management strategy
- Monitoring and evaluation program.

4.6 Bushfire management

4.6.1 Policy framework, site context and management objectives

State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP3.7) (WAPC 2015a) stipulates that any development proposal which occurs partly or wholly within a designated bushfire prone area is required to be accompanied by a bushfire management plan (BMP). The preparation of a BMP is required to incorporate the following tasks:

- Classification of existing vegetation types and effective slope within the site and surrounding 150 m, in accordance with *Australia Standard 3959-2018 Construction of buildings in bushfire-prone areas* (AS 3959) (Standards Australia 2018).
- Assessment of bushfire hazard levels within the site and surrounding 150 m, in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2017).
- Completion of an indicative Bushfire Attack Level (BAL) assessment and preparation of an associated BAL contour plan.
- Assessment of the structure plan design against the bushfire protection criteria, in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2017).

Policy objective 5.4 of SPP 3.7 specifies that development is required to:

'achieve an appropriate balance between bushfire risk management measures and biodiversity conservation values, environmental protection and biodiversity management and landscape amenity'.

This policy objective ensures that future development appropriately considers the bushfire risks, and provides appropriate separation from any identified risks without negatively impacting existing environmental values.

Based on the bushfire hazard level assessment, the site is located in an area of extreme and moderate bushfire hazard level. As development within the site is progressed, classified vegetation will be removed and development will be located within an area subject to a bushfire hazard level of low or moderate. The bushfire hazards likely to affect The Kings College future development (in the post-development scenario) will largely be associated with the revegetation of the 'Park Recreation and Drainage' reserve. No fuel management of this area is proposed, and will therefore be a bushfire hazard for the foreseeable future. In addition, vegetation within unmanaged rural-residential landholdings to the east will also pose a long-term bushfire hazard to the site.

The principal management objective for the bushfire risk to the site is to ensure that the risk to future people, property and infrastructure is appropriately minimised without negatively impacting on environmental values within or surrounding the site.

4.6.2 Structure plan layout considerations for bushfire management

In accordance with the BMP (Emerge Associates 2020a) prepared for the site, the structure plan has provided an appropriate spatial response to bushfire risk through:

- Ensuring future development areas will be able to accommodate the separation necessary to ensure built form is able to achieve a bushfire attack level (BAL) rating of BAL-29 or less and allow for the revegetation of the wetland buffer in the post development scenario. This has been achieved through the provision of an asset protection zone, in accordance with the Guidelines which is composed of:
  - The Kings college outdoor play and recreation open space will be appropriately designed and implemented to achieve low threat standards in accordance with AS 3959, to support the use of this area as part of an APZ. This area will form a 'managed interface' between the Kings College and Bollard Bulrush Swamp (and the associated wetland rehabilitation area) and will incorporate a balance of native planted pockets and open turf areas with a planting of average density of 1 plant per 2 m^2 but clumped around retained mature trees and mulched to supress weeds
  - Managed internal driveway reserves and footpaths.
- Providing an integrated internal road network that connects with the existing external public road network and provides access to multiple destinations, supporting appropriate emergency evacuation and response.

4.6.3 Future bushfire management requirements

The BMP (Emerge Associates 2020a) demonstrates that SPP 3.7 and the bushfire protection criteria (outlined within the Guidelines (WAPC and DFES 2017)) can be satisfied through an 'acceptable solution' approach. Going forward and based on satisfying the bushfire protection criteria, detailed design and construction will need to consider the following:

- *Element 1 Location*: all future built form should be located in an area subject to a low or moderate bushfire hazard, and should achieve a BAL rating of BAL-29 or less, without requiring clearing or modification of vegetation in areas where remnant vegetation is proposed to be retained, and allowing for the proposed revegetation of the wetland buffer. Based on the bushfire hazard level assessment, the site is located in an area of extreme and moderate bushfire hazard level. As development within the site is progressed, classified vegetation will be removed and development will be located within an area subject to a bushfire hazard level of low or moderate.
- *Element 2 Siting and Design*: provision of appropriate separation to ensure future built form can achieve a BAL rating of BAL-29 or less. All future habitable school buildings can be sited within the proposed development so that BAL-29 or less can be achieved based on the proposed LSP. This has been achieved through the strategic location of internal driveway reserves and footpaths and the managed recreational open spaces which will be designed and maintained to low threat in order minimise the hazard to the school development.

- *Element 3 Vehicular Access*: provision of an integrated road network that provides access to at least two different destinations, with roads to comply with the technical requirements outlined in Table 6 of Appendix Four in the Guidelines (WAPC & DFES 2017), including roads with a trafficable surface width of at least 6 m. The proposed LSP provides for a perimeter driveway will connect to the existing public road network, specifically Bertram Road to the north, further connecting onto Mortimer Road to the east and Challenger Avenue to the west. If development is staged, temporary turn-around areas and/or temporary emergency access ways may be required.
- *Element 4 Water*: the site is located within the current reticulated water supply network and therefore, will be provided with a permanent and secure reticulated water supply.

The proposed The Kings College primary and secondary buildings will meet the criteria of a 'vulnerable' land use in accordance with the definitions provided in SPP 3.7 and the Guidelines. The buildings will accommodate groups of young children who are generally classed to have reduced physical and mental ability to respond in a bushfire event.

The BAL assessment indicates that The Kings College development area will be mostly located within BAL – LOW with a small proportion classified as BAL – 12.5. Where vulnerable land uses are proposed to be developed in an area exposed to a BAL rating of BAL-12.5 or greater, development applications for these types of land uses are required to be supported by a Bushfire Management Plan and an Emergency Evacuation Plan. Evacuation is recommended for vulnerable students (susceptibility to smoke effects) and the site offers area accessible on foot that are BAL-LOW suitable for assembly and staging for evacuation.

5 Implementation Framework

A summary of how the structure plan responds to the environmental values and attributes within the site is provided in **Table 4**. The table also outlines the future management likely to be required as part of the subdivision and development process.

Table 4: Environmental management framework implementation table

Factor	Structure plan phase (completed)	Development approval and/or subdivision phase	Part of development works
Acid sulfate soils	• Consider ASS Risk mapping as prepared by DWER. No spatial response in LSP required.	• If required, preparation of an Acid Sulfate Soil Management Plan.	• If required, implementation of an Acid Sulfate Soil Management Plan.
Native vegetation	• Consideration of remnant native tree retention opportunities within passive recreational open space. • Provision of a 'Parks Drainage and Recreation Reserve' to retain and rehabilitate vegetation associated with the Bollard Bulrush Swamp CCW.	• Preparation of a Wetland Management Plan identifying vegetation retention and revegetation works. • Consideration of potential requirement for Clearing Permit if clearing of native trees undertaken prior to subdivision approval.	• Ensure trees for retention within the passive recreational open space are protected where possible, accommodate these as part of construction and landscaping works. • Undertake revegetation work as required.
Native fauna	• Consideration of remnant native tree retention opportunities within passive recreational open space. • Provision of a 'Parks Drainage and Recreation Reserve' to enhance and retain the Bollard Bulrush Swamp CCW creating additional fauna habitat values for a number of conservation significant fauna species including the Quenda.	• Preparation of a Construction Environmental Management Plan to manage potential impacts to fauna. • Undertake detailed analysis of at engineering design phase to determine further potential tree retention opportunities.	• Ensure trees for retention are protected, accommodate these as part of construction and landscaping works. • Implement pre-clearance checks and/or management plan requirements to ensure fauna is managed appropriately to minimise harm. • If required, obtain and implement licences pursuant to the *Biodiversity Conservation Act 2016* to disturb/relocate fauna prior to works commencing.

Table 4: Environmental management framework implementation table (continued)

Factor	Structure plan phase (completed)	Development approval and/or subdivision phase	Part of development works
Wetlands	• Preparation of a Wetland and Waterway Management Strategy outlining specific strategies for the preservation the Bollard Bulrush Swamp • Incorporation of a 50 m spatial separation as appropriate to adequately protect the CCW from further weed infestation and from inappropriate recreational uses.	• Preparation of a Wetland Management Plan	• Implementation of a Wetland Management Plan
Hydrology	• Preparation of a Local Water Management Strategy. • Ensure the Urban Water Management criteria for ecological protection is met as part of development within the site. • Spatial providing for drainage features to accommodate stormwater (i.e. biofiltration swales).	• Implementation of the Local Water Management Strategy • Preparation of an Urban Water Management Plan. • Provision for drainage features (i.e. biofiltration swales).	• Implementation of the UWMP. • Design and implementation of drainage features/management features as per the requirements of the UWMP.
Bushfire risk	• Preparation of a Bushfire Management Plan. • Ensure future built form is able to achieve a bushfire attack level (BAL) rating of BAL-29 or less by providing appropriate separation from the revegetation of the 'Parks Recreation and Drainage' reserve to a Forest (Class A) vegetation classification. • Provision for a road network that connects the site to the public road network and provides access to at least two destinations.	• Complete detailed BAL assessment to determine the separation requirements necessary to achieve BAL-29 or less and confirm subdivision and/or development layout can accommodate this. • Provision for egress to at least two destinations, ensuring the perimeter driveway will connect to the existing public road network, specifically Bertram Road to the north, further connecting onto Mortimer Road to the east and Challenger Avenue to the west • Preparation of an updated BMP to support the subdivision application.	• Ensure passive recreational open spaces to be designed and maintained as low threat in accordance with Clause 2.2.3.2(f) of AS 3959. • The land use is likely to be considered 'vulnerable' (as per Clause 6.6 of SPP 3.7), development approval to be supported by a BMP and emergency evacuation plan.

6 Conclusions

This EAMS has been prepared on behalf of The Kings College to support an amendment to the existing LSP over Lot 500 Bertram Road, Wellard to facilitate the future development of The Kings College primary and secondary school. The proposed LSP prepared by Harley Dykstra (2020) (**Appendix A**) extends over northern portion of Lot 500 Bertram Road applying to the land zoned 'Urban' under the MRS and 'Development' under the City of Kwinana TPS No.2.

The development of the site is guided by the provisions of City of Kwinana TPS No. 2, which requires environmental management plans to be prepared to support the structure planning process. As such, the proposed LSP is supported by the following:

- *Bushfire Management Plan – Lot 500 Bertram Road, Wellard Local Structure Plan Amendment (Emerge Associates 2020b)*
- *Local Water Management Strategy – Lot 500 Bertram Road, Wellard Local Structure Plan Amendment (Emerge Associates 2020c)*
- *Reconnaissance Flora and Fauna Survey - Lot 500 Bertram Road, Wellard Local Structure Plan Amendment (Emerge Associates 2020d)*

The structure plan design has responded to site-specific environmental considerations, including the accommodation of a 50 m buffer to the Bollard Bullrush Swamp CCW (and associated vegetation) and providing appropriate separation between future built form (The Kings College school development) and areas of bushfire hazard within and external to the site. The proposed LSP will provide the opportunity to rehabilitate a portion of the Bollard Bullrush CCW 50 m buffer through the provision of a 'Parks Recreation and Drainage' reserve. This reserve encapsulates the significant wetland vegetation values known to provide suitable habitat for a number of conservation significant flora and fauna species.

This document provides an outline of the management requirements that will need to be considered as part of future subdivision and development stages. The key management considerations are summarised as follows.

- **Acid sulfate soils:** The implementation of the LSP and subsequent development of school infrastructure, is unlikely to require the level of disturbance (i.e installation of deep sewer, dewatering and/or major excavation) that would have otherwise been required for the previously proposed residential development of the site. However, once detailed earthworks designs and depths of trenching/excavation are known, and therefore the likelihood of disturbance below 3 m of the natural soil as part of the construction process, an investigation to determine the actual presence of ASS may be undertaken. Dependent on the findings of the ASS investigations, and if ASS are found within the areas that are proposed to be developed or detailed designs indicate that ASS is likely to be disturbed due to excavation for the installation of services, then an appropriate ASS and dewatering management plan (ASSDMP) may need to be prepared to support development.
- **Native vegetation:** The proposed LSP will provide an opportunity to rehabilitate the vegetation associated with Bollard Bulrush Swamp CCW (UFI 15866) and the 50 m buffer through the consolidation of a 'Parks Recreation and Drainage' reserve which encapsulates the significant

flora and vegetation values of the wetland, including the potential occurrence of a Priority Ecological Community (PEC) and threatened and priority flora. Opportunities to retain the remnant native trees within the school development will be possible, and will be confirmed during final development design and bulk earthworks requirements. Where clearing of remnant native trees within the site is proposed, a clearing permit will need to be attained pursuant to Part V of the *Environmental Protection Act 1986* (unless a valid exemption applies).

- **Native fauna:** The proposed LSP will provide an opportunity to enhance and retain the Bollard Bulrush Swamp CCW (UFI 15866) which supports dense cover of remnant native understorey vegetation, known to provide suitable habitat for a number of conservation significant fauna species including the Quenda. The 50 m wetland buffer will provide a separation from the urban land use, limiting the potential to disturb any fauna associated with the Bollard Bulrush Swamp. The proposed LSP will provide opportunities for the retention of native Swamp Paperbark and Flooded Gum trees, which provide potential habitat for the three threatened species of black cockatoo. As part of the future subdivision and development, a Wetland Management Plan (WMP) and Construction Environmental Management Plan (CEMP) will be required to be prepared to manage potential impacts to fauna.
- **Hydrology:** An LWMS has been developed by Emerge Associates (2020d) to support the proposed LSP. The overarching objective for the site is to maintain the pre-development hydrological regime and is based on an at source infiltration approach, and by minimising the potential for nutrient impacts on the Bollard Bulrush Swamp. No drainage from the site will be directly connected or piped into the wetland, and no drainage infrastructure from the site will be located within the wetland buffer, with the exception of a swale which is proposed within the southern portion of the site, to manage runoff from the dual-use pathway. This will ensure the Urban Water Management criteria for ecological protection is met as part of development within the site. The LWMS will be implemented as part of the future development stage.
- **Wetlands:** The proposed LSP provides a 50 m wetland buffer through two landscaping zones; Zone A and Zone B allowing for a combination of outdoor play and recreation and conservation land uses. The separation from the urban land use will reduce the impact of human activities on both the vegetation and fauna of the wetland. No drainage from the site will be directly connected or piped into the wetland and no drainage infrastructure will be located within the wetland buffer, with the exception of a swale to manage runoff from the Dual-use Pathway. A WMP will be prepared at the subdivision or development stage, outlining specific strategies for the preservation the Bollard Bulrush Swamp.
- **Bushfire risks**: From a bushfire hazard management perspective, the key consideration as part of future development within the site is to ensuring future development areas will be able to accommodate the separation necessary to ensure built form to achieve a bushfire attack level (BAL) rating of BAL-29 or less without requiring clearing or modification of vegetation in areas where remnant vegetation is proposed to be retained, and allowing for the proposed revegetation of the 'Parks Recreation and Drainage' reserve. This has been achieved through the strategic location of internal driveway reserves and footpaths and the managed recreational open spaces which will be designed and maintained to low threat in order minimise the hazard to the school development. Vehicle access will accommodate egress to at least two destinations, ensuring the perimeter driveway will connect to the existing public road network, specifically Bertram Road to the north, further connecting onto Mortimer Road to the east and Challenger

Avenue to the west. This will be detailed as part of future bushfire management plans supporting subdivision or development approval.

Overall, the environmental attributes and values of the site can be accommodated through the structure plan design, or can be managed appropriately through the future subdivision and development phases in line with the relevant state and local government legislation, policies and guidelines and best management practices.

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7.2 Online references

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Figures

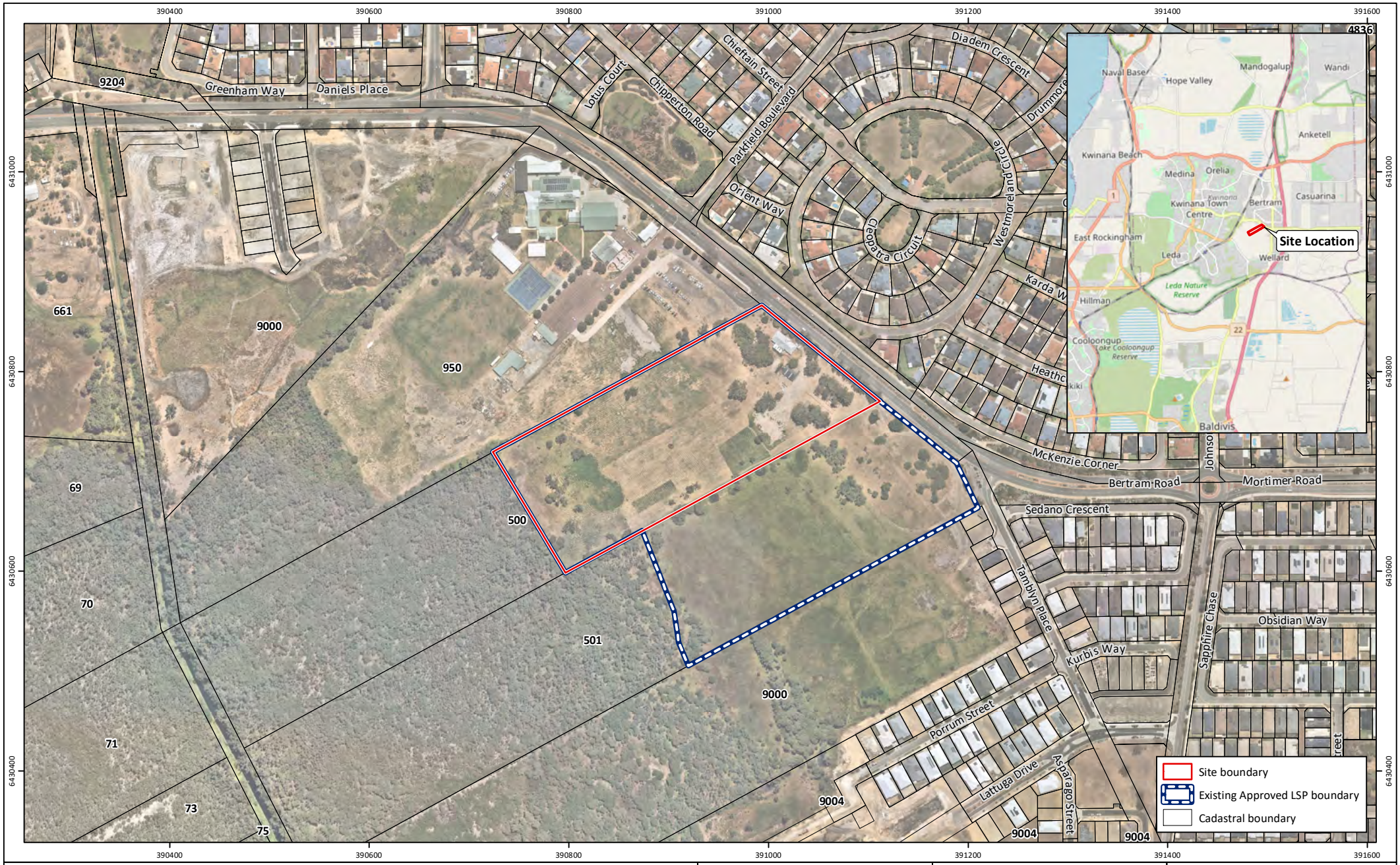

Figure 1: Site Location

Project:	Lot 500 Bertram Road, Wellard Local Structure Plan Amendment Environmental Assessment and Management Strategy
Client:	The Kings College

Plan Number:
EP20-047(05)--F11

Drawn:	GAR
Date:	06/11/2020
Checked:	BRB
Approved:	JDH
Date:	08/12/2020

N

0 100 200
Metres

Scale: 1:5,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

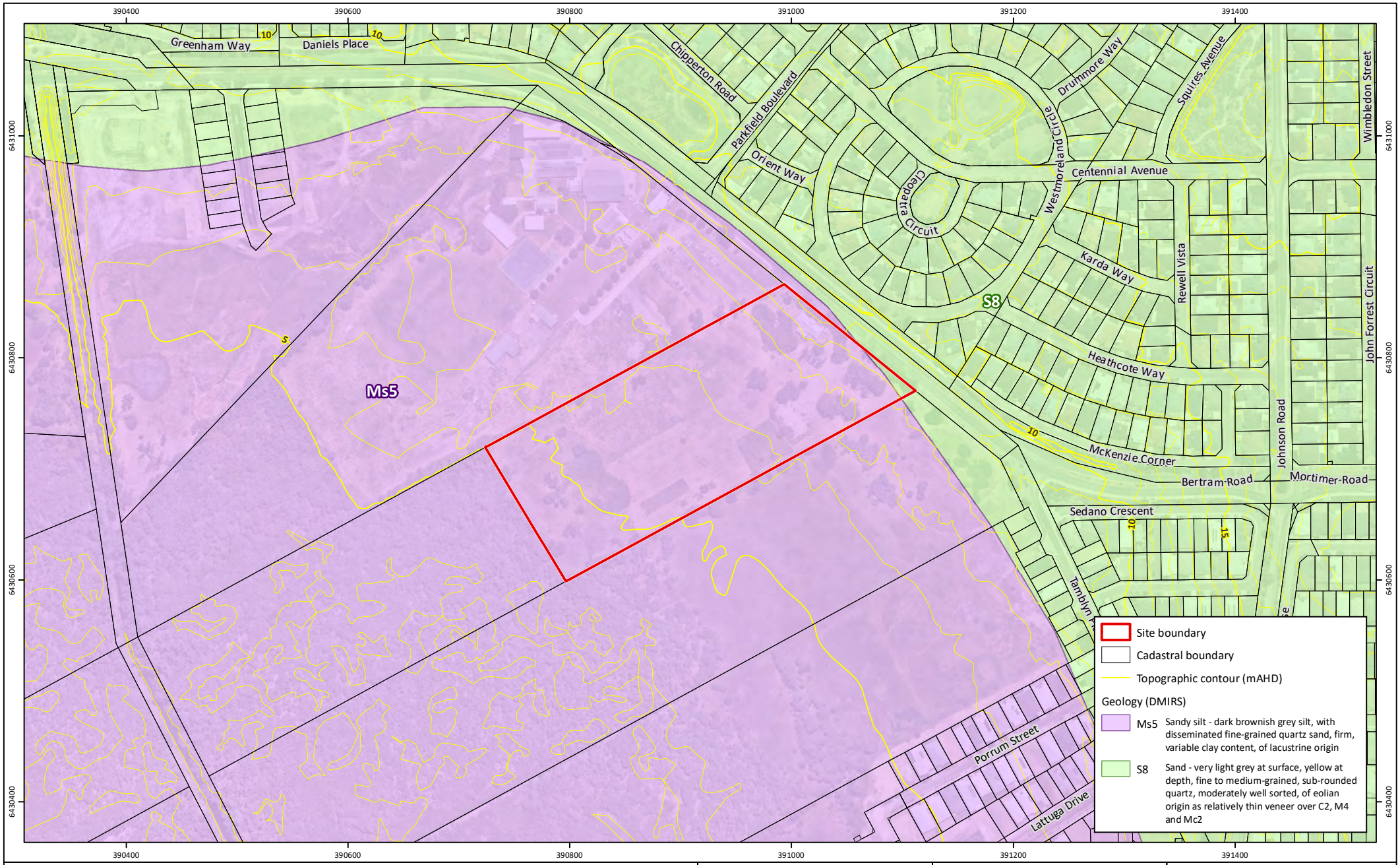

Figure 2: Soils and Topography

Project: Lot 500 Bertram Road, Wellard Local Structure Plan Amendment
Environmental Assessment and Management Strategy

Client: The Kings College

Plan Number:
EP20-047(05)--F14

Drawn:	GAR
Date:	06/11/2020
Checked:	BRB
Approved:	JDH
Date:	08/12/2020

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Metres

Scale: 1:4,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

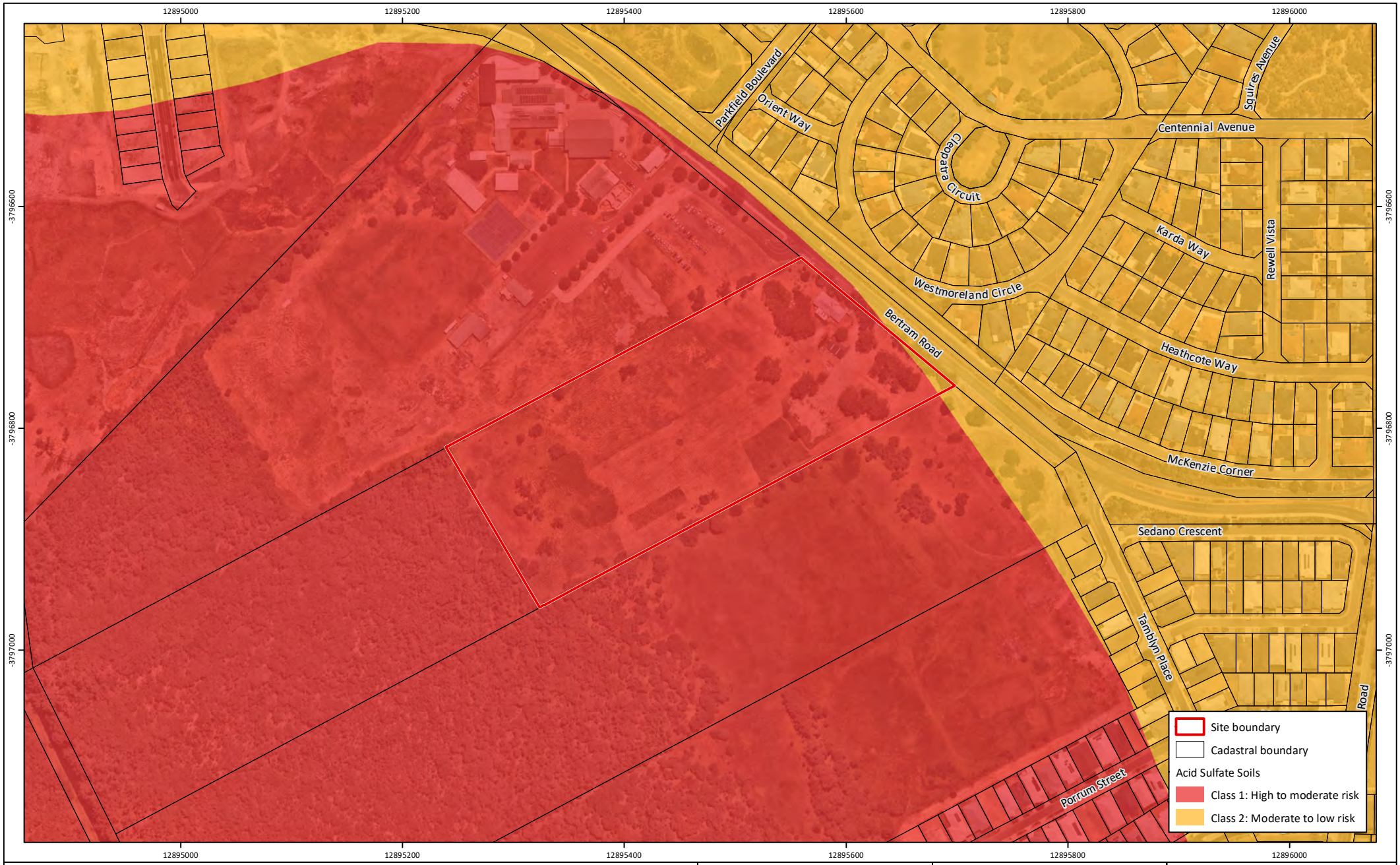

Figure 3: Acid Sulfate Soil Mapping

Project:	Lot 500 Bertram Road, Wellard Local Structure Plan Amendment Environmental Assessment and Management Strategy
Client:	The Kings College

Plan Number:
EP20-047(05)--F15

Drawn:	GAR
Date:	06/11/2020
Checked:	BRB
Approved:	JDH
Date:	08/12/2020

N

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Metres

Scale: 1:4,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

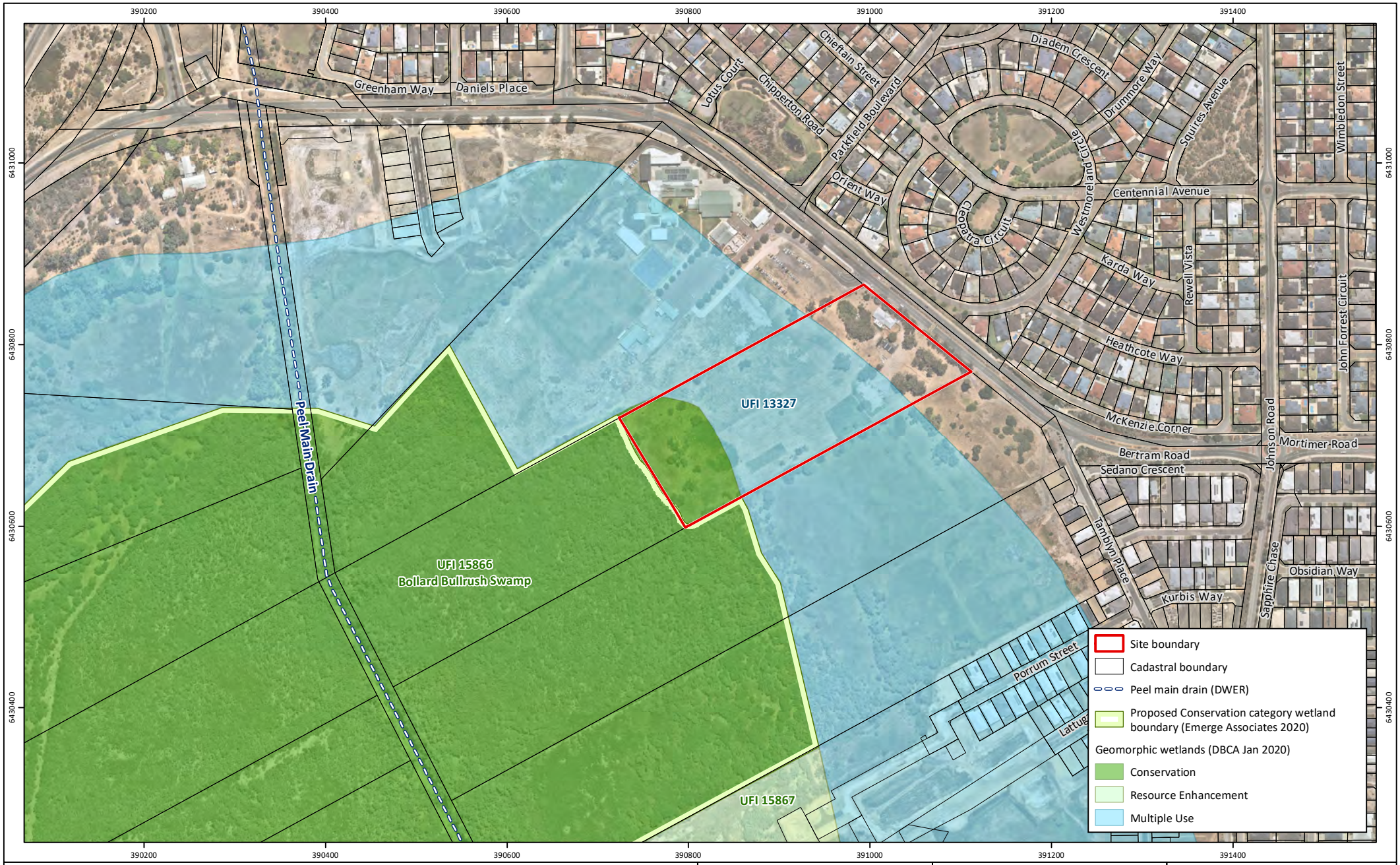

Figure 4: Geomorphic Wetlands and Hydrological Features

Project:	Lot 500 Bertram Road, Wellard Local Structure Plan Amendment Environmental Assessment and Management Strategy
Client:	The Kings College

Plan Number:
EP20-047(05)--F16a

Drawn:	GAR
Date:	10/12/2020
Checked:	BRB
Approved:	JDH
Date:	10/12/2020

N

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Metres

Scale: 1:5,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

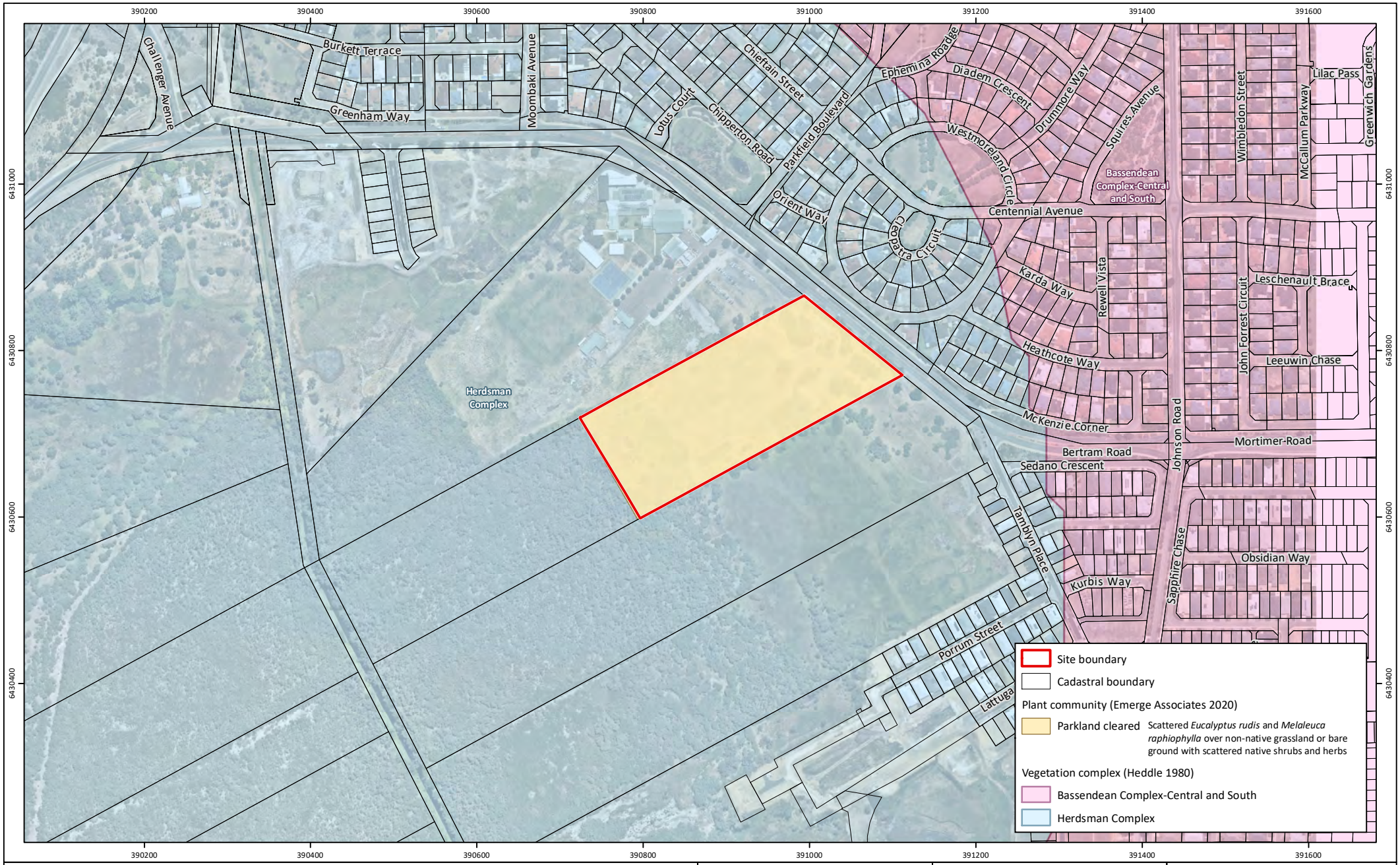

Figure 5: Plant Community and Regional Vegetation Complex Mapping

Project:	Lot 500 Bertram Road, Wellard Local Structure Plan Amendment Environmental Assessment and Management Strategy
Client:	The Kings College

Plan Number:
EP20-047(05)--F17

Drawn:	GAR
Date:	06/11/2020
Checked:	BRB
Approved:	JDH
Date:	08/12/2020

N

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Metres

Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

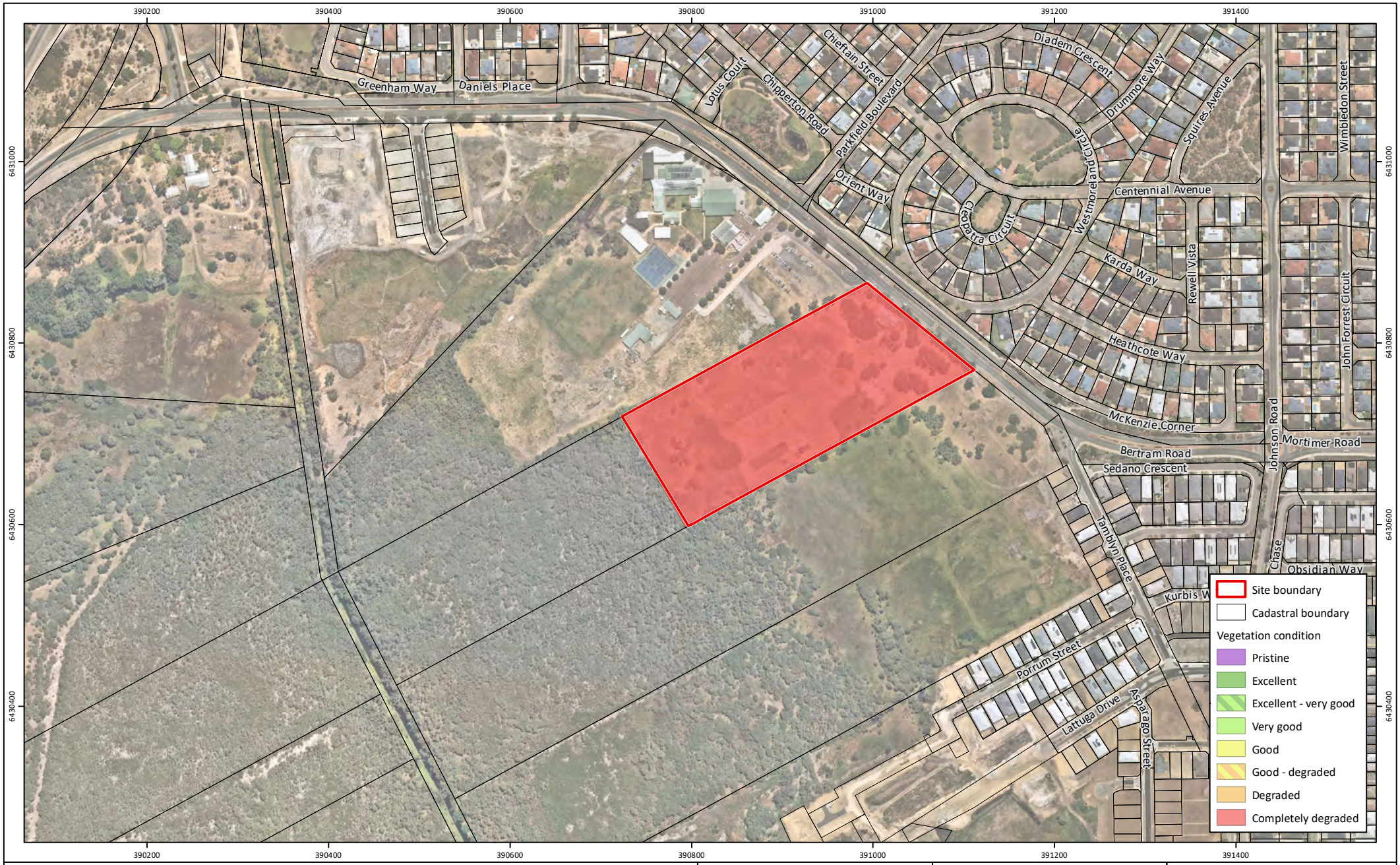

Figure 6: Vegetation Condition

Project:	Lot 500 Bertram Road, Wellard Local Structure Plan Amendment Environmental Assessment and Management Strategy
Client:	The Kings College

Plan Number:
EP20-047(05)--F18

Drawn:	GAR
Date:	06/11/2020
Checked:	BRB
Approved:	JDH
Date:	08/12/2020

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Metres

Scale: 1:5,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

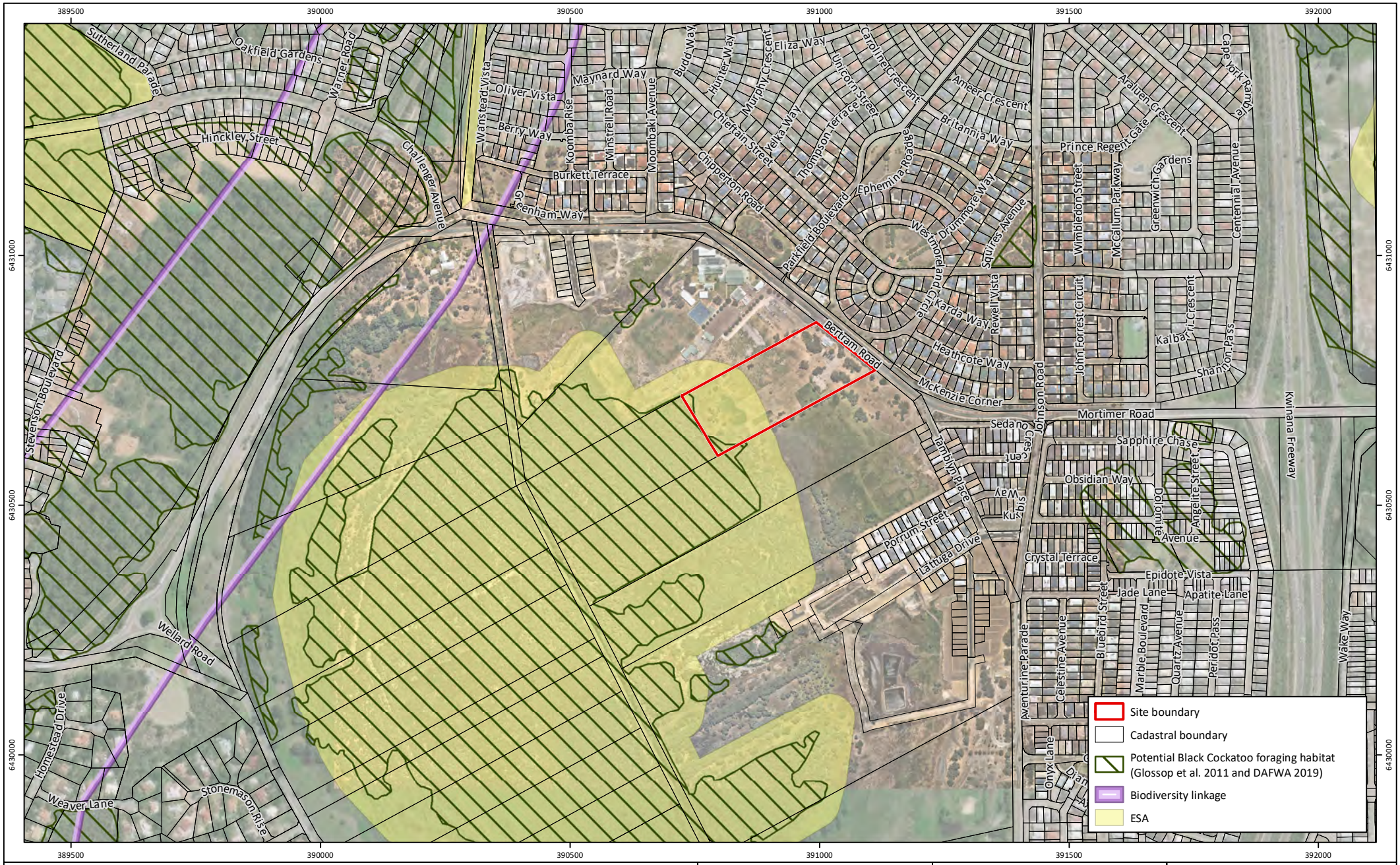

Figure 7: Environmental Features

Project:	Lot 500 Bertram Road, Wellard Local Structure Plan Amendment Environmental Assessment and Management Strategy
Client:	The Kings College

Plan Number:
EP20-047(05)--F19

Drawn:	GAR
Date:	06/11/2020
Checked:	BRB
Approved:	JDH
Date:	08/12/2020

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Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

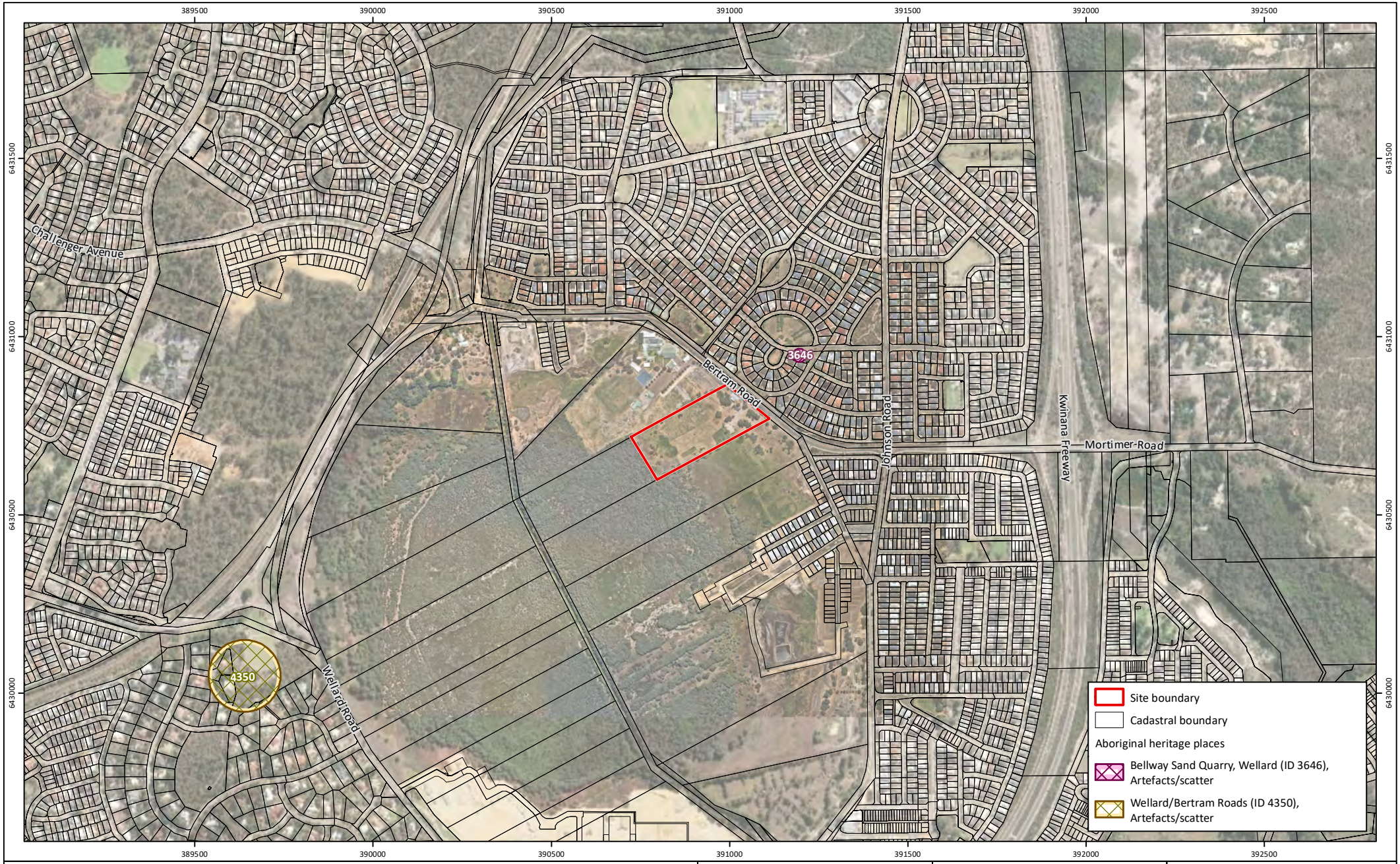

Figure 8: Aboriginal Heritage Sites

Project: Lot 500 Bertram Road, Wellard Local Structure Plan Amendment
Environmental Assessment and Management Strategy

Client: The Kings College

Plan Number:
EP20-047(05)--F20

Drawn:	GAR
Date:	06/11/2020
Checked:	BRB
Approved:	JDH
Date:	08/12/2020

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Metres

Scale: 1:14,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

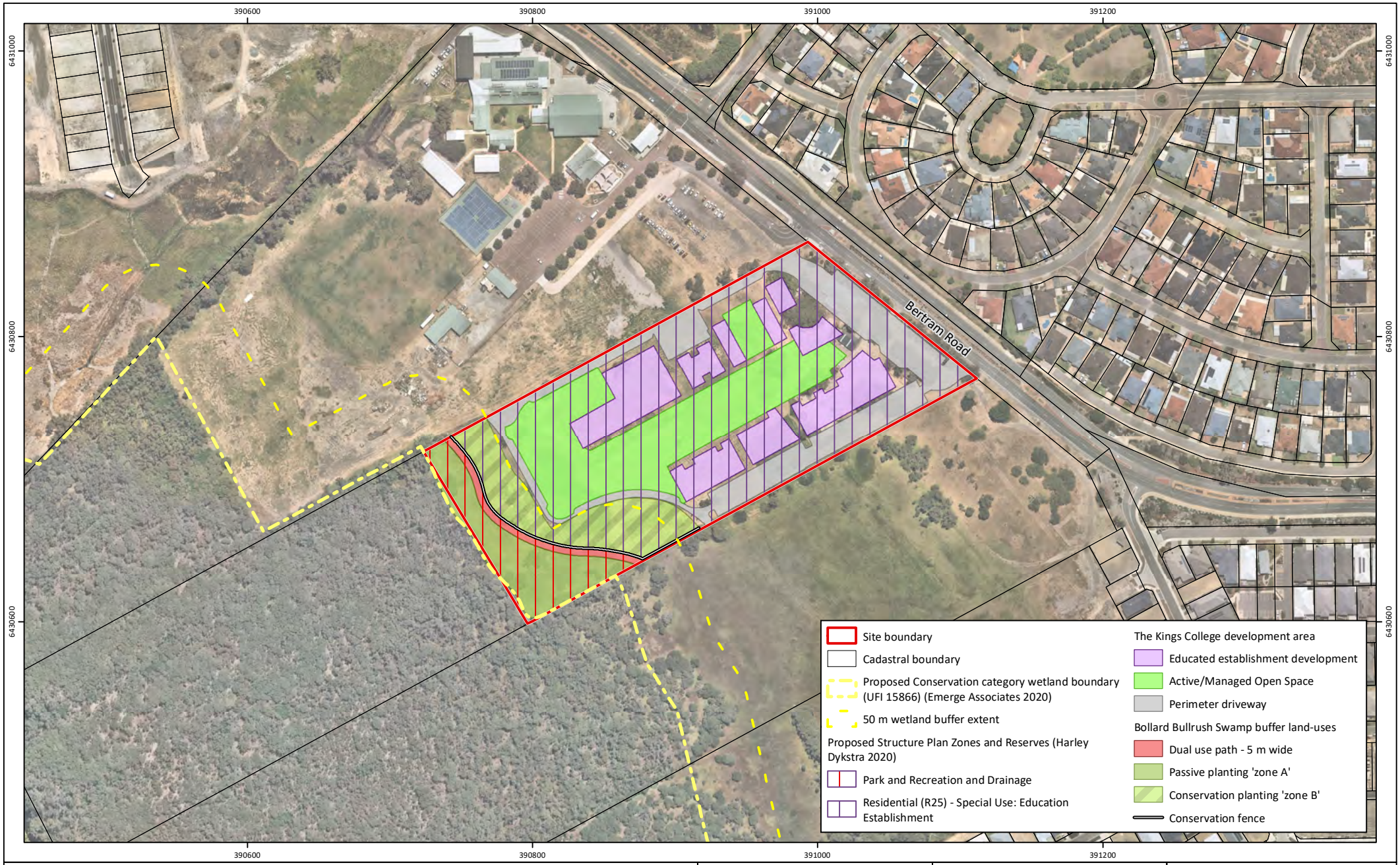


Figure 9: Local Structure Plan Response to Wetland Features

Project: Lot 500 Bertram Road, Wellard Local Structure Plan Amendment
Environmental Assessment and Management Strategy

Client: The Kings College

Plan Number:
EP20-047(05)--F21a

Drawn:	GAR
Date:	10/12/2020
Checked:	BRB
Approved:	JDH
Date:	10/12/2020

N

0 50 100 150
Metres

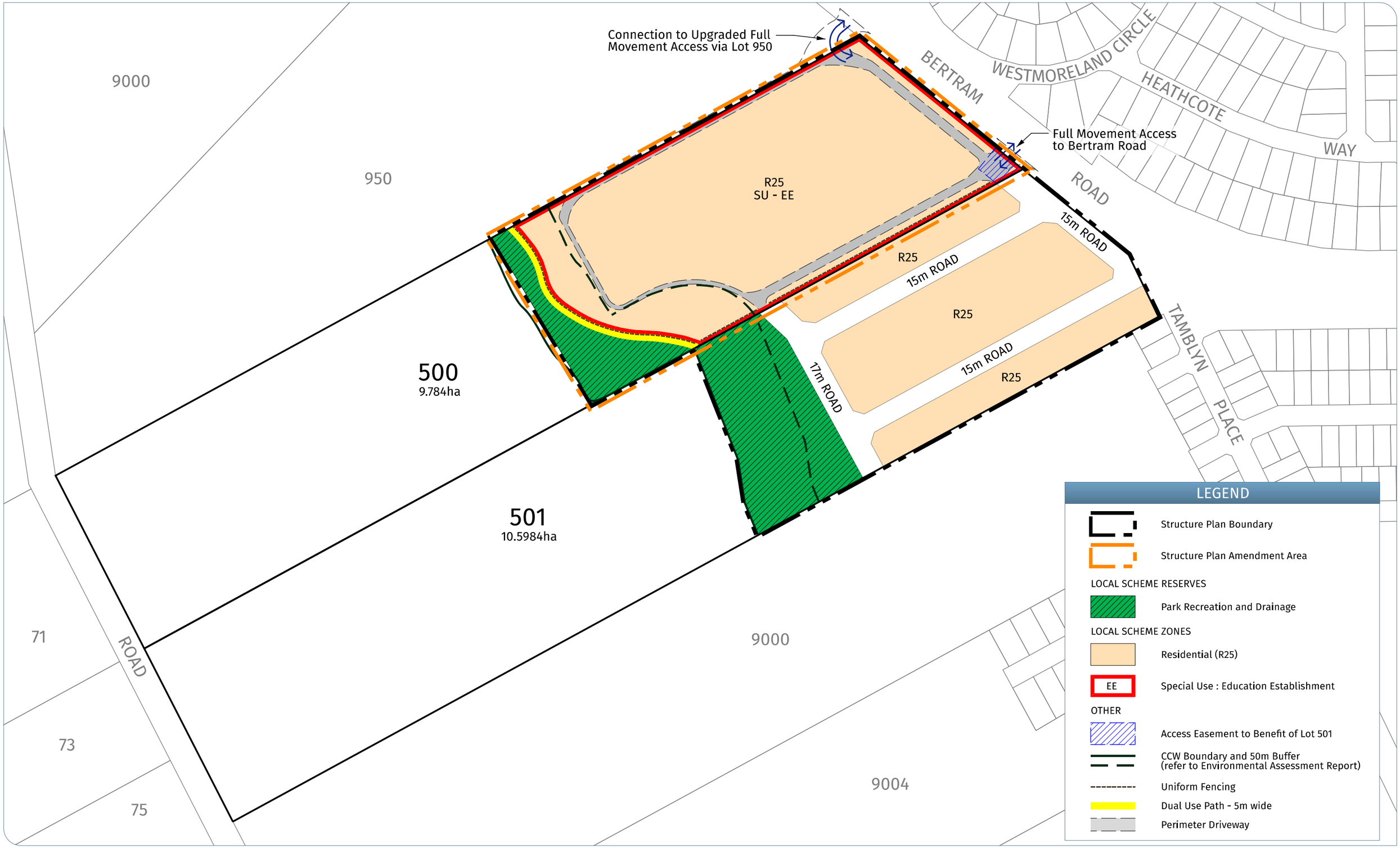
Scale: 1:3,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix A

Lots 500 (No.2) & 501 (No.214) Bertram Road, Wellard Local Structure Plan
(Harley Dykstra 2020)



LEGEND

- Structure Plan Boundary
- Structure Plan Amendment Area

LOCAL SCHEME RESERVES

- Park Recreation and Drainage

LOCAL SCHEME ZONES

- Residential (R25)
- EE — Special Use : Education Establishment

OTHER

- Access Easement to Benefit of Lot 501
- CCW Boundary and 50m Buffer (refer to Environmental Assessment Report)
- Uniform Fencing
- Dual Use Path - 5m wide
- Perimeter Driveway

STRUCTURE PLAN

Lots 500 (No. 202) & 501 (No.214) Bertram Road, WELLARD

Plan No.	21968-04	
Date	27/10/20	
Drawn	NP	
Checked	DM	
Revision	A	
Scale	1:2500@A3	0 20m 40m 60m

PERTH & FORRESTDALE:
Lvl 1, 252 Fitzgerald St
PERTH WA 6000
15/2 Hensbrook Loop,
FORRESTDALE WA 6112
T: 08 9495 1947
E: metro@harleydykstra.com.au
ALBANY | BUNBURY | BUSSELTON | FORRESTDALE | PERTH

NOTE: This plan has been prepared for planning purposes. Areas, Contours and Dimensions shown are subject to survey

Harley Dykstra®
PLANNING & SURVEY SOLUTIONS

Appendix B

Reconnaissance Flora and Fauna Survey (Emerge Associates 2020)

TECHNICAL MEMORANDUM

PROJECT NUMBER	EP20-047(01)	**DOC. NUMBER**	EP20-047(01)--002
PROJECT NAME	EP20-047 TKC Wellard School Planning Support Phase 01 - Background Review	**CLIENT**	The Kings College
AUTHOR	TAA	**REVIEWER**	JDH
VERSION	1	**DATE**	26/05/2020

1. METHODS

1.1. Desktop assessment

Nil.

1.2. Field surveys

An ecologist from Emerge (TAA) visited the site on 4 May 2020 to conduct reconnaissance flora and vegetation survey within the site.

The site was traversed on foot. Opportunistic records were made of flora and fauna species and the structure, composition and condition of vegetation was recorded. Tree species and location were recorded in the southern half of site only (not near old vacant buildings).

Asterisk '*'in text and raw data refers to non-native (weed) species, 'Pl' refers to planted induviduals and 'DP' refers to declared pest under the *Biosecurity and Management Act 2007.*

2. RESULTS AND DISCUSSION

2.1. Flora

A total of 7 native and 16 non-native (weed) species were recorded within wetland and near wetland parkland cleared areas.

Status	Species
Pl	*Agonis flexuosa*
*	*Atriplex prostrata*
	Banksia littoralis
	Baumea articulata
*	*Carduus* sp.
?	*Cassytha* sp.
*	*Cenchrus clandestinus*
	Centella asiatica
*	*Conyza* sp.
*	*Cortaderia selloana*
*	*Cynodon dactylon*
*	*Ehrharta longifolia*
Pl	*Eucalyptus camaldulensis*
	Eucalyptus rudis
*	*Ficus carica*

*	*Holcus lanatus*
*	*Hypochaeris* sp.
*	*Ipomoea indica*
	Melaleuca preissiana
	Melaleuca raphiophylla
	Melaleuca viminea
*	*Plantago ?lanceolata*
Pl	*Platanus × acerifolia*
DP	*Rubus ulmifolius*
*	*Rumex ?crispus*
*	*Schinus terebinthifolius*
*	*Symphyotrichum subulatum*
	Typha orientalis

2.1.1. Threatened and priority flora

No threatened or priority flora were recorded.

2.1.2. Declared pests

Rubus ulmifolius 'C3 management / exempt' category.

2.2. Vegetation

2.2.1. Plant communities

The banksia woodland vegetation was determined to represent two plant communities, **ErMr** and **parkland cleared**, as described in **Table 1** and shown in Error! Reference source not found..

Table 1: Plant communities present within the site

Plant community	Description	Area (ha)
ErMr	Low closed forest of *Eucalyptus rudis* and *Melaleuca raphiophylla* (with occasional *B. littoralis*) over tall rushland of *Baumea articulata* and *Typha* spp. or bare ground or open grassland and herb land of **Cynodon dactylon*, **Ehrharta longifolia*, *Atriplex prostrata in degraded parts. (**Plate 2** and **Plate 1**).	5.06
Parkland cleared	Scattered *Eucalyptus rudis* and *Melaleuca raphiophylla* over non-native grassland or bare ground with scattered native shrubs and forbs (Error! Reference source not found.).	4.71

*Plate 1: Plant community **ErMr** in 'very good – good' condition*

*Plate 2: Plant community **parkland cleared** in 'completely degraded' condition*

2.2.2. Vegetation condition

The extent of vegetation by condition category is detailed in **Table 2** and shown in Error! Reference source not found..

Table 2: Vegetation condition categories within the site

Condition category (Keighery (1994))	Size (ha)
Excellent - good	4.30
Good - degraded	0.76
Completely degraded^	4.71

^Note that vegetation in 'completely degraded' condition occurs adjacent to the **ErMr** vegetation

2.2.3. Floristic community type

Plant community **ErMr** most likely represents FCT 11 wet forest or woodlands. Parts of **ErMr** may represent FCT 15 deeper wetlands of the Swan Coastal Plain.

Parts of **parkland cleared** community are also likely to have represented FCT 11 but are now too degraded to assign an FCT.

2.2.4. Threatened and priority ecological communities

FCT 15 is a State listed TEC ('Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain'). This TEC is not listed at the Commonwealth level.

2.2.5. Wetlands

A portion of wetland feature CCW 15866 occurs within the site. The boundary of plant community **ErMr** provides an appropriate basis to define the extent of the portion of wetland feature CCW15866 that occurs within the site. Using the fence line as basis for defining the plant community edge.

2.2.6. Trees

Tress recorded include individuals of *Eucalyptus rudis* (flooded gum) and *Melaleuca raphiophylla* (freshwater paperbark). Other individuals of flooded gum occur near the vacant buildings to the north east of the site but were not recorded.

2.3. Fauna

A total of 11 birds species and one marsupial mammal were recorded as outlined in **Table 3**.

Table 3: Fauna records

Species	Common	ID	Notes
Corvus coronoides	Australia raven	TAA	sight
Trichoglossus moluccanus	Rainbow lorikeet	TAA	sight
Cacatua ?tenuirostris	Long billed corella	TAA	Sight, call
Gymnorhina tibicen	Magpie	TAA	sight
Anthochaera carunculata	Red wattle bird	TAA	sight
Barnardius zonarius	Australian Ringneck	TAA	sight, call
Cracticus ?torquatus	Grey butcher bird	?	sight
Chenonetta jubata	Australian wood duck	TAA	sight
Ocyphaps lophotes	Crested pidgeon	TAA	sight
Grallina cyanoleuca	Magpie-lark	TAA	sight
Strepera versicolor	Grey currawong	TAA	sight
Isoodon obesulus fusciventer	Quenda	TAA	diggings
?	Couple different chirpy LBBs no I'd	?	call

3. CONCLUSIONS

N/A

4. REFERENCES

4.1. General references

Keighery, B. 1994, *Bushland Plant Survey: A guide to plant community survey for the community*, Wildflower Society of WA (Inc), Nedlands.

4.2. Online references

Western Australian Herbarium (2018). *FloraBase—the Western Australian Flora.* Department of Biodiversity, Conservation and Attractions. <https://florabase.dpaw.wa.gov.au>

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Figures

If required insert subtitle with Emerge-H2 (Internal NoTOC)

Figure 1: Preliminary Vegetation

Project: Wellard School Planning Support Background Review
Client: The Kings College

Plan Number:
EP20-047(01)--F09
Drawn: AFF
Date: 21/05/2020
Checked: TAA
Approved: TAA
Date: 25/05/2020

N

0 50 100
Metres
Scale: 1:4,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix C

The Kings College, Johnson Road, Wellard Landscape Masterplan (Emerge Associates 2020)

THE KINGS COLLEGE, BERTRAM ROAD, WELLARD

December 2020

Site Structure Plan Amendment

emerge ASSOCIATES

LOCATION PLAN

BACKGROUND:

The Kings College (the proponent) are progressing with an amendment to the existing Local Structure Plan over Lot 500 Bertram Road, Wellard to facilitate the development of The Kings College primary and secondary school. The existing Structure Plan for Lot 500 and 501, Bertram Road, Wellard, approved in 2017 was prepared in anticipation of the site being developed as for residential development, which will require an amendment to enable the proposed land use. The expansion of The Kings College will occur over the northern portion of Lot 500 Bertram Road, Wellard (the site).

The site is 5.00 hectares (ha) in size and is located approximately 32 km south of the Perth Central Business District, within the City of Kwinana. The site is located within a mixed urban and rural-residential area, with Bertram Road and urban development to the north, large rural-residential lots to the east, the Bollard Bulrush Swamp Conservation Category Wetland (CCW) (UFI 15866) and Peel Main Drain to the south, The Kings College buildings and sporting ovals and the Freeway Church to the west. The site is currently zoned 'Urban' under the Metropolitan Region Scheme (MRS), and 'Development', under the City of Kwinana Town Planning Scheme (TPS) No.2.

PURPOSE OF THIS REPORT:

The purpose of the Landscape Report is to provide a synthesis of information regarding the landscape values and attributes of the site. Specifically, this report:

- Identifies the landscape uses and attributes of the site
- Discusses the land use for the structure plan area.
- Discusses how the structure plan layout responds to the existing environmental features and values, and future landscape management requirements as part of the future planning and development process.
- Addresses the interface of the site with the adjacent wetland

LANDSCAPE MASTER PLAN:

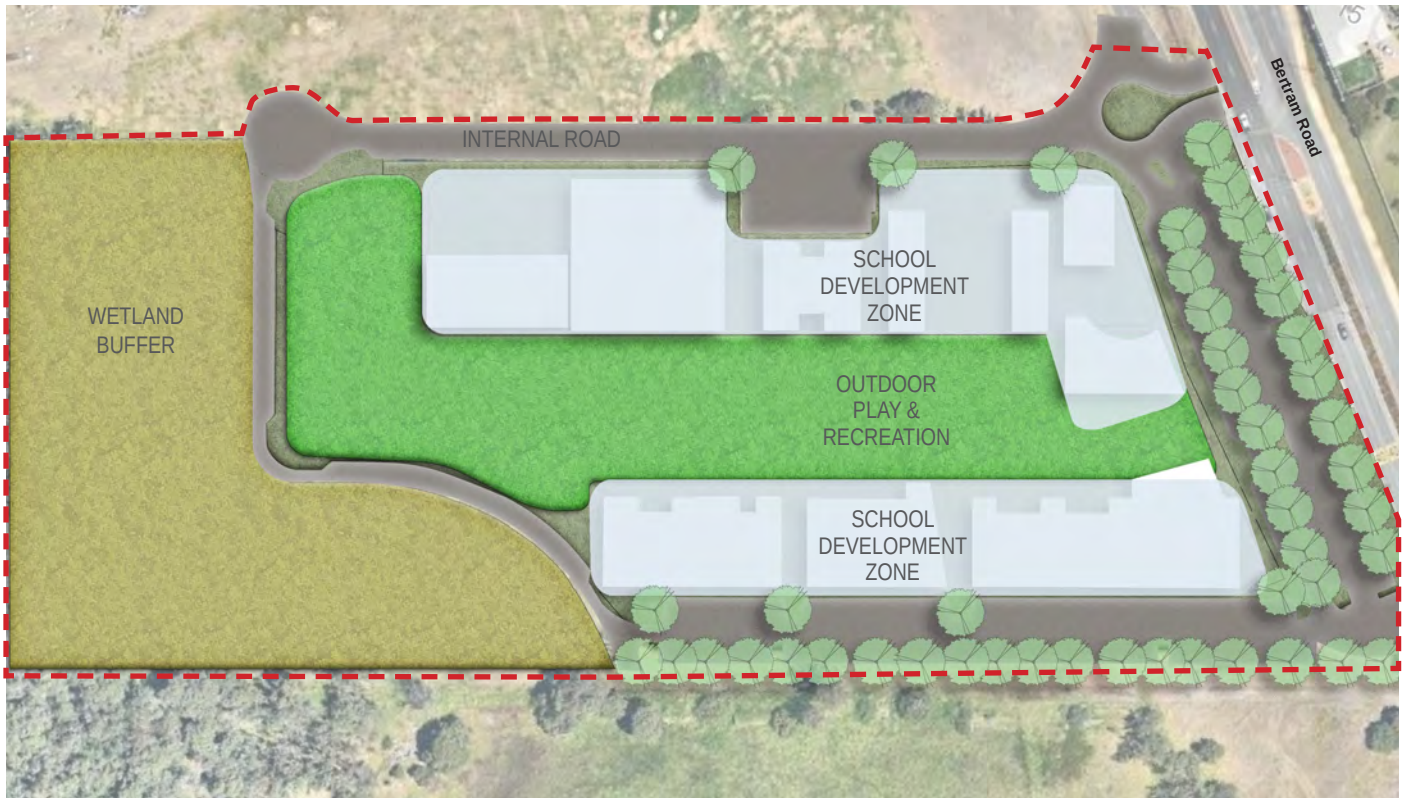
The landscape master plan offers a range of active and passive opportunities for the students of The Kings College, providing accessibility and connectivity throughout the site whilst also playing an important role in protecting the sites adjacent natural assets.

The plan provides connections both externally and internally to key nodes from the school, adjacent landowners and natural assets. Continuous pedestrian/cycling paths will link along the wetland in accordance with the Bollard Bulrush Wetland Masterplan and will include appropriate planting, amenities in the form of passive recreation opportunities and seating.

The plan identifies the requirement for a balanced approach to ensure the social and recreational requirements of the future students and users of Bollard Bulrush Wetland are balanced with the ecological and engineering constraints imposed by the site.

DWG ENVIRO-73
REV D
DATE DEC 2020

LANDSCAPE STRATEGY PLAN



LEGEND

- EXTENT OF WORKS
- INDICATIVE TREES

KINGS COLLEGE SUMMARY

SCHOOL DEVELOPMENT LANDSCAPE
- Turf area for active recreation
- Hard courts for play and active recreation
- Gathering spaces for students to congregate
- Play space and picnic facilities
- Pedestrian/Cycle Path network links to adjacent development.
- Planting appropriate to Education Department specification.

OUTDOOR PLAY & RECREATION
- Balance of native planted pockets and open turf areas
- Large gathering spaces beneath trees
- Informal seating spaces on walls or boulders
- Informal active recreation space

STREETSCAPE
- Predominantly native planted
- Trees planted in rows to provide shade for carparks
- Primary focus on providing shade and heavy green infrastructure

WETLAND BUFFER - 50m
- Balance of passive recreation areas incorporating native planting to comply with the requirements for low threat vegetation and the opportunity to retain mature trees.
- Revegetation of native plant species to a portion of the 50 m buffer at the Bollard Bulrush Swamp interface.

SITE STRUCTURE PLAN

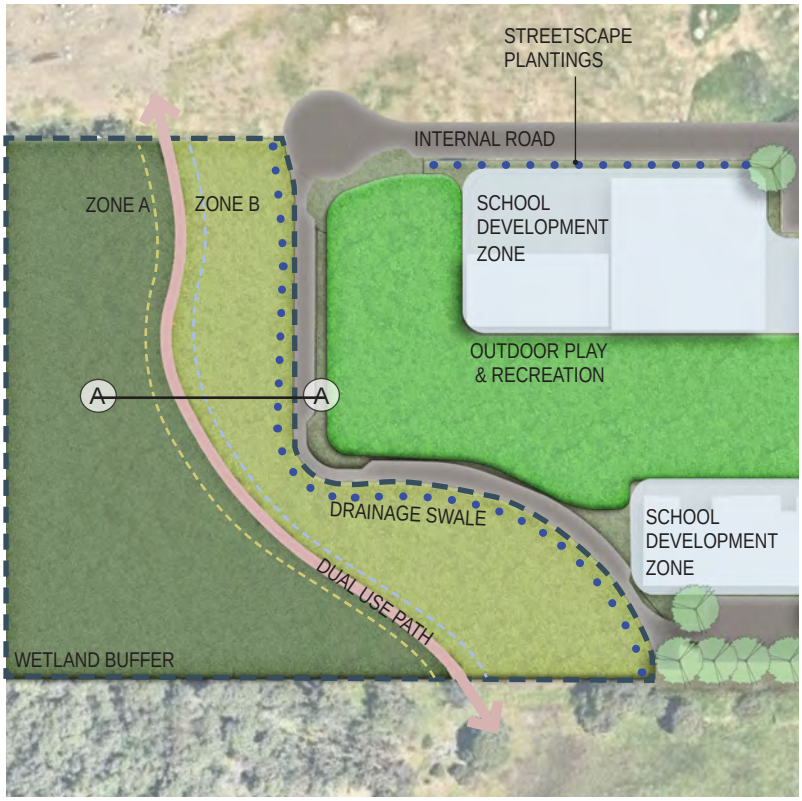
THE KINGS COLLEGE, BERTRAM ROAD WELLARD

DWG **ENVIRO-73**
REV **D**
DATE **DEC 2020**
0 25 50 75 100 m
SCALE **1 : 2000 @ A4**

emerge ASSOCIATES

CONNECTION BETWEEN SCHOOL AND BOLLARD BULLRUSH SWAMP

SWALE AND WETLAND BUFFER INTERFACE



CONCEPT

- Maintain and enhance the existing vegetation within a portion of the wetalnd buffer.
- Meandering dual use path runs the length of the wetland buffer and links to greater path networks
- Native seed planting within passive recreational open spaces between The Kings College and the wetland rehabilitation area, designed to achieve a low threat vegetation standard in accordance with AS3959
- Restricted access to wetland

FUNCTIONS

- Strategic revegetation
- Dual use path
- Provide linkages to pedestrian networks within and outside the development
- Drainage swale

ENVIRONMENTAL CONSIDERATIONS

- No irrigation
- Revegetation of native plant communities to a portion of the 50 m buffer (Zone A) at the Bollard Bulrush Swamp interface
- Removal of weed species
- A portion of the 50 m buffer (Zone B) will be landscaped to provide a managed interface to the wetland reserve. This area will be designed to achieve 'low threat' vegetation in accordance with Section 2.2.3.2 of AS 3959.

BOLLARD BULLRUSH SWAMP BUFFER

WETLAND BUFFER - 50m

- Balance of passive recreation open spaces incorporating planting to achieve a 'low threat' bushfire classification, in addition to rehabilitation planting at the interface of the Bollard Bullrush Swamp.
- Clearance provided for fire vehicle access
- Creating a connection from the school to the wetland, turning open spaces in to unique and welcoming places

DUAL USE PATH

- Provides secondary fire access between buffer and the school. Access points to core firebreak to be provided every 400m. DUP to align where possible with developers approved LSP plans.

ROADSIDE DRAINAGE SWALE

CONSERVATION FENCE AND LIMESTONE TRACK

SCHOOL BOUNDARY FENCE

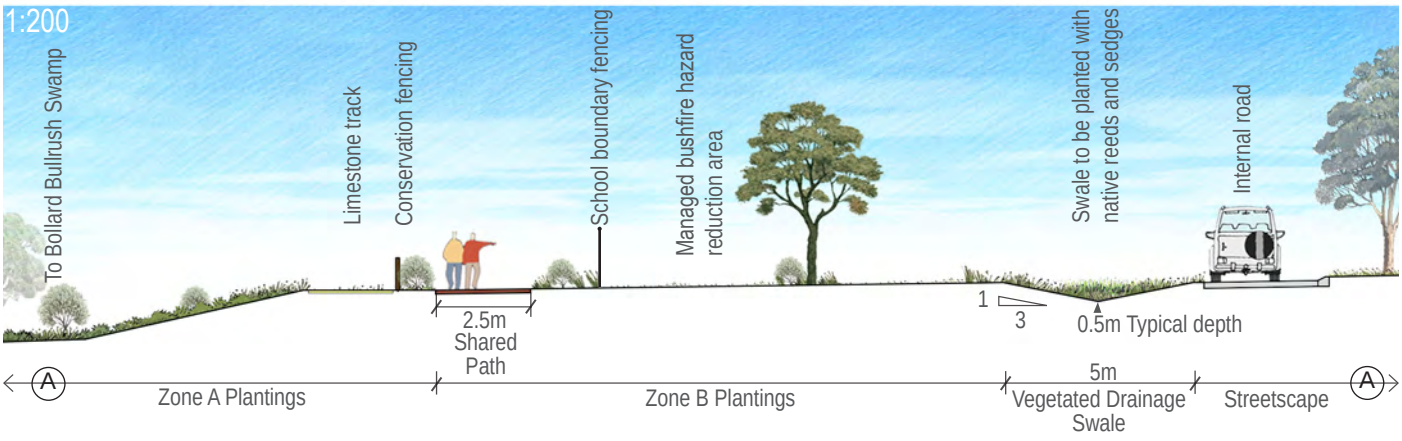
ZONE A

- Revegetation planting to wetland side
- Density of 1 plant mer m^2

ZONE B

- A passive recreation area between The Kings College and Bollard Bulrush Swamp (and the associated Wetland rehabilitation area), incorporating drainage and the opportunity to retain mature trees.
- Will be landscaped and maintained to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959.
- Average density of 1 plant per 2 m^2 but clumped around retained mature trees interspersed with areas of thick woodchip to suppress weeds.

INDICATIVE SECTION



SECTION A - INDICATIVE SECTION WHERE PATH IS LOCATED AT EDGE OF WETLAND BUFFER ZONE

- Sections are conceptual and are subject to change during the detailed design process
- Levels provided are indicative and subject to change during the detail design process

SITE STRUCTURE PLAN

THE KINGS COLLEGE, BERTRAM ROAD WELLARD

DWG ENVIRO-73
REV D
DATE DEC 2020
SCALE 1 : 2000 @ A4

emerge ASSOCIATES

PLANTING CONSIDERATIONS

- A range of native plant species that complement the surroundings have been selected.
- Plants chosen range from low, dense groundcovers to strappy leafed plants, grasses and small to medium sized shrubs.
- Plants native to the local area will provide colourful floral displays throughout the year and attract native birds to the area.
- The use of native plants will minimise maintenance and irrigation requirements and ensure long term plant survival.
- A portion of the 50 m buffer (Zone B) will be designed to achieve 'low threat' vegetation in accordance with Section 2.2.3.2 of AS 3959. and cross referenced with Councils preferred environmental planting suggestions.
- Clear views to the existing wetland trees will be maintained.

Groundcovers

Adenanthos cuneatus

Casuarina glauca

Calothamnus quadrifidus 'Little Ripper'

Calothamnus hirsutus

Convolvulus Moroccan

Erempohila glabra 'Kalbarri Carpet'

Grevillea Gingin Gem

Juniperus conferta

Eremophila glabra

Scaevola 'Purple Passion'

Shrubs

Adenanthos sericea dwarf

Olearia axillaris 'Little Smokie'

Calothamnus quadrifidus 'One-sided Bottlebrush'

Grevillea olivacea

Westringia grey box

Dianella revoluta 'Variegated'

Dianella 'Tas Red'

Melaleuca 'Little Nessie'

Lomandra Tanika

Lomandra wingarra

Trees

Agonis flexuosa

Eucalyptus sideroxylon

Eucalyptus torquata

Melaleuca quinquenervia

VTipuana tipu

DWG ENVIRO-73
REV D
DATE DEC 2020 SCALE NOT TO SCALE

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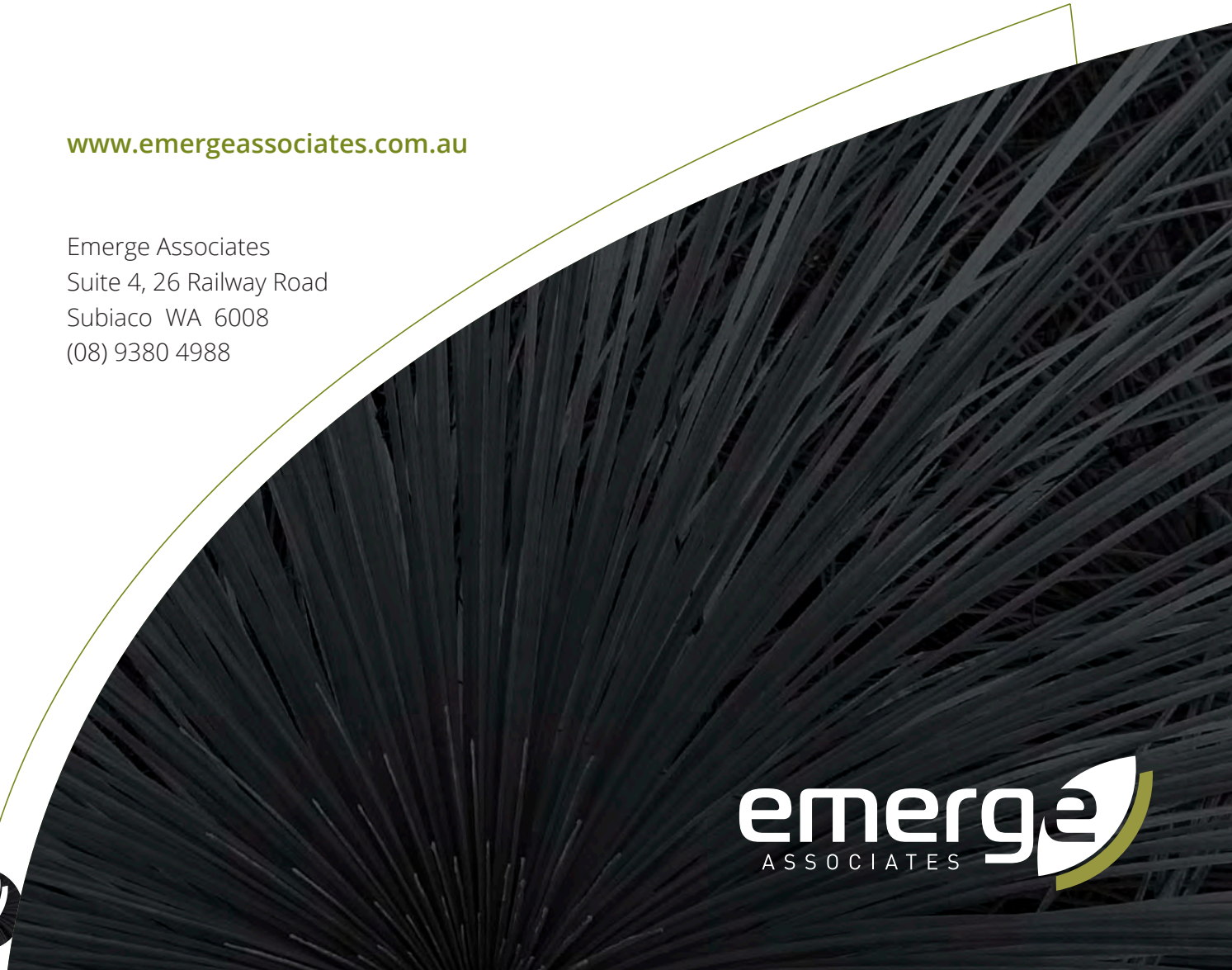

APPENDIX G | TRANSPORT IMPACT ASSESSMENT

Lots 500 & 501 Bertram Road Wellard

Local Structure Plan Amendment

Transport Impact Assessment

PREPARED FOR:
Total Project Management

November 2020

Document history and status

Author	Revision	Approved by	Date	Revision type
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1.0 Introduction

This Transport Assessment has been prepared by Transcore on behalf of Total Project Management for The King's College, Wellard. The subject of this report is a proposed Local Structure Plan (LSP) Amendment for Lots 500 and 501 Bertram Road, Wellard in the City of Kwinana.

The LSP area is located on the southwest side of Bertram Road as shown in Figure 1 in relation to the various zones and reservations of City of Kwinana Local Planning Scheme No. 2. The King's College is currently located on Lot 950 which is located adjacent to the northwest boundary of the LSP area.

Figure 1: Site location

The existing structure plan was for Residential R25 development of Lots 500 and 501 but the proposed LSP Amendment is to facilitate the proposed development of a new, larger, school site for The King's College instead of residential development on Lot 500.

2.0 Proposed Local Structure Plan Amendment

The current Local Structure Plan for Lots 500 and 501 Bertram Road was based on the subdivision concept plan shown in Figure 2. It anticipated residential subdivision of the north-eastern half of these lots to yield approximately 126 residential lots.

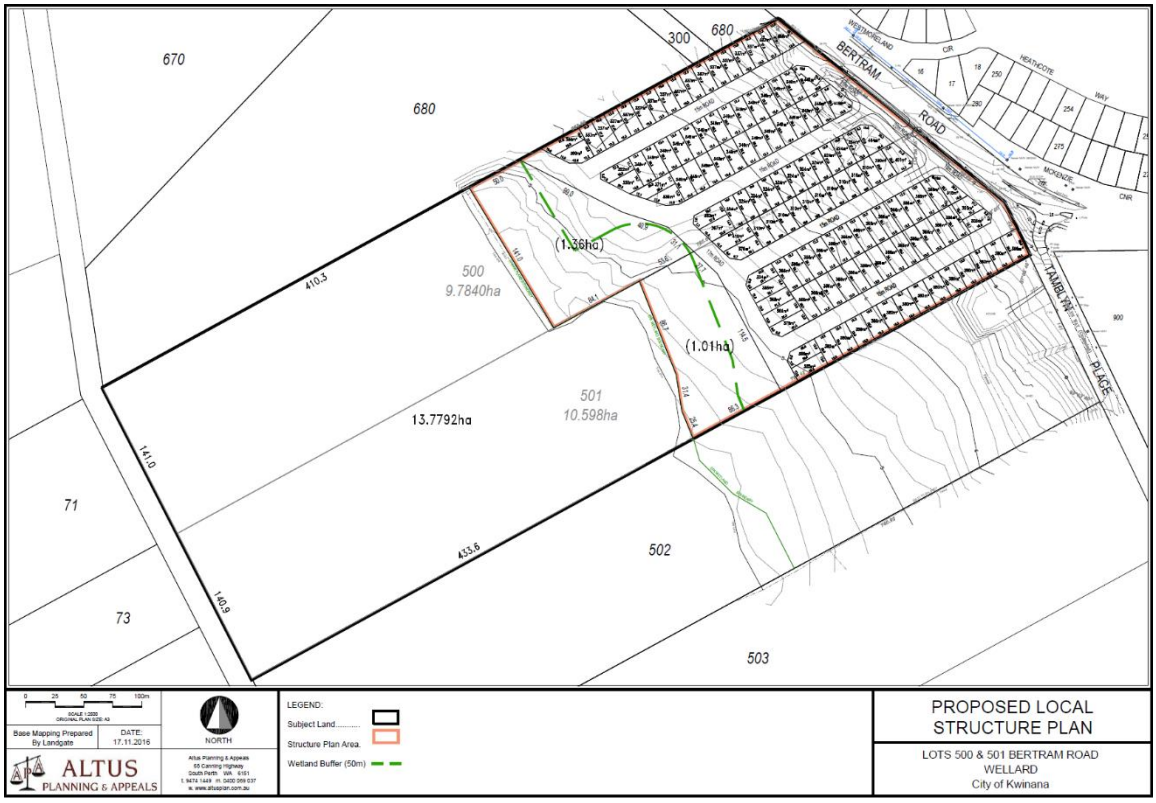


Figure 2: 2016 LSP concept plan for Lots 500 & 501

The current LSP concept plan incorporates a road connection across the LSP area to connect to the adjacent properties to the northwest and southeast of this LSP area. Road access to this LSP area was anticipated to be provided by a left in / left out (LILO) intersection on Bertram Road at the Lot 500 / Lot 501 boundary, and to Tamblyn Place via the future subdivision road network of the adjacent Lot 502.

The proposed LSP Amendment is to facilitate the proposed development of a new, larger, school site for The King's College instead of residential development on Lot 500.

The proposed LSP plan is included at Appendix A.

The existing The King's College development is located on the adjacent lot northwest of this LSP area and currently has an enrolment of approximately 500 students (502 in 2019). The proposed new school development for The King's College on Lot 500 would ultimately replace that existing school completely and the capacity of the new school is anticipated to be approximately 1292 students. It is understood that the existing school

buildings are planned to ultimately be converted for other use including development of a new place of worship.

Lot 501 is still proposed to be subdivided for residential development and is anticipated to yield approximately 64 residential lots.

The proposed LSP plan maintains the potential future local road connection to Tamblyn Place via the future subdivision road network of the adjacent Lot 502. However, the main access points are proposed to be two full-movement T-intersections on Bertram Road, as indicated in Figure 3.

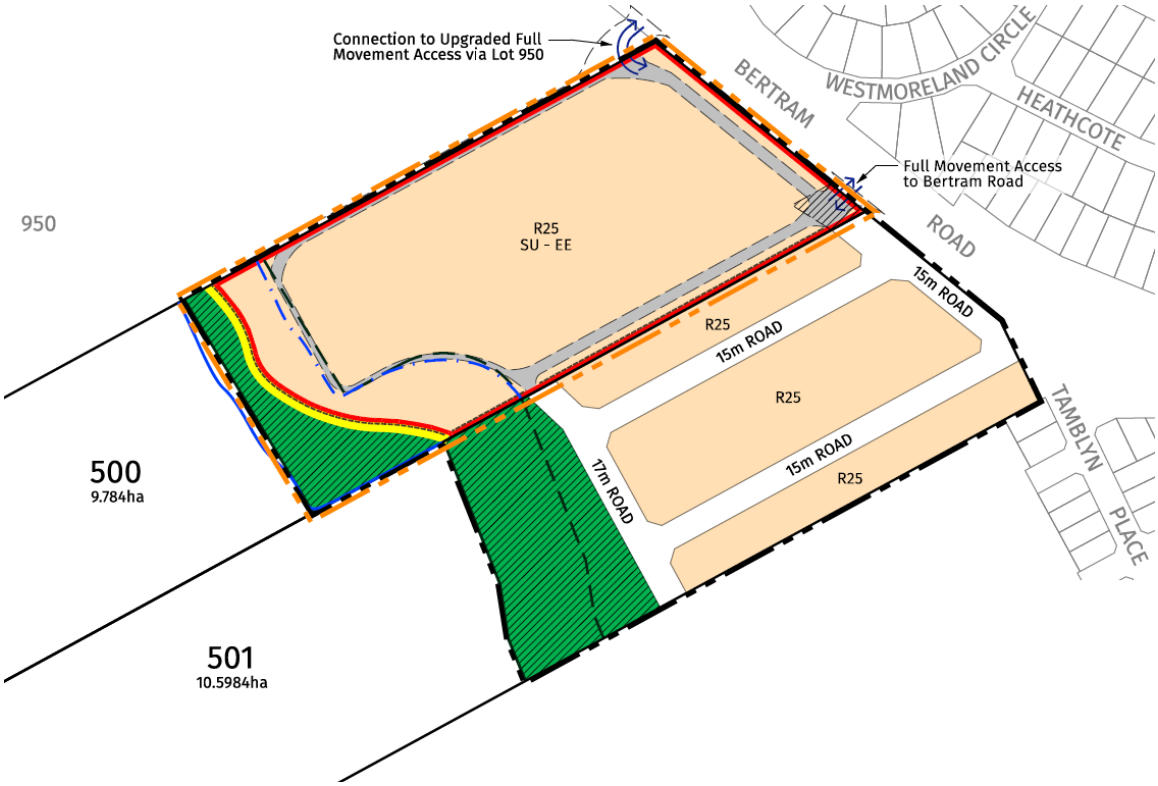


Figure 3: Proposed Amended LSP plan for Lots 500 & 501

The northern access to Bertram Road at the northern corner of Lot 500 is the existing main access for the existing The King's College on Lot 950, which is constructed as a full-movement T-intersection on Bertram Road.

The central access to Bertram Road at the boundary of Lots 500 and 501 is a proposed new full-movement T-intersection on Bertram Road.

The grey strips shown around the proposed school site on Lot 501 are the proposed school's perimeter driveway system connecting parking areas and providing vehicle circulation and emergency services access all the way around the proposed school site.

The proposed LSP plan also makes provision for a dual use path around the southwest side of the proposed school site adjacent to the park recreation and drainage reserve.

3.0 Existing Situation

3.1 Existing Land Use

The LSP area is currently rural land with one dwelling on Lot 500, as shown in Figure 4.

Figure 4: Existing land use

The existing The King's College school site and the Freeway Church are located on the adjacent lot northwest of this LSP area.

The southwest half of both Lots is natural wetland and is still covered with natural vegetation.

Land on the northeast side of Bertram Road is existing suburban residential development and residential subdivision development is progressing to the east of the LSP area.

3.2 Existing Road Network

The existing road network and its classification in the Main Roads WA functional road hierarchy is illustrated in Figure 5**.**

Figure 5: Existing road hierarchy

Bertram Road is classified as a District Distributor A in the Main Roads WA functional road hierarchy. A posted speed limit of 70km/h applies on Bertram Road but there is also a school zone in the vicinity of The King's College, which applies a 40km/h speed limit 7.30-9AM and 2.30-4PM on school days.

Bertram Road is constructed as a dual carriageway road, two lanes in each direction separated by a 5m-wide central median. Right turn lanes are provided in the median and left turn deceleration lanes for key intersections including the existing access to The King's College, as shown in Figure 6.

Tamblyn Place is classified as an Access Road in the Main Roads WA functional road hierarchy. It is constructed with a 6m carriageway width and the default built up area speed limit of 50km/h applies.

The Bertram Rd / Tamblyn Place T-intersection operates under Give Way sign control on the Tamblyn Place approach and has a right turn lane in the median on Bertram Road, as shown in Figure 7.

Figure 6: Bertram Rd / Parkfield Blvd intersection and access to The King's College

Figure 7: Bertram Rd / Tamblyn Place intersection

3.3 Existing Traffic Volumes

Traffic counts undertaken on Bertram Road in 2016 indicate that average weekday traffic flows on Bertram Rd east of Parkwood Blvd were 10,846 vehicles per day (vpd) with 874 vehicles per hour (vph) in the 8-9AM peak hour and 946 vph in the 3-4PM peak hour.

Existing AM and PM peak hour turning traffic volumes were counted on Wednesday 1 July 2020 at the Bertram Rd / Parkfield Blvd intersection, at The King's College access intersection on Bertram Rd and at the Bertram Rd / Tamblyn Place intersection for this project. Those existing peak hour turn traffic volumes are shown in Figure 8. The through traffic volumes shown on Bertram Rd are estimated by factoring up the 2016 Bertram Rd traffic counts at a typical growth rate of 2% per year.

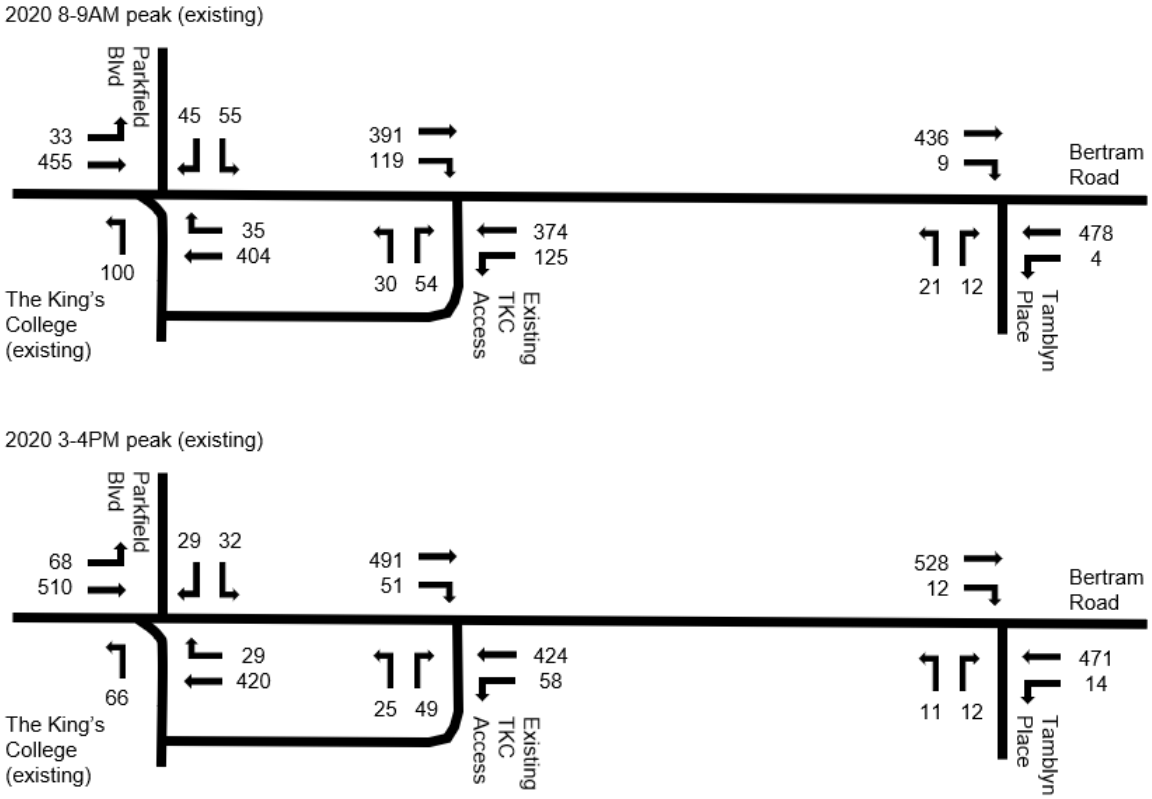


Figure 8: Existing traffic volumes

3.4 Public Transport

Existing bus route 543 (Kwinana Station – Kwinana Bus Station via Bertram) runs on Bertram Road adjacent to the LSP area, as shown in Figure 9. It provides 20 to 30 minute service frequency during weekday peak periods and hourly during the day and on Saturdays, and at two hour intervals on Sundays and public holidays.

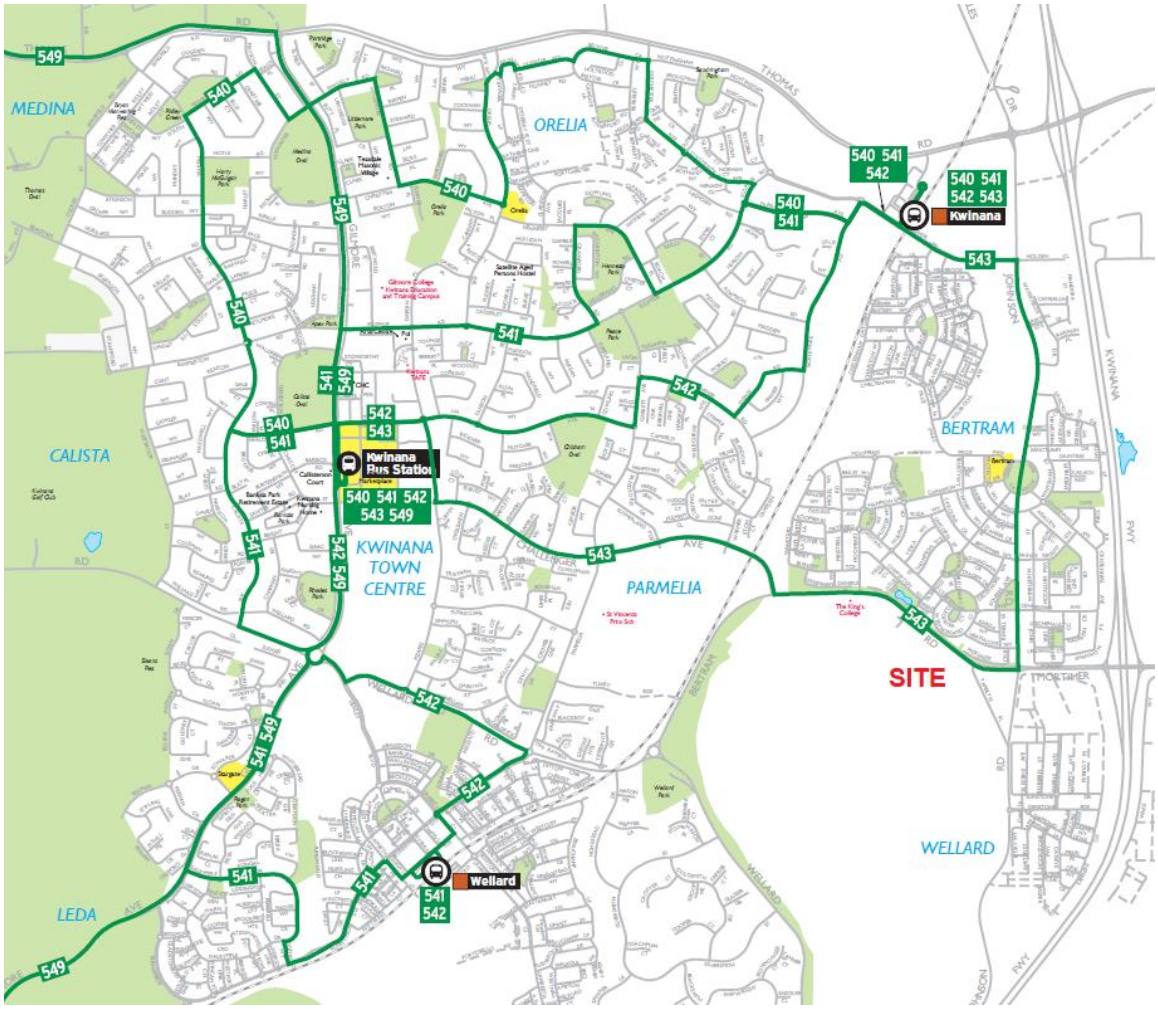


Figure 9: Existing bus routes

3.5 Pedestrian and Cyclist Facilities

Existing bicycle facilities (as at 2016), are shown in Figure 10, which is taken from the Department of Transport's *Perth Bike Map* series. It shows that Bertram Road has a shared path on the northern side and is signed as a Perth Bicycle Network route connecting to the Principal Shared Path alongside the Kwinana Freeway.

There is an existing school crossing facility provided for The King's College on Bertram Road adjacent to the Parkfield Blvd intersection and shared path on the southwest verge of Bertram Road west of the LSP area, as can be seen in Figure 6.

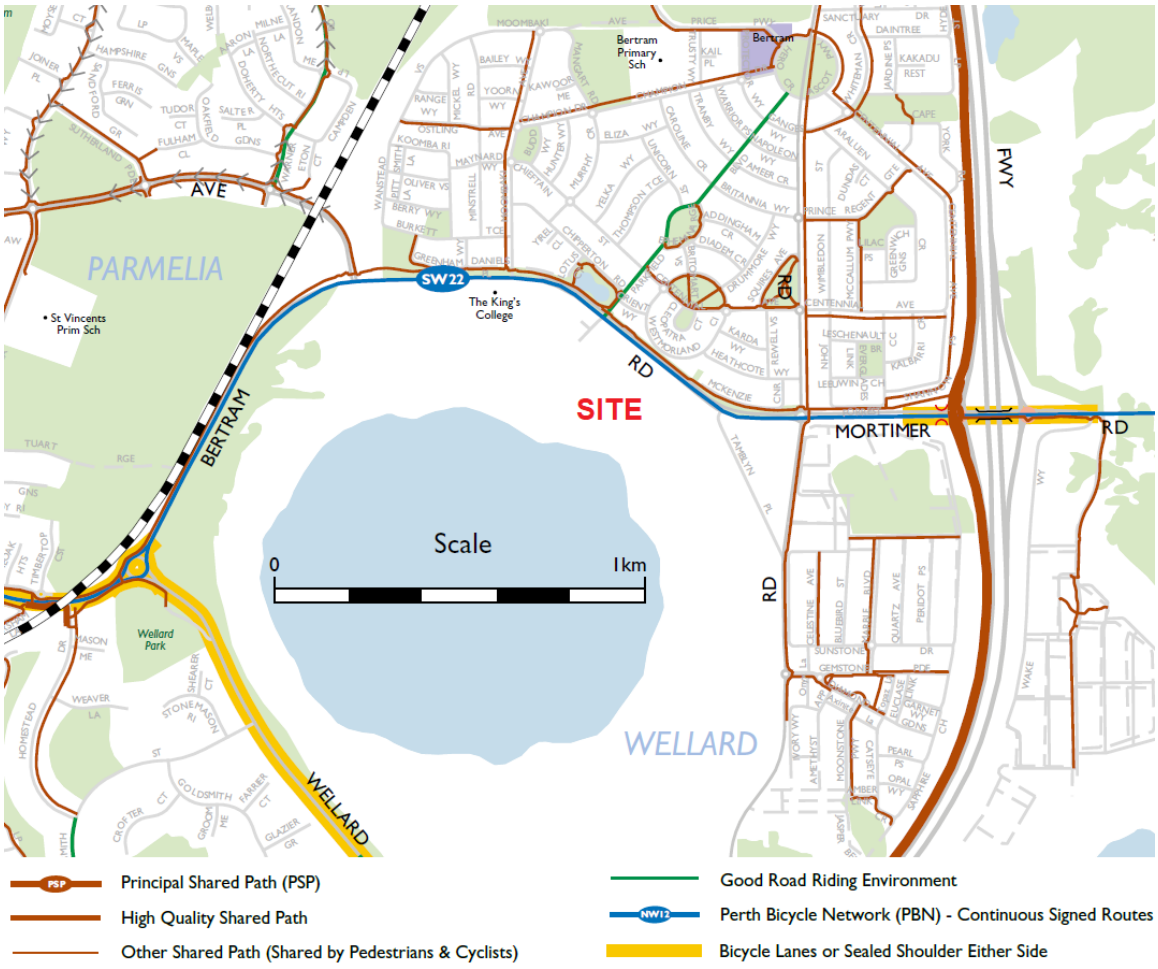


Figure 10: Bike map

3.6 Changes to Surrounding Road Network

The State Government report *Perth and Peel @ 3.5million: The Transport Network* (March 2018) shows Bertram Road as part of a future east-west integrator arterial route (Wellard Rd – Bertram Rd – Mortimer Rd – etc.) as shown in Figure 11. Bertram Road is already constructed to this standard.

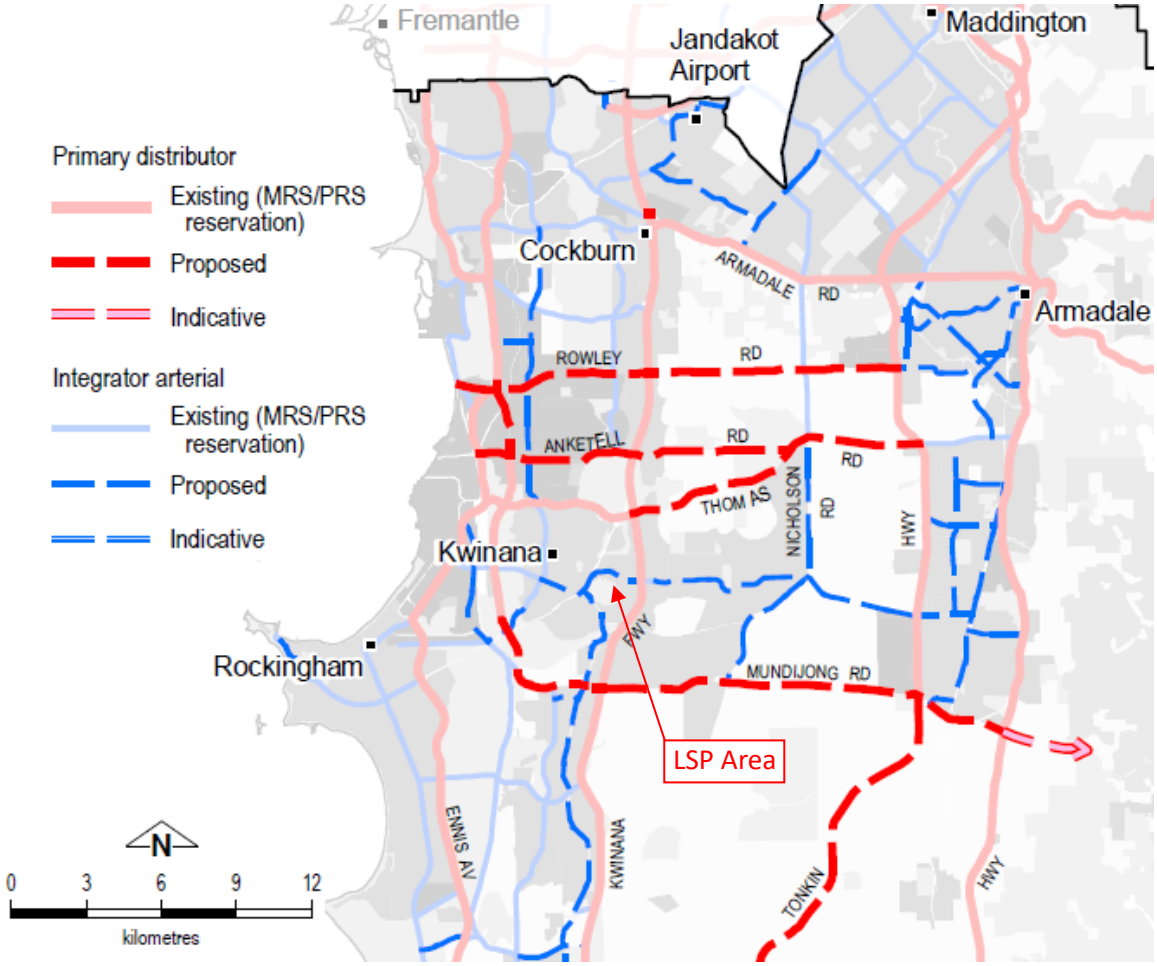


Figure 11: South Metropolitan Peel Sub-region 2050 Road Network

4.0 Proposed Transport Network

4.1 Road Hierarchy

The hierarchy of roads in and around the LSP area is illustrated in **Figure 12**.

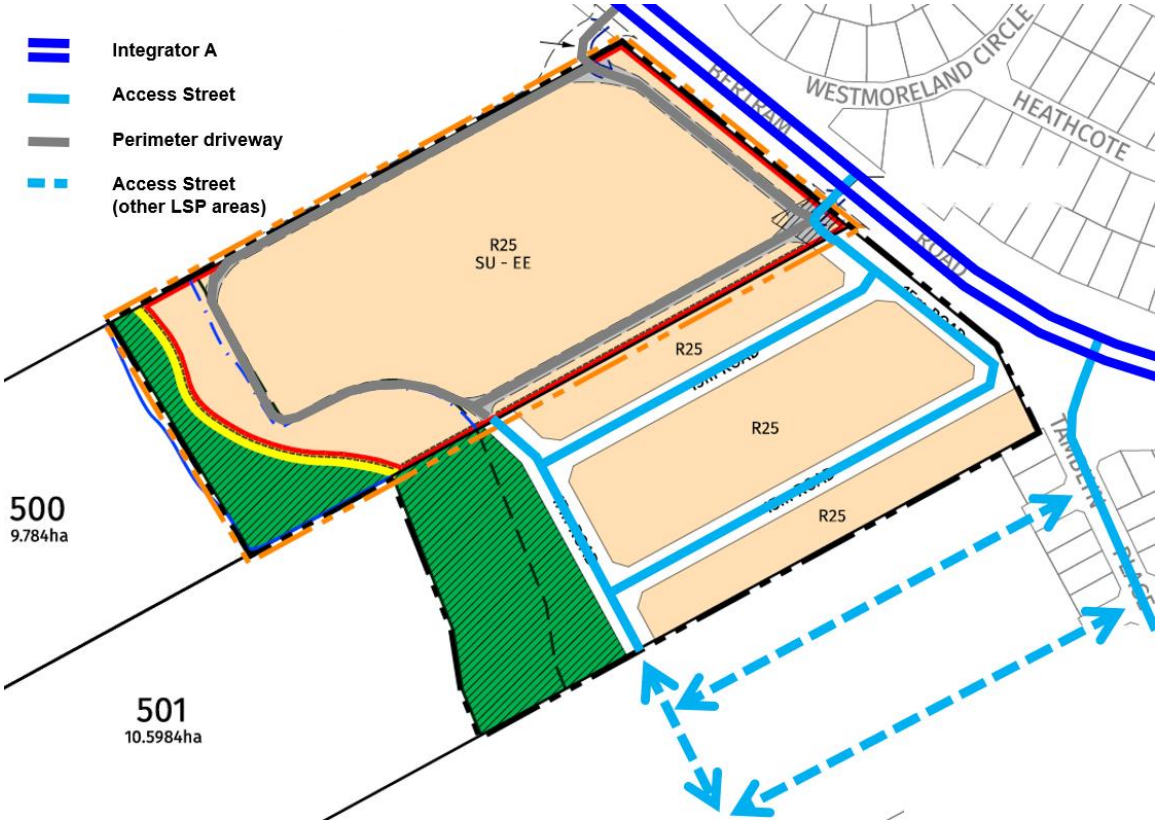


Figure 12: Road Hierarchy

Access Streets
All of the planned roads within the LSP area will be classed as Access Streets.

The *Access Street D* (typical reservation of 15m) is appropriate for low volume (less than 1,000 vpd) streets and is the predominant road type within the LSP area. The standard Access Street D width in *Liveable Neighbourhoods* is 14.2m with 6.0m road width, although 15m road reserve width is proposed in this LSP area in accordance with common practice in new residential subdivisions throughout the Perth metropolitan area.

Perimeter Driveways

The perimeter driveways for the proposed Education Establishment (The King's College) will be private driveways within the school site and will be designed in accordance with the requirements of Australian Standard AS 2890.1 (Parking Facilities Part 1: Off-street car parking).

4.2 Public Transport

Existing bus services in this area are described in section 3.4 of this report.

It is anticipated that the proposed Education Establishment (The King's College) would include provision for school bus bays within the school site, accessed via the perimeter driveway system.

4.3 Pedestrian and Cyclist Facilities

Footpaths at least 1.5m wide would be provided on at least one side of all Access Streets within the LSP area, in accordance with Liveable Neighbourhoods policy requirements.

A comprehensive path network would be provided within the proposed Education Establishment (The King's College) site as part of that development.

There is currently no path on the southwest verge of Bertram Road adjacent to lots 500 and 501. In the Liveable Neighbourhoods policy an Integrator A road is normally required to have 2.5m shared paths on both sides, so a 2.5m shared path will be required on the southwest verge of Bertram Road adjacent to the LSP area. This would connect with the existing shared path on the verge of Bertram Road in front of the adjacent Lot 950 and extend that shared path all the way to Tamblyn Place, completing that missing link in the existing path network.

5.0 Integration with Surrounding Area

The proposed LSP Amendment retains the planned residential subdivision development of Lot 501 and allows for the existing education establishment (The King's College) to relocate and expand upon Lot 500.

The proposed land uses are therefore compatible and consistent with the existing land uses in this area and the movement network of the LSP area will be designed to integrate seamlessly with the adjacent road and path networks.

6.0 Analysis of the Transport Network

6.1 Assessment Period

The assessment year that has been adopted for this analysis is nominally 2031, consistent with the normal planning horizon of regional road traffic projections in Main Roads WA traffic modelling. This analysis also assumes full development of the proposed land uses in the LSP area within that timeframe.

The road network peak hours on Bertram Road basically coincide with the before and after school peak periods of The King's College so those will be the critical peak periods in the future, full development scenario. Therefore, the 8-9AM and 3-4PM peak periods will be appropriate for analysis of key intersections in this report.

6.2 Traffic Generation and Distribution

Residential and school traffic generation rates used in this assessment are the weekday AM and PM peak hour trip generation rates recommended in the Western Australian Planning Commission (WAPC) *Transport Impact Assessment Guidelines* (2016). The trip rate used for residential land use is 0.8 vehicle trips per hour (vph) per dwelling and 1.0 vph per student for schools.

Therefore, the anticipated yield of approximately 64 dwellings on Lot 501 would generate peak hour traffic flows of approximately 51vph.

The existing The King's College currently had an enrolment of 502 students in 2019, so the proposed future capacity of 1,292 students would be an increase of 790 students and is therefore anticipated to increase the peak hour traffic generation of the existing school by approximately 790vph.

The existing traffic generation of The King's College is included in the existing traffic counts documented in Figure 8. Some parents currently choose to park north of Bertram Road to drop off and pick up students and those students cross Bertram Road on foot via the existing school crossing facility adjacent to the Parkfield Boulevard intersection. It is anticipated that a similar number of students would continue to be dropped off and picked up north of Bertram Road but for this traffic analysis it is assumed that all of the increase of 790 students should be accommodated for drop off and pick up within the proposed school site on Lot 500.

Based on the observed traffic distribution in the existing traffic counts documented in Figure 8 the anticipated traffic distribution for the additional traffic generated by the proposed land uses in the LSP area is as shown in Table 1.

Table 1: Trip distribution

Approach	School traffic	Residential traffic
Bertram Rd west	50% of inbound / 67% of outbound	50%
Bertram Rd east	50% of inbound / 33% of outbound	30%
Tamblyn Place south	-	20%

6.3 Traffic Flow Forecasts

Future traffic flows at the proposed access intersections on Bertram Road for the LSP area have been calculated by applying the following methodology:

- Through traffic on Bertram Road is factored up from 2020 to 2031 at a typical growth rate of 2% per year;
- Existing traffic flows at the driveways of The King's College have been manually reassigned to the two proposed access points for the LSP area on Bertram Rd;
- The traffic generated by the proposed 790 students increase in capacity of the new The King's College have been assigned to the two proposed access points for the LSP area on Bertram Rd;
- The traffic generated by the anticipated 64 dwellings on Lot 501 have been assigned to the two proposed access points for the LSP area on Bertram Rd and the planned access road link to Tamblyn Place; and
- Total 2031 peak hour traffic flows are calculated by adding together all of the traffic components listed above.

The AM and PM peak hour traffic flows calculated by this method are illustrated in Figure 13 to Figure 16.

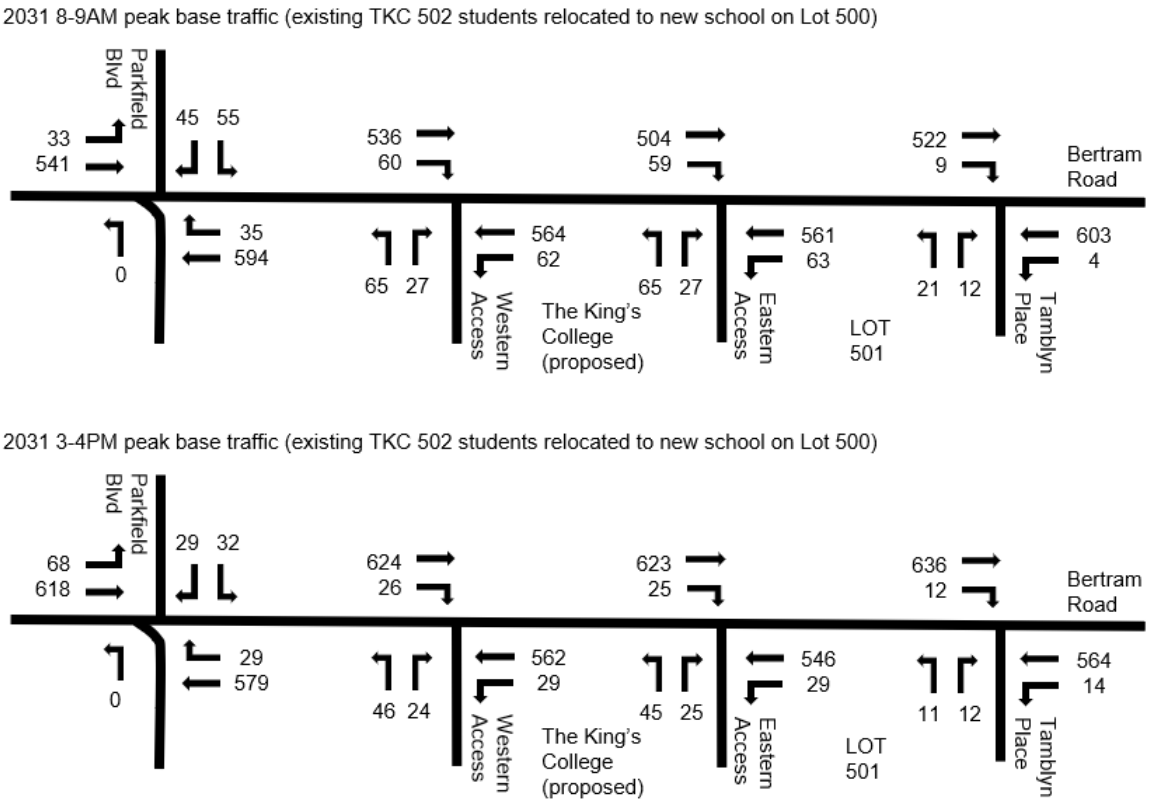


Figure 13: 2031 base traffic with existing TKC relocated to Lot 500

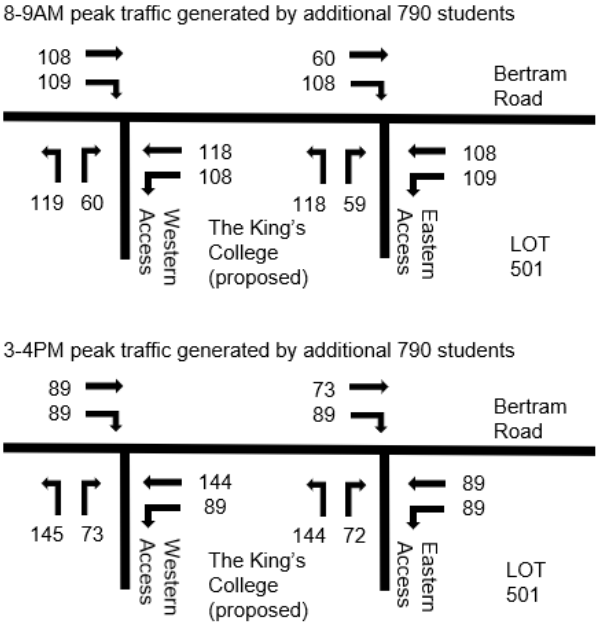


Figure 14: TKC traffic generated by increase of 790 students on Lot 500

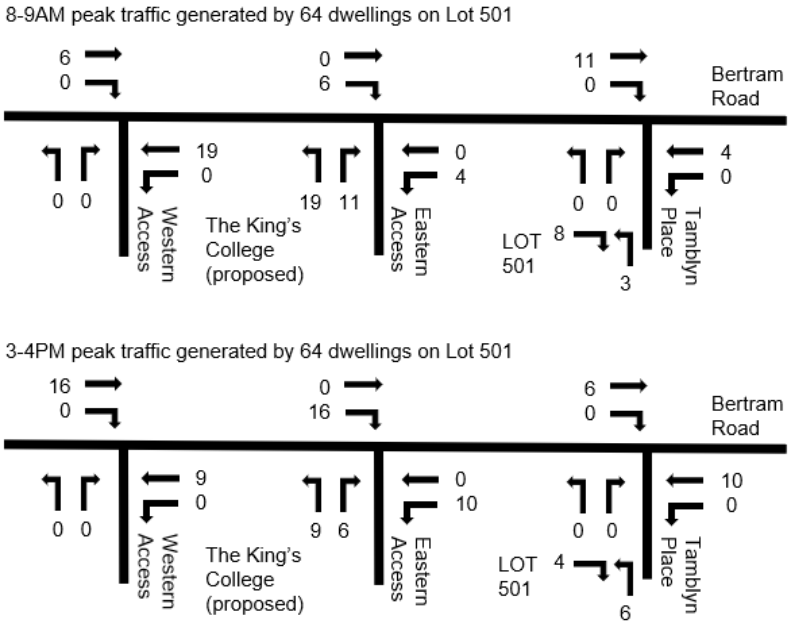


Figure 15: Traffic generated by 64 dwellings on Lot 501

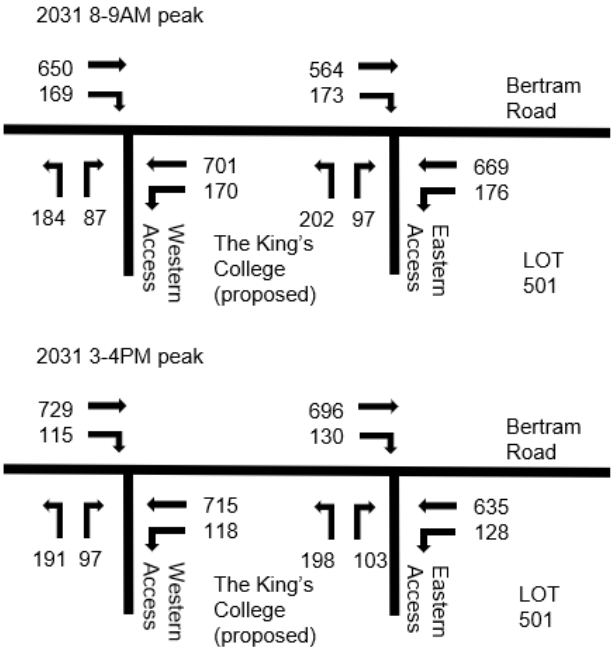


Figure 16: 2031 total traffic flows with full development of the LSP area

6.4 Roads and Intersections

The proposed road network to accommodate these future traffic volumes has been detailed in section 4.0 of this transport assessment, including the details of the proposed road hierarchy in section 4.1.

The northern access to Bertram Road at the northern corner of Lot 500 is the existing main access for the existing The King's College on Lot 950, which is constructed as a full-movement T-intersection on Bertram Road with a right turn lane in the median on Bertram Road and a left turn lane in the southwest verge of Bertram Rd.

The proposed second access to Bertram Road at the boundary of Lots 500 and 501 is a proposed new full-movement T-intersection on Bertram Road. This will also have a right turn lane in the median on Bertram Road and a left turn lane in the southwest verge of Bertram Rd.

6.5 Intersection Analysis

Intersection capacity analysis has been undertaken for the two key intersections on Bertram Road that will provide access to the proposed The King's College development on Lot 500 and residential subdivision on Lot 501. Analysis has been undertaken for the 2031 weekday 8-9AM peak and 3-4PM peak hour flows in Figure 16.

Capacity analysis of these intersections has been undertaken using the SIDRA computer software package. SIDRA is an intersection modelling tool commonly used by traffic engineers for all types of intersections. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- Degree of Saturation is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for infrequent traffic flow up to one for saturated flow or capacity.
- Level of Service is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- Average Delay is the average of all travel time delays for vehicles through the intersection.
- 95% Queue is the queue length below which 95% of all observed queue lengths fall.

The results of the SIDRA analysis are summarised in Appendix B.

The SIDRA analysis shows that the two T- intersections on Bertram Road would operate at a degree of saturation of just under 0.6 in the AM peak and both under 0.4 in the PM peak with full development of both Lots 500 and 501 as proposed in this LSP Amendment. All movements would operate at level of service A except the right turns in and out at both intersections. All of the right turn movements would operate at level of service C in the AM peak and level of service B or C in the PM peak period, which indicates satisfactory intersection operation under the forecast full development traffic flows in 2031.

6.6 Access to Frontage Properties

The WAPC *Liveable Neighbourhoods* policy requires that "Development along integrator B and neighbourhood connector streets with ultimate vehicle volumes over 5,000 vehicles per day should be designed either so vehicles entering the street can do so travelling forward, or are provided with alternative forms of vehicle access."

Bertram Road is the only road within or adjacent to the LSP area that will carry more than 5,000vpd in future. All residential lots within the LSP area are planned to have driveway access from internal Access Streets and will not directly abut Bertram Road.

The proposed Education Establishment (The King's College) on Lot 500 will be accessed by the two access points proposed on Bertram Road for this LSP area, both designed as full-movement T-intersections.

All of the roads in the LSP area are expected to carry less than 5,000vpd, so no restriction on vehicular access is required.

6.7 Pedestrian / Cycle Networks

The proposed network of paths and other facilities for pedestrians and cyclists is described in section 4.3 of this report. This network of paths will provide an excellent level of accessibility and permeability for pedestrians and cyclists within the LSP area, and connections to external pedestrian and cyclist links outside the LSP area.

The WAPC *Transport Impact Assessment Guidelines* (2016) provides guidance on the levels of traffic volumes that are likely to affect the ability for pedestrians to cross various types of road. Based on that guidance an undivided two-lane road should be acceptable for pedestrians crossing traffic volumes of up to approximately 11,000 vpd and this threshold can be increased to around 28,000 vpd by adding a central median or pedestrian refuge islands. On a four-lane road, because of its greater carriageway width, this threshold is lower; even with a median island the threshold is only around 16,000 vpd.

Bertram Road already has a warden-controlled school crossing adjacent to the Parkfield Boulevard intersection to ensure safe access across this road for students of The King's College.

6.8 Access to Schools

As noted in section 4.3 a 2.5m shared path will be required on the southwest verge of Bertram Road adjacent to the LSP area, which will complete the missing link in the existing path network and provide pedestrian and cyclist access to the proposed Education Establishment (relocation and expansion of The King's College on Lot 500).

The only other significant issue for pedestrian and cyclist access to The King's College is crossing Bertram Road, which is currently facilitated by a warden-controlled school crossing facility adjacent to the Parkfield Boulevard intersection. At this stage it is anticipated that this facility will remain in place to serve The King's College as it is relocated and expanded on Lot 500. This will require appropriate supervision of students to ensure all movements across Bertram Road occur at that location.

In time, as staged development of The King's College progresses, it may be decided that it would be beneficial to relocate that school crossing facility further east, closer to the new school location. As these school crossing facilities can only be applied for by a School Principal or the President / Secretary of the relevant school/parent organisation (eg. P&C or P&F) and only when the number of student movements at a particular location actually meets the required warrants, any potential relocation of this existing facility will be a matter for future review.

6.9 Access to Public Transport

At this stage of the structure planning process the WAPC *Transport Impact Assessment Guidelines* (2016) suggest that it is desirable for at least 90 per cent of dwellings to be within 400m straight line distance of a bus route.

The proposed residential area on Lot 501 only extends about 200m southwest from Bertram Road and there is currently a bus service on Bertram Road adjacent to the LSP area, which satisfies the abovementioned criterion.

7.0 Conclusions

The main findings of the transport impact assessment for the proposed Local Structure Plan (LSP) Amendment for Lots 500 and 501 Bertram Road, Wellard, are outlined below.

The existing structure plan was for Residential R25 development of Lots 500 and 501 but the proposed LSP Amendment is to facilitate the proposed development of a new, larger, school site for The King's College instead of residential development on Lot 500.

The LSP area is now anticipated to accommodate approximately 64 dwellings on Lot 501 and an Education Establishment (The King's College) on Lot 500 with an ultimate capacity of approximately 1292 students.

The residential component is anticipated to generate peak hour traffic flows of approximately 51 vehicles per hour (vph) and the 790-student increase o The King's College is anticipated to generate peak hour traffic flows of 790vph.

The residential component of the LSP area on Lot 501 will have a local road network of Access Streets designed in accordance with WAPC *Liveable Neighbourhoods* guidelines.

The proposed Education Establishment on Lot 500 will be served by a perimeter driveway network designed in accordance with Australian Standard AS 2890.1 (Parking Facilities Part 1: Off-street car parking).

The LSP area is proposed to be accessed by two T-intersections on Bertram Road. The northern access to Bertram Road at the northern corner of Lot 500 is the existing main access for the existing The King's College on Lot 950, which is constructed as a full-movement T-intersection on Bertram Road. The proposed second access to Bertram Road will also be a full-movement T-intersection and will be located at the boundary of Lots 500 and 501 on Bertram Road.

Intersection capacity analysis confirms that these two T-intersections on Bertram Road will operate satisfactorily under the anticipated future traffic flows with full development of this LSP area.

The LSP area already has satisfactory public transport access provided by the existing Transperth bus route on Bertram Road.

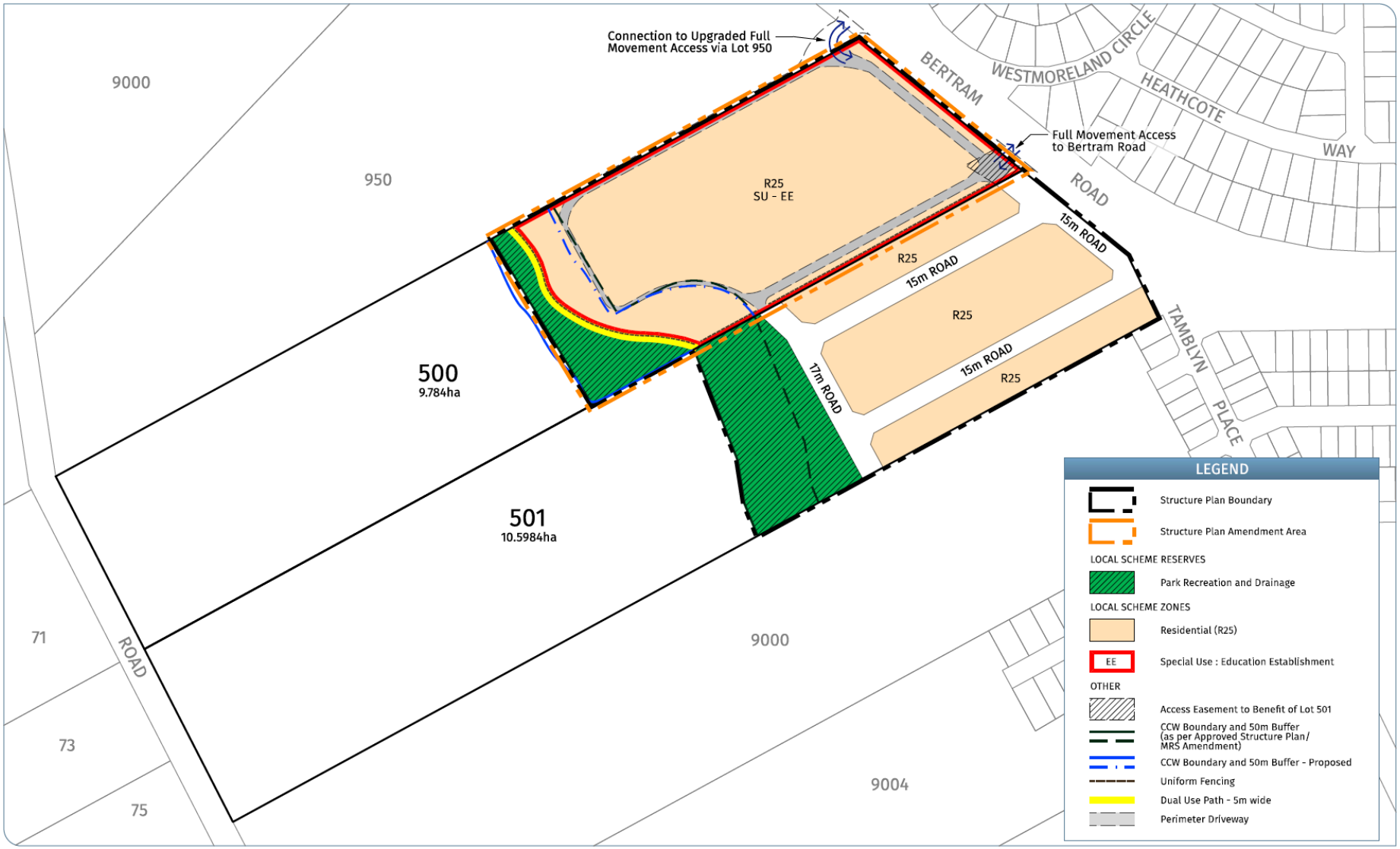
A 2.5m shared path will be required on the southwest verge of Bertram Road adjacent to the LSP area, which will complete the missing link in the existing path network and provide pedestrian and cyclist access to the LSP area along Bertram Road.

The existing school crossing facility on Bertram Road adjacent to the Parkfield Boulevard intersection will continue to serve students of The King's College as staged development and relocation of this school progresses. Potential future relocation of this school

crossing facility closer to the LSP area would require further review in future when actual future travel patterns can be observed and assessed.

Appendix A

Proposed Local Structure Plan



STRUCTURE PLAN

Lots 500 (No. 202) & 501 (No.214) Bertram Road, WELLARD

Plan No.	21968-04
Date	21/10/20
Drawn	NP
Checked	DM
Revision	A
Scale	1:2500@A3

0 20m 40m 60m

NOTE: This plan has been prepared for planning purposes. Areas, Contours and Dimensions shown are subject to survey

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Appendix B

SIDRA Intersection Analysis

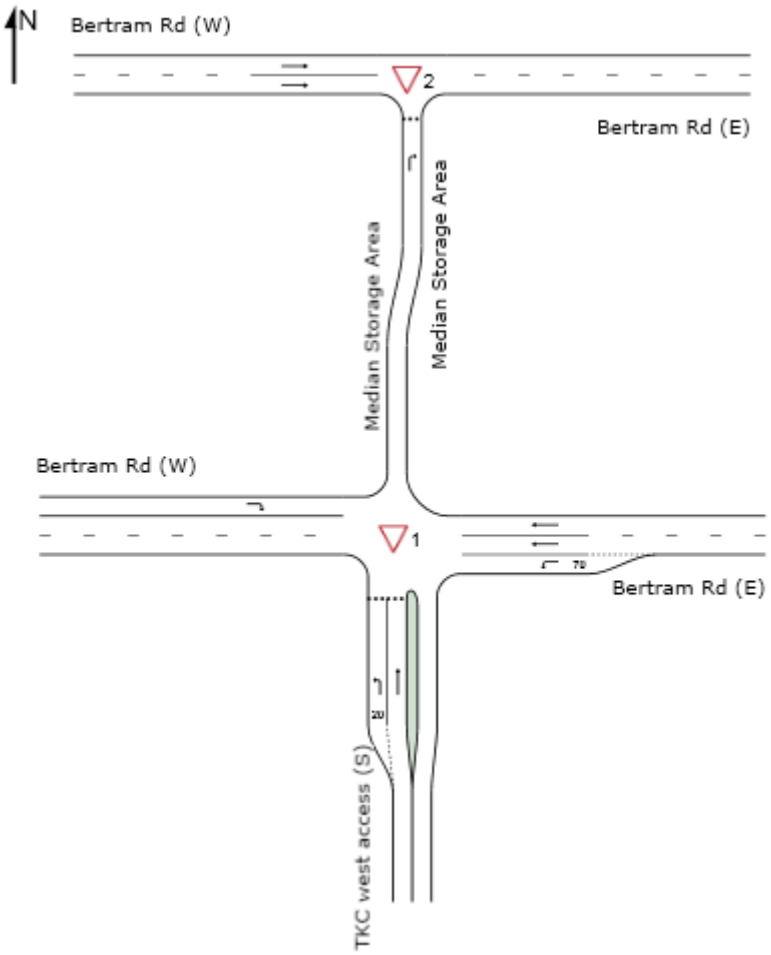


Figure B1. Bertram Rd / Western access intersection layout analysed in SIDRA

Note: The two-stage right turn out to the median then to Bertram Road eastbound requires this intersection to be modelled as two intersections linked together in SIDRA Network analysis. The right turn in is modelled as part of intersection 1. The distance between the two intersections is 5m, which is the existing median width (diagram not to scale).

Table B1a. SIDRA results – Bertram Rd / Western access intersection – 2031 weekday 8-9AM peak

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: TKC west access (S)														
1	L2	194	0.0	194	0.0	0.215	5.5	LOS A	0.8	6.2	0.46	0.64	0.46	33.0
2	T1	92	0.0	92	0.0	0.325	18.2	LOS C	1.3	9.5	0.82	0.95	1.00	20.5
Approach		285	0.0	285	0.0	0.325	9.6	LOS A	1.3	9.5	0.58	0.74	0.63	28.8
East: Bertram Rd (E)														
4	L2	179	0.0	179	0.0	0.095	3.4	LOS A	0.0	0.0	0.00	0.45	0.00	35.8
5	T1	738	6.8	738	6.8	0.201	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	40.0
Approach		917	5.5	917	5.5	0.201	0.7	NA	0.0	0.0	0.00	0.09	0.00	38.9
West: Bertram Rd (W)														
12	R2	178	0.0	178	0.0	0.592	20.8	LOS C	2.9	21.2	0.86	1.07	1.42	23.0
Approach		178	0.0	178	0.0	0.592	20.8	NA	2.9	21.2	0.86	1.07	1.42	23.0
All Vehicles		1380	3.6	1380	3.6	0.592	5.1	NA	2.9	21.2	0.23	0.35	0.31	33.3

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Median Storage Area														
3	R2	92	0.0	92	0.0	0.117	3.5	LOS A	0.4	2.8	0.50	0.60	0.50	26.0
Approach		92	0.0	92	0.0	0.117	3.5	LOS A	0.4	2.8	0.50	0.60	0.50	26.0
West: Bertram Rd (W)														
11	T1	684	6.8	684	6.8	0.187	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	40.0
Approach		684	6.8	684	6.8	0.187	0.0	NA	0.0	0.0	0.00	0.00	0.00	40.0
All Vehicles		776	6.0	776	6.0	0.187	0.4	NA	0.4	2.8	0.06	0.07	0.06	38.7

Table B1b. SIDRA results – Bertram Rd / Western access intersection – 2031 weekday 3-4PM peak

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: TKC west access (S)														
1	L2	201	0.0	201	0.0	0.225	5.5	LOS A	0.9	6.5	0.47	0.65	0.47	33.0
2	T1	102	0.0	102	0.0	0.328	16.6	LOS C	1.3	9.9	0.80	0.94	0.98	21.5
Approach		303	0.0	303	0.0	0.328	9.3	LOS A	1.3	9.9	0.58	0.75	0.64	29.0
East: Bertram Rd (E)														
4	L2	124	0.0	124	0.0	0.066	3.4	LOS A	0.0	0.0	0.00	0.45	0.00	35.8
5	T1	753	6.8	753	6.8	0.205	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	40.0
Approach		877	5.8	877	5.8	0.205	0.5	NA	0.0	0.0	0.00	0.06	0.00	39.1
West: Bertram Rd (W)														
12	R2	121	0.0	121	0.0	0.382	16.0	LOS C	1.5	11.2	0.78	0.95	1.02	25.4
Approach		121	0.0	121	0.0	0.382	16.0	NA	1.5	11.2	0.78	0.95	1.02	25.4
All Vehicles		1301	3.9	1301	3.9	0.382	4.0	NA	1.5	11.2	0.21	0.31	0.24	34.5

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Median Storage Area														
3	R2	102	0.0	102	0.0	0.143	4.1	LOS A	0.5	3.4	0.54	0.65	0.54	27.3
Approach		102	0.0	102	0.0	0.143	4.1	LOS A	0.5	3.4	0.54	0.65	0.54	27.3
West: Bertram Rd (W)														
11	T1	767	6.8	767	6.8	0.209	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	40.0
Approach		767	6.8	767	6.8	0.209	0.0	NA	0.0	0.0	0.00	0.00	0.00	40.0
All Vehicles		869	6.0	869	6.0	0.209	0.5	NA	0.5	3.4	0.06	0.08	0.06	38.6

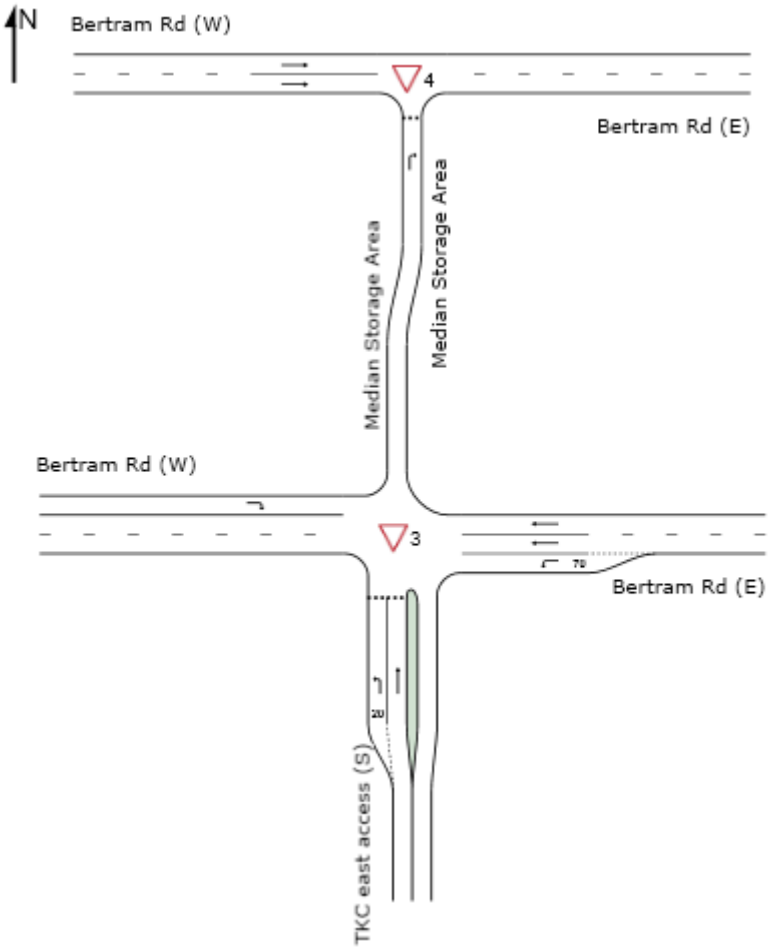


Figure B2. Bertram Rd / Eastern access intersection layout analysed in SIDRA

Note: The two-stage right turn out to the median then to Bertram Road eastbound requires this intersection to be modelled as two intersections linked together in SIDRA Network analysis. The right turn in is modelled as part of intersection 3. The distance between the two intersections is 5m, which is the existing median width (diagram not to scale).

Table B2a. SIDRA results – Bertram Rd / Eastern access intersection – 2031 weekday 8-9 AM peak

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: TKC east access (S)														
1	L2	213	0.0	213	0.0	0.231	5.4	LOS A	0.9	6.7	0.45	0.63	0.45	34.1
2	T1	102	0.0	102	0.0	0.346	17.8	LOS C	1.4	10.4	0.82	0.95	1.02	20.8
Approach		315	0.0	315	0.0	0.346	9.4	LOS A	1.4	10.4	0.57	0.74	0.64	30.0
East: Bertram Rd (E)														
4	L2	185	0.0	185	0.0	0.099	3.4	LOS A	0.0	0.0	0.00	0.45	0.00	35.6
5	T1	704	6.8	704	6.8	0.192	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	40.0
Approach		889	5.4	889	5.4	0.192	0.7	NA	0.0	0.0	0.00	0.09	0.00	38.9
West: Bertram Rd (W)														
12	R2	182	0.0	182	0.0	0.578	19.6	LOS C	2.8	20.8	0.84	1.06	1.38	25.2
Approach		182	0.0	182	0.0	0.578	19.6	NA	2.8	20.8	0.84	1.06	1.38	25.2
All Vehicles		1386	3.5	1386	3.5	0.578	5.2	NA	2.8	20.8	0.24	0.37	0.33	33.9

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Median Storage Area														
3	R2	102	0.0	102	0.0	0.119	3.0	LOS A	0.4	2.8	0.47	0.56	0.47	27.6
Approach		102	0.0	102	0.0	0.119	3.0	LOS A	0.4	2.8	0.47	0.56	0.47	27.6
West: Bertram Rd (W)														
11	T1	594	6.8	594	6.8	0.162	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	40.0
Approach		594	6.8	594	6.8	0.162	0.0	NA	0.0	0.0	0.00	0.00	0.00	40.0
All Vehicles		696	5.8	696	5.8	0.162	0.4	NA	0.4	2.8	0.07	0.08	0.07	38.6

Table B2b. SIDRA results – Bertram Rd / Eastern access intersection – 2031 weekday 3-4PM peak

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: TKC east access (S)														
1	L2	208	0.0	208	0.0	0.221	5.2	LOS A	0.9	6.4	0.44	0.62	0.44	34.2
2	T1	108	0.0	108	0.0	0.310	14.7	LOS B	1.3	9.4	0.77	0.92	0.93	22.7
Approach		317	0.0	317	0.0	0.310	8.5	LOS A	1.3	9.4	0.55	0.72	0.61	30.6
East: Bertram Rd (E)														
4	L2	135	0.0	135	0.0	0.072	3.4	LOS A	0.0	0.0	0.00	0.45	0.00	35.6
5	T1	668	6.8	668	6.8	0.182	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	40.0
Approach		803	5.7	803	5.7	0.182	0.6	NA	0.0	0.0	0.00	0.08	0.00	39.1
West: Bertram Rd (W)														
12	R2	137	0.0	137	0.0	0.382	14.2	LOS B	1.6	11.6	0.75	0.93	0.99	27.9
Approach		137	0.0	137	0.0	0.382	14.2	NA	1.6	11.6	0.75	0.93	0.99	27.9
All Vehicles		1257	3.6	1257	3.6	0.382	4.1	NA	1.6	11.6	0.22	0.33	0.26	35.0

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Median Storage Area														
3	R2	108	0.0	108	0.0	0.146	3.8	LOS A	0.5	3.5	0.52	0.64	0.52	26.5
Approach		108	0.0	108	0.0	0.146	3.8	LOS A	0.5	3.5	0.52	0.64	0.52	26.5
West: Bertram Rd (W)														
11	T1	733	6.8	733	6.8	0.200	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	40.0
Approach		733	6.8	733	6.8	0.200	0.0	NA	0.0	0.0	0.00	0.00	0.00	40.0
All Vehicles		841	5.9	841	5.9	0.200	0.5	NA	0.5	3.5	0.07	0.08	0.07	38.6

APPENDIX H | MASTERPLAN

TAYLOR
ROBINSON
CHANEY
BRODERICK

The King's College 20027 Masterplan

The King's College
November 2020

LEGEND

- SITE BOUNDARY
- REVEGETATED PLANTING 'A' TO WETLAND SIDE
- REVEGETATED PLANTING 'B' TO BUFFER SIDE
- DUAL USE PATH
- FIRE BREAK
- ADMIN
- CAFE / ALFRESCO
- PRIMARY CLASSROOMS
- GYM
- SWIMMING FACILITIES
- PERFORMING ARTS
- SCIENCE
- CANTEEN
- COOKING
- WORKSHOPS/ART
- PLACE OF WORSHIP

The King's College
B
1:1000 @ A3

Proposed Ground Floor Masterplan

SK01
20020

Masterplan
November 2020

TAYLOR ROBINSON CHANEY BRODERICK

LEGEND

- SITE BOUNDARY
- REVEGETATED PLANTING 'A' TO WETLAND SIDE
- REVEGETATED PLANTING 'B' TO BUFFER SIDE
- DUAL USE PATH
- FIRE BREAK
- PRIMARY CLASSROOMS
- GYM
- LIBRARY
- SECONDARY CLASSROOMS
- PLACE OF WORSHIP
- DRAMA / MUSIC
- PERFORMING ARTS
- HUB

The King's College

Proposed First Floor Masterplan

Masterplan

B

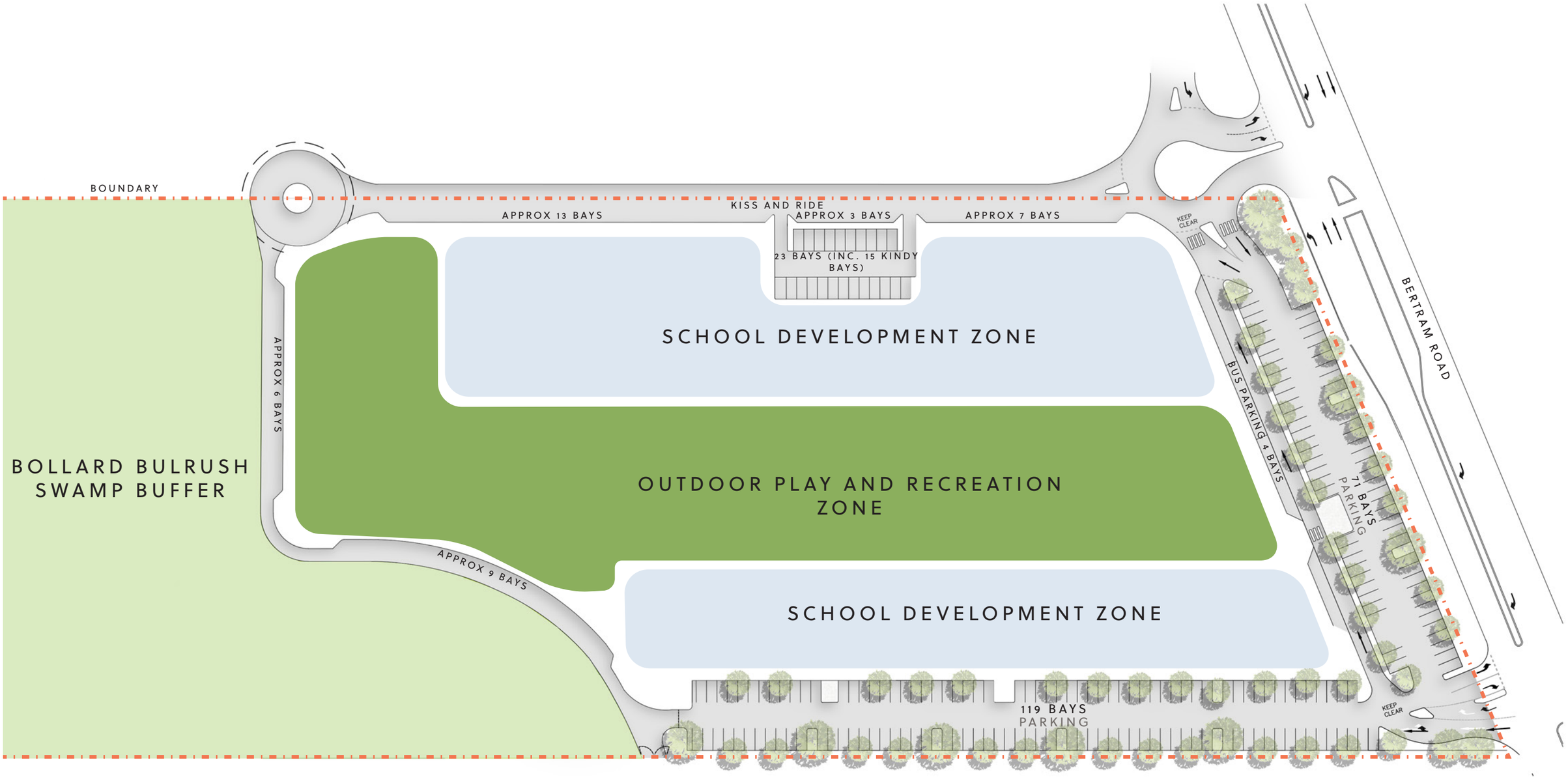
SK02

November 2020

1:1000 @ A3

20020

TAYLOR ROBINSON CHANEY BRODERICK



The King's College

Proposed Masterplan for Structure Plan. Lot 500 Bertram Road, Wellard.

Masterplan

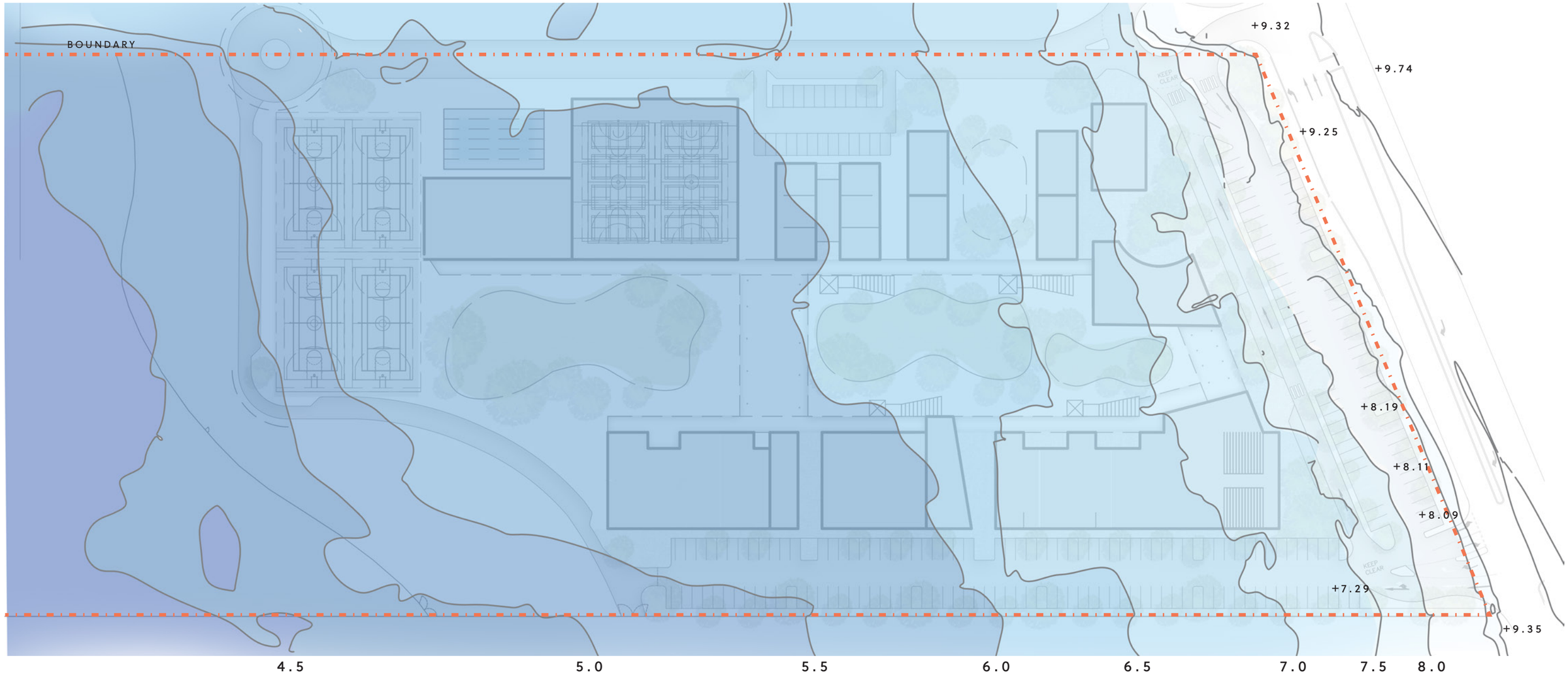
B

November 2020

1:1000 @ A3

20020

TAYLOR ROBINSON CHANEY BRODERICK

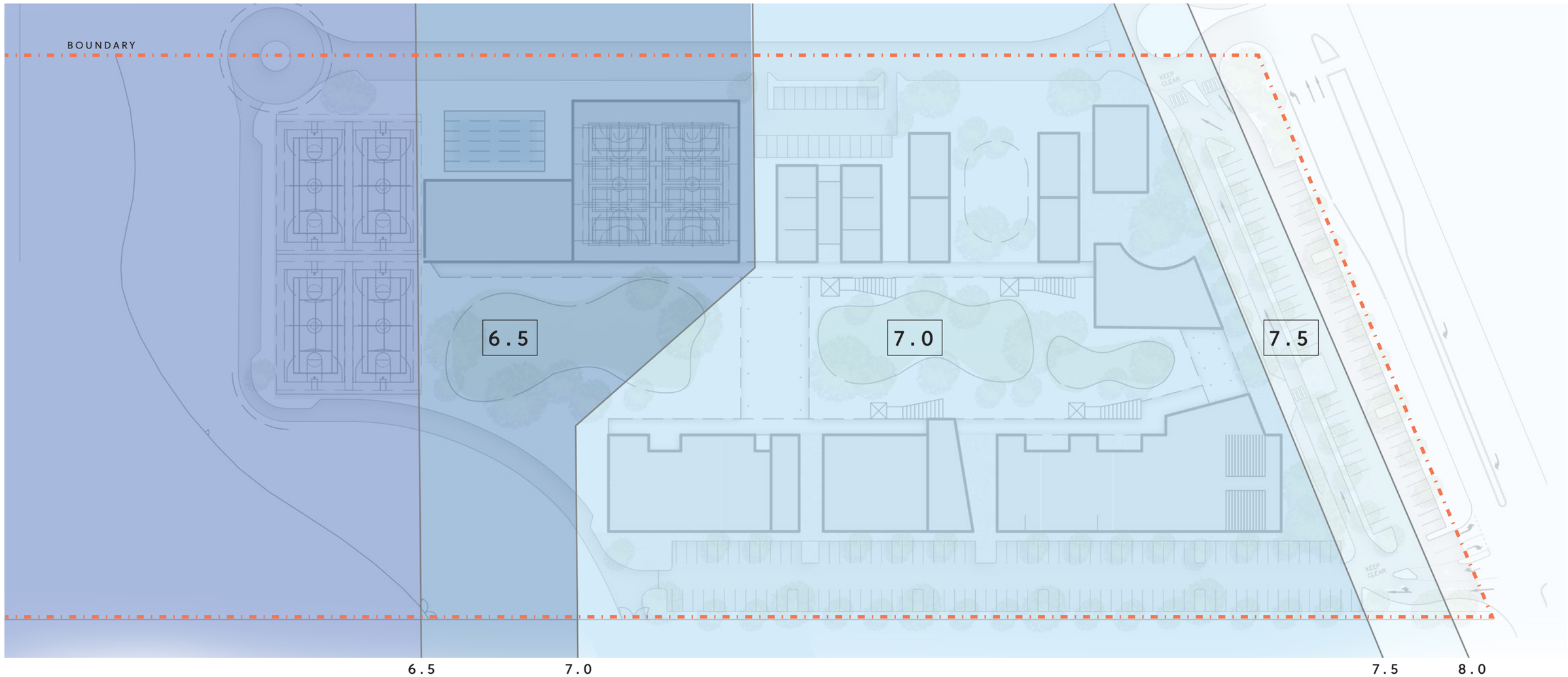


The King's College
Existing Site Contours
Masterplan

B
SK04
November 2020

1:1000 @ A3
20020

TAYLOR ROBINSON CHANEY BRODERICK

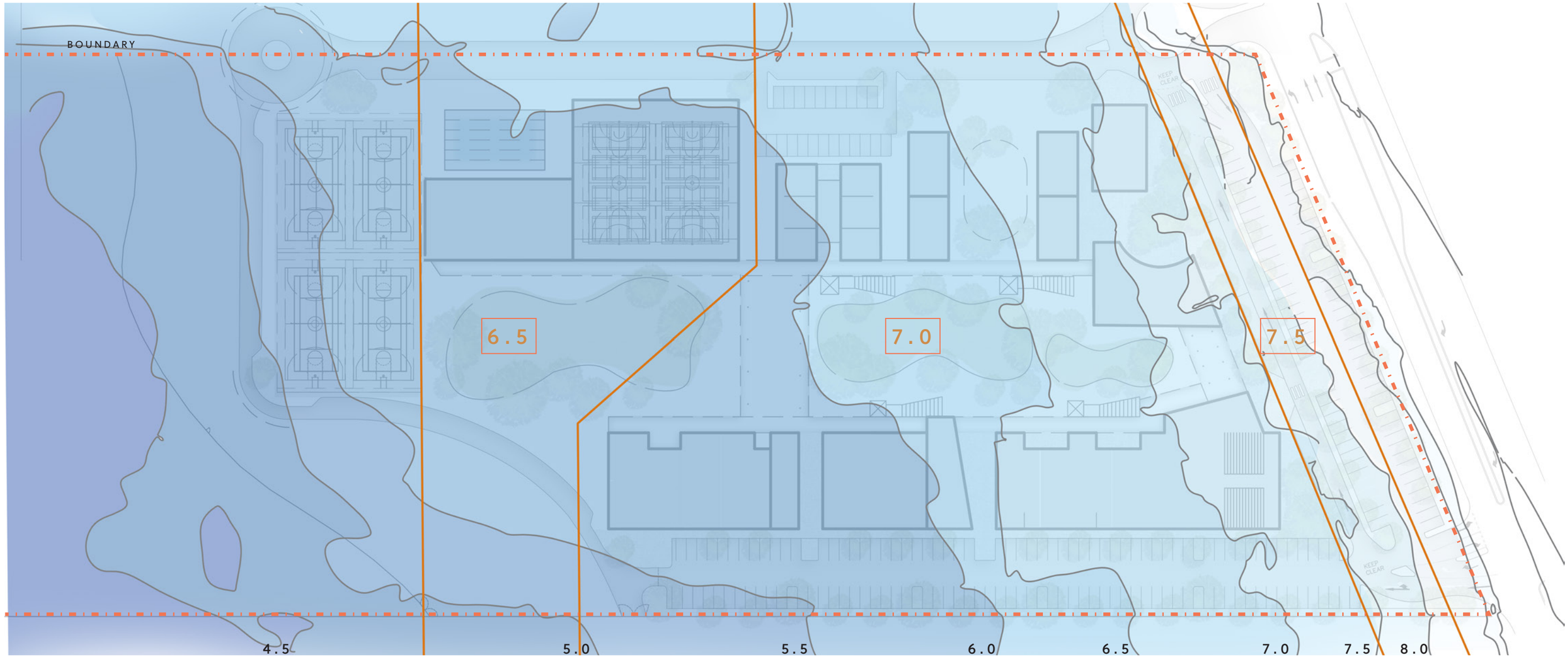


The King's College
Proposed Site Contours
Masterplan

B
SK05
November 2020

1:1000 @ A3
20020

TAYLOR ROBINSON CHANEY BRODERICK



LEGEND

EXISTING

PROPOSED

The King's College

Proposed and Existing Site Contours

Masterplan

B

SK06

November 2020

1:1000 @ A3

20020

TAYLOR ROBINSON CHANEY BRODERICK

The King's College
View from Bertram Road
Masterplan

B
SK07
November 2020

20020

TAYLOR
ROBINSON
CHANEY
BRODERICK

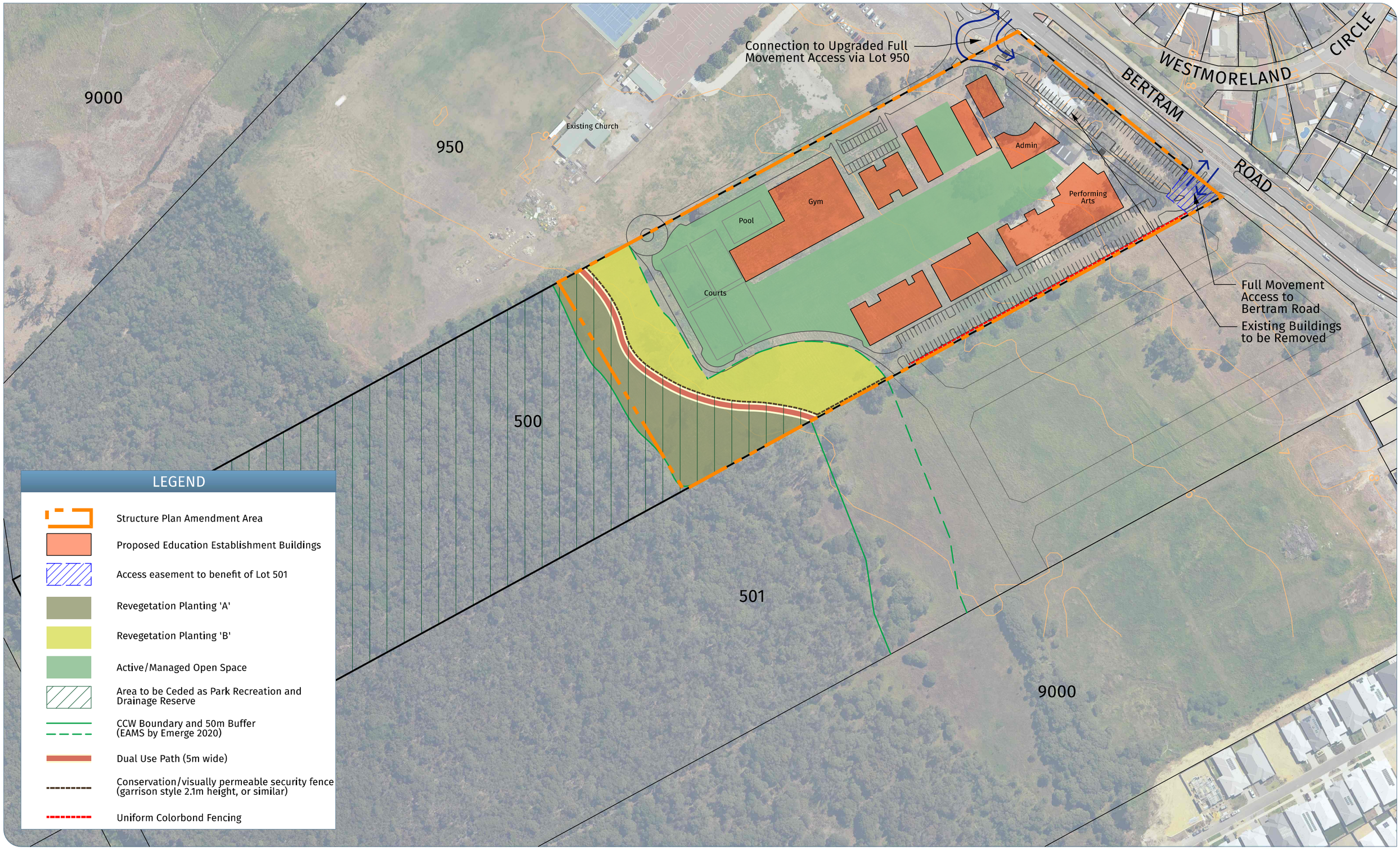
The King's College
View from Wetlands
Masterplan

B
SK08
November 2020

20020

TAYLOR
ROBINSON
CHANEY
BRODERICK

APPENDIX I | OPPORTUNITIES AND CONSTRAINTS PLAN



LEGEND

- Structure Plan Amendment Area
- Proposed Education Establishment Buildings
- Access easement to benefit of Lot 501
- Revegetation Planting 'A'
- Revegetation Planting 'B'
- Active/Managed Open Space
- Area to be Ceded as Park Recreation and Drainage Reserve
- CCW Boundary and 50m Buffer (EAMS by Emerge 2020)
- Dual Use Path (5m wide)
- Conservation/visually permeable security fence (garrison style 2.1m height, or similar)
- Uniform Colorbond Fencing

OPPORTUNITIES & CONSTRAINTS PLAN

Lot 500 Bertram Road, WELLARD

Plan No.	|	21968-03
Date	|	11/12/20
Drawn	|	NP
Checked	|	DM
Revision	|	B
Scale	|	1:2000@A3

0 20m 40m 60m

NOTE: This plan has been prepared for planning purposes. Areas, Contours and Dimensions shown are subject to survey

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